IntechOpen

Advances in Speech-language Pathology

Edited by Fernanda Dreux M. Fernandes

ADVANCES IN SPEECH-LANGUAGE PATHOLOGY

Edited by **Fernanda Dreux M. Fernandes**

Advances in Speech-language Pathology
http://dx.doi.org/10.5772/66241
Edited by Fernanda Dreux M. Fernandes

Contributors

Lucy Dipper, Madeleine Pritchard, Alejandro Brice, Jennifer Walker, Carmen Julia Coloma, Maria Mercedes Pavez, Simone Aparecida Lopes-Herrera, Camilla Guarnieri, Luis Jesus, Inês Belo, Jessica Machado, Andreia Hall, Ana Inês Tavares, Kateřina Vitásková, Lucie Kytnarová, Daniele Farneti, Elisabetta Genovese, Goran V. Savić, Ana Luiza Navas, Tais Ciboto, Juliana P.A. Borges, Şermin Tükel, Helena Björelius, Nada AlRabiah, Renata Mlčáková, Annamaria Gyorfi, Amparo Ygual Fernández, José F Cervera-Mérida, Tatiana Tumanova, Tatiana Filicheva, Milene Rossi P. Barbosa, Fernanda Dreux M. Fernandes, Haydée Wertzner, Danira Francisco, Tatiane Barrozo, Luciana Pagan-Neves, Daniela Molini-Avejonas, Cibelle Amato, Laís Ferreira, Yuko Yamashita

First published in Croatia, 2017 by INTECH d.o.o.
eBook (PDF) Published by IN TECH d.o.o.
Place and year of publication of eBook (PDF): Rijeka, 2019.
IntechOpen is the global imprint of IN TECH d.o.o.
Printed in Croatia

Legal deposit, Croatia: National and University Library in Zagreb

Additional hard and PDF copies can be obtained from orders@intechopen.com

Advances in Speech-language Pathology
Edited by Fernanda Dreux M. Fernandes

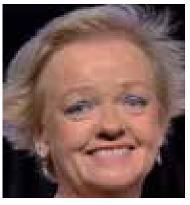
p. cm.

Print ISBN 978-953-51-3509-8

Online ISBN 978-953-51-3510-4

eBook (PDF) ISBN 978-953-51-4657-5

Meet the editor



Fernanda Dreux M. Fernandes, PhD, is an associate professor of the Speech-Language Pathology and Audiology Program at the School of Medicine, Universidade de São Paulo, Brazil, for over 30 years. She is a former president of the Brazilian SLP & A Association and received the Life Achievement Honor Award by this association. She is also an ASHA fellow and former member of the International Issues Board of the American Speech-Language and Hearing Association. Dr. Fernandes is in her second term as a member of the board of the International Association of Logopedics and Phoniatrics (IALP). She is on the editorial board of several scientific journals and researches in the area of communication in children with autism, has acted as an adviser in over 30 master's degree and doctorate degree researches, and has published over 100 papers.

Contents

Preface

Speech-language pathology has different practice and research histories, standards, methods, and challenges in different countries and regions. Awareness of these different realities may contribute to the scientific development of the field and improve the services delivered to different populations. Sharing solutions to similar problems in different contexts can increase evidence-based practice that is relevant in specific situations.

The aim of this book was to build a panel of contributions from different countries and several areas of research. Authors were invited to contribute with their newest conclusions and results about the themes they considered most relevant. The result includes discussions about new theoretical trends, research results, and new proposals for assessment and intervention.

In the first part of the book, the chapters discuss new trends and theoretical formulations in speech-language pathology. Dipper and Pritchard discuss methods and developments regarding discourse analysis and intervention. The second chapter provides a comprehensive review of the present knowledge about formulaic language in patients with aphasia that may have implications for future researches. Tumanova and Filicheva present an interesting synthesis of the Russian current research and theoretical trends regarding specific language impairment. Phonological disorders in Spanish-speaking children from the natural phonology theory framework are discussed by Pavez and Coloma. Farneti and Genovese contribute to the knowledge about swallowing disorders in newborn and small children from etiological, physical, and developmental perspectives and their implications to assessment and intervention. The role and competences of the speech-language pathologist in the assessment of and intervention in reading disorders are discussed by Navas, Ciboto, and Borges. The last chapter of this first part focuses on studies about comorbidity of sensory and motor dysfunctions in motor speech disorders.

Chapters that focus on new research results about speech and language are grouped in the second part of this book. Amato, Molini-Avejonas and Varanda studied the information about autism spectrum disorders available to foreigners living in Brazil. In Chapter 9, the authors compared the results of token test and sentence comprehension test in preschool Czech children with typical language development and with speech-language disorders and didn’t find significant differences. In the next chapter, the authors studied speech impairment, phonation, writing, salivation, and swallowing in 64 patients with Parkinson’s disease compared with normal young and elderly controls and identified various degrees of deficits in all the areas in the patients with Parkinson’s disease. Yamashita assessed Japanese- and English-speaking parents to study their response behaviors during conversations with their toddlers and obtained data that may be useful in understanding communication between parents and children with different cultures. The variables that influence articulation accuracy in children with Down syndrome and specific language disorders were studied by Ygual who reports differences and similarities with important clinical implications.

In Part 3 are the chapters with new ideas about speech and language assessment. The cross-cultural adaptation of the GRBAS and CAPE-V scales for Portugal and a new training program for perceptual voice evaluation are described by Jesus, Tavares, and Hall. In the next chapter, the development of databases comprised by a sample of 709 individuals recruited in Portugal, called Advanced Voice Function Assessment Databases, is described. The chapter by Molini-Avejonas, Ferreira, and Amato discusses the risk factors for speech language disorders in children, from a public health perspective. Wertzner, Francisco, Barroso, and Neves present evidence for speech sound disorder assessment based on the use of different equipment.

The fourth part includes the chapters that refer to new ideas about speech and language intervention. A creative proposal of intervention with children with selective mutism is described in a case study by Alrabiah. The following chapter presents a speech-language intervention alternative that includes the participation of parents remotely monitored with the use of simple technological resources. Brice and Brice report two case studies about the recovery from diffuse brain injuries with different etiologies. An intervention program for children with language delay is described by Guarnieri and Lopes-Herrera. Finally, Vitaskova discusses the role of the speech-language therapist in the intervention with children with autism spectrum disorders.

Fernanda Dreux M. Fernandes, PhD
School of Medicine, Universidade de São Paulo
Brazil

Section 1

New Thoughs About Speech and Language Development and Pathology

Discourse: Assessment and Therapy

Lucy T. Dipper and Madeleine Pritchard

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69894

Abstract

Discourse is essential for interaction and for the expression of ideas, feelings and opinions. Telling personal stories, such as talking about your day or recounting what happened in the playground, is essential for communication and establishing relationships. However, due to their language impairments, people with aphasia (PWA) and children with developmental language disorder (DLD) often have problems with everyday discourse which impact on their lives more widely. While improvement in language skills is supported by speech-language pathology (therapy), it tends to focus on smaller linguistic components, such as single words and sentences. This chapter outlines how speakers construct discourse in everyday situations and focuses on the meanings that people use discourse to convey, as well as the lexical and grammatical resources they use to convey these meanings. Current methods for discourse analysis will be outlined and key developments in narrative discourse production therapy will be reviewed.

Keywords: discourse, narrative, connected speech, aphasia, language impairment, DLD, SLI

1. Introduction

Broadly speaking, discourse refers to the use of spoken or written language in a social context. However, in linguistics, the term 'discourse' is used to mean a unit of language longer than a single sentence [1]. In this chapter, we focus on this more narrow definition and use the term discourse to mean language beyond a single simple clause, used for a specific purpose or function. Using this definition, discourse is the basis for the vast majority of everyday communication. Everyday examples of discourse include: giving instructions about how to carry out a procedure, such as using a piece of computer software; recounting an experience, such as your day at work or school; or sharing an opinion, such as your views on social media use.

Discourse, then, is fundamental to everyday communication and so when language impairment affects it, there is a knock-on effect to the person's life. Children need narrative to make sense of their experiences and take control of their lives, through reporting and describing things that have happened and to scaffold their literacy development. Adults need narrative to make and sustain friendships through the sharing of anecdotes, to express their opinions, and to enable others to see their perspective.

Narrative and discourse are increasingly the focus of clinical practice and research with both paediatric and adult client groups. The foundational work underpinning this clinical practice has been completed independently for child and adult groups. However, the advances made for each population have great potential to inform the other, and so in this chapter, we aim to synthesise the theory and findings from both fields. There is rationale for treating discourse in both health care and educational contexts. Discourse and narrative are given strong emphasis within early years and school curricula. For example, in the UK, the Early Years Foundation stage Statutory Framework [2] gives multiple examples of discourse and narrative production being prime early learning goals for children from birth to 5 years old. In the International Classification of Functioning, Disability and Health, from the World Health Organisation, difficulties with discourse reflect *body function* categories of impairment, including 'speaking' [3, 4] which impact on activities and social participation, such as 'telling a story' [3]. For example, a child with discourse impairment is likely to face challenges with accessing early years and school curricula, and an adult with discourse impairment is likely to have difficulty interacting with family, friends and colleagues. A broad range of everyday activities and social situations would be impossible without the skills to communicate information beyond single words and sentences. This chapter aims to provide the background for the assessment and intervention approaches for use by speech language pathologists (therapists) to improve discourse.

2. Discourse in people with language difficulties

Throughout this chapter, we will examine discourse through the lens of a number of seminal works because, although there have been recent advances in discourse measurement and treatment, the theoretical foundation is consistent. We will focus on the discourse of speakers with aphasia, a language impairment commonly arising following stroke, and developmental language disorder (DLD). DLD is the term agreed through expert consensus to describe children with language difficulties that create obstacles to communication or learning in everyday life, who are unlikely to catch up spontaneously and do not have language disorder arising from any other aetiology [5]. The evidence base we review is derived from English speakers. We examine discourse as a tool to convey meaning, focusing on three central components: (1) how language is used in discourse (lexical and grammatical resources), (2) what information is included in discourse and (3) how the information is structured. The relationship between these three components is not straightforward. To explore this complexity, we will refer to a model of discourse processing developed by Frederiksen et al. [6] and adapted as a framework for discourse production by Sherratt [7]. This model incorporates detail from a number of widely used and validated models of discourse and language production.

In Sherratt's discourse production framework, discourse starts as an idea which must be packaged for spoken language though a series of stages, which may take place repeatedly and/or simultaneously. First, the speaker identifies a meaning that they wish to communicate, for example, that they want to explain a specific procedure to someone. Next, the overarching discourse structure is identified (in this example, it would be a procedural discourse—see next section for more information on discourse types). The discourse structure guides both the information included and the structuring of that information. To include the key information, a speaker accesses semantic and episodic memory and then synthesizes and integrates information into the appropriate discourse structure. For example, in a procedural narrative instructing a friend about how to use a mobile phone to make a phone call, this could involve describing which buttons to press and the order in which to press them. Next, information is sequenced and edited based on the speaker's knowledge of context including the listener's background and world knowledge. For example, if the friend had never used a mobile phone before, you would give more information and include more steps in the procedure than you might when talking to someone more experienced. Next, the speaker assigns logical relationships to the ideas in the discourse, including foregrounding and backgrounding information, temporal sequencing, and causation and consequence. In the example, this may include a decision to first explain how to switch on the phone and find the appropriate buttons, before beginning the steps needed to make a phone call. Finally, the discourse is linguistically encoded and articulated.

Although there is evidence from child language development of a close link between overall language skills and discourse ability [8], the relationship is far from straightforward. The evidence base indicates that typically developing children aged 3–4 years old produce longer and more complex narratives if they are syntactically advanced, compared with children who are syntactically delayed. However, while some children with DLD and adults with aphasia have a relatively severe linguistic impairment, they are able to sometimes produce discourses containing a large amount of well-structured information. For example, a child or adult with a difficulty remembering or producing a particular word may be able to work around their impairment by using a close synonym, for example, replacing the word 'pony' with the word 'horse'. Such a substitution is unlikely to affect the overall organisation of the discourse. However, the reverse is also true, as some speakers with relatively mild language impairments produce discourse containing only limited information.

2.1. Discourse contexts, types, frames and genres

Discourse used for specific purposes often necessitates specific kinds of language, information and information structures. For example, a child describing their favourite meal and the story of *Rapunzel* would communicate different information in each discourse, use a different discourse structure and use different words. In the discourse literature, discourse 'purposes' have been described variously as 'contexts', 'types', 'frames' and 'genres' [1]. Throughout this chapter, we will use the term discourse *type*. Fields of study differ in their categorisations: for example, in education, discourse types (particularly written discourse, or text types) are commonly classified into narrative, report, recount, procedure, persuasion (exposition), description and explanation; whereas in linguistics, discourse genres are often exemplified in more concrete terms, such as stories, lectures, conversations, speeches, interviews, protocols, notices, advertisements, novels and diaries. While these sets overlap, they do not align because of the different theoretical frameworks that underpin them. To map across the literature, the most common terms are outlined in **Table 1**.

Much of what we know about the discourse of children and adults with language impairment and the majority of the published clinical tools come from picture descriptions (for adults [18]) and fictional narrative discourse (for children). Consequently, there is little clinical information available about expository or personal discourse. Although there is no widely used clinical tool including a procedural discourse, there is more evidence in the research literature for procedural discourse than for expository or personal discourses. However, there is little consensus about how to analyse procedural discourse or the indicators of impairment. Developmental research suggests that discourse skills develop in narrative discourse ahead of other discourse types [19], and in the aphasia research, there is evidence that different discourse types elicit different language, information content and information structures.

Discourse type (& definition)	Elicited example(s)	Real world example(s)
Narrative discourse	Cinderella story [9] Bus story test [10] Squirrel story narrative assessment [11] 'Frog, where are you?' [12] Peter and the Cat [13] Expression, Reception and Recall of Narrative Instrument—ERRNI [14]	Campfire ghost stories
Procedural discourse	Can you tell me how you make a cup of tea? Can you tell me how you would wrap a box in paper for a present? Tell me about what you normally do on Sundays?	Giving instructions or explaining how to do something, e.g. getting up to the slide from the climbing frame, completing a maths problem, assembling flat-pack furniture, or using a specific function in an IT programme
Personal discourse	Tell me about your stroke what did you do at the weekend?	Explaining a playground situation or argument; recounting your day; talking about life events (e.g. giving 'news' in class); taking something back in a shop
Descriptive discourse	'Cookie theft' picture description from the Boston Diagnostic Aphasia Examination [15] 'Picnic scene' from the Western Aphasia Battery [16]	Describing scenes observed, e.g. beautiful views from holiday, car crash on the way into work
Expository discourse	What is your favourite game or sport? Why is it your favourite game? [17]	Arguing, persuading and advising, e.g. political discourse or classroom questions that require a student to reason about a situation, identify cause and effect or justify their opinions

Table 1. Discourse types and examples.

2.2. Discourse development

Although standardised norms are lacking in the field, a large body of evidence about discourse development [20–23] provides normative evidence, meaning clinicians can assess children's discourse skills. Berman [19] summarises the evidence base that indicates that the development of discourse ability starts very early (by the age of 2 years) when children first start talking about events (although 2 and 3 year olds cannot construct a discourse autonomously without scaffolding from an external stimuli, such as a picture book or by responding to an older conversational partner). By 5 years old, general discourse structure has been established (beginning, middle, end), but is context and task dependent. For example, 5-year-old children find personal narratives easier than producing fictional narrative discourse because they have not yet developed the discourse skills needed to provide the necessary background information or evaluative comment (expected by 10 years of age but perhaps not fully proficient until adolescence). Within this evidence base, Berman [19] distinguishes three broad theoretical approaches to discourse development in which each give more detail on specific components of discourse. The three approaches focus either on (1) the relationship between linguistic form and discourse function; (2) elements of discourse content or (3) the structural features of a well-formed discourse. This distinction aligns with the approach taken in the whole of this chapter, in which we discuss (1) how language is used, (2) what information is included and (3) how the information is structured.

2.2.1. Development of the use of language for particular discourse functions

In this group of studies, the focus is the relationship between linguistic forms (words, phrases and sentence structure) and the functions that these forms perform in discourse (e.g. reference, temporality, connectivity). Much of the research in this area uses the 'Frog Story' wordless picture book as a means of elicitation [e.g., 21, 22]. In discourse, reference is a means of introducing participants and maintaining reference to them or shifting reference to other participants. Although the linguistic forms needed for referencing are available to pre-school children (e.g. proper nouns, indefinite and definite noun phrases, pronouns), the ability to make appropriate reference is a later-developing ability [24]. Referencing develops later because of the cognitive difficulty involved in keeping information in mind across the discourse. For example, the speaker needs to keep track of what/who has been mentioned, when and how (memory) and take into account shared speaker-listener knowledge. This provides listeners with appropriate amounts of information at each point in the discourse (drawing on theory of mind, memory and pragmatics). This field of research has also highlighted the use tense morphology for storytelling purposes [19]. For example, Berman and Slobin [22] identify an 'anchor tense' (typically past and/or perfect forms or, in picture book storytelling, on-going present tense) used consistently across the discourse by all children, with older children also varying tense for pragmatic effects such as foregrounding and 'flashbacking'. Another key finding relates to words marking connectivity in a discourse: as children develop, they increasingly supplement 'and' with other words such as 'because', 'so', 'next' and 'then' [22, 23]. This work on connectivity complements traditional school-based studies of written discourse based on 'T-Units' [25] or 'C-Units' [26], a count of the number of clauses as a proxy measure of syntactic complexity (a lower number of clauses representing more densely packaged clause structure and therefore a higher degree of syntactic complexity).

2.2.2. *Development of discourse information content*

Labov's work [27, 28] on 'narrative evaluation' is perhaps the best-known study to look at discourse information content. Labov and Waletzky [28] collected over 600 discourses from inner-city adolescents in the USA (asked to tell about a life-threatening experience) and analysed the temporal sequencing within them. Labov distinguishes 'referential information' (about the characters and events in the story) from 'evaluative information' (about a character's motivation, emotion or internal state). Referential elements form the 'plotline' of the discourse and usually move from background orientation via an initiating event to the central events in the discourse before the resolution is reached. In Labov's research, adolescent narrators typically marked resolution with evaluative comment [28]. Peterson and McCabe's [23] study of the personal narratives of 4–10 year olds built on Labov's work, identifying six patterns of personal narrative storytelling, with only the older children consistently using the full structure described by Labov, while younger children either ended in the middle of the discourse (at the complicating event or 'high point') or used a simple 'chronological' structure. They also found that, with age, children make reference to more, and more different types of, evaluative elements. A complementary body of work looking at the emergence of discourse content is provided by Applebee [20] whose work acknowledges that young children begin with producing discourse in a much less mature way because their language and cognition are still developing.

2.2.3. *Development of discourse information structure*

The most widely used framework for looking at the structural features of a well-formed discourse is story grammar. While various story grammars have been proposed since the late 1970s, Stein and Glenn's [29] study is the most widely cited source. Story grammar describes both the speaker's knowledge of narrative discourse structure and the listener's internalized framework used to comprehend the discourse. The elements composing the discourse are defined as abstract categories (e.g. setting, episodes, outcome) with each episode having the potential to subdivide (e.g. into initiating event, goal, plot, resolution). Stein and Glenn asked first- and fifth-grade children (equivalent to key stage 1 in UK primary schools, which is age 6–7 years, and key stage 2, 10–11 years) to retell short simple stories they had heard. The older children remembered the stories better than the younger children, while the younger children recalled only referential information (mainly events), the older children also recalled evaluative comments [29]. Stein and Glen's research forms the basis of a large body of subsequent story grammar work, where consensus suggests that by 6 years, children can recount stories they have encountered in the expected (adult like) order of a story grammar, although they would not necessarily recall the exact wording of the original. It is important to note that story grammar research has generally focused on children's comprehension and recall of narrative discourse rather than on spontaneous narrative production and so does not deal directly with children's developing abilities in the construction of discourse. In their exploration of narrative discourse in adolescents with DLD, Wetherell et al. highlight the dispute in the literature about the age at which children complete development of narrative discourse [30]. Although some researchers argue that the development of narrative ability is achieved by 10 years old, some aspects of discourse skill—such as length, syntactic complexity, episodic density and evaluative comments—continue to increase throughout adolescence and into adulthood [21].

2.3. Discourse in healthy ageing

Successful discourse production relies on language and cognition, both of which are likely to change as a result of healthy ageing. Understanding how these changes affect discourse is paramount to recognising impairments. If discourse changes as a result of healthy ageing, we do not expect healthy adults to produce perfect discourses and so, our benchmark when considering clients with impairments is the imperfect discourse of healthily ageing adults, rather than a perfect discourse. Evidence suggests that in healthy ageing, we should expect changes in the length of a discourse; the syntactic structures a speaker uses; the cohesion of the discourse; the amount of information a speaker is able to communicate and also the overall coherence of the discourse.

2.3.1. How language is used in discourse

In general, older speakers produce longer discourses than younger speakers. In the following studies, 'older' is a term most often used for people aged 60 plus, and 'younger' most often means people younger than 40. Older speakers have larger vocabularies than younger speakers [31], although they are likely to have more trouble with confrontation naming tasks [32]. Older speakers are more likely to give more detail in their discourses and to provide more explanation than younger speakers [33], which may result in them producing longer discourses. However, discourse length may be affected by the discourse type: although Juncos-Rabadán et al. [34] found that older adults produce longer narrative discourses, Ulatowska et al. [35] found that the length of procedural discourses produced by younger and older adults was similar. Glosser and Deser [36] found no difference in lexical production errors between younger and older adults, suggesting that ageing is not associated with more lexical errors. Reduced syntax may occur as a result of healthy ageing. Walker et al. [37] found that older adults aged 60–91 years produced shorter sentences than college students, and that those shorter sentences also contained fewer embedded clauses; and Kemper and colleagues found a reduced range of complex syntax in older adults [38–40]. However, other studies suggest no difference between the syntax use of younger and older adults [41, 42]. This conflicting picture may be based on differences between discourse genres or on differences between sentence-level methods of measurement. Reduced syntax is therefore not necessarily an indicator of impairment.

2.3.2. What information is included in discourse (coherence)

Information content in a discourse can be measured in countable 'units' of information, in how relevant that information is or how logically it links together. Communicating information and marking how it relates to other information may change as a speaker ages. Older speakers are likely to produce discourses with less information, or less dense information content, than discourses produced by younger speakers [34, 35, 43]. Furthermore, when compared to younger speakers, older speakers are likely to produce discourses which are less coherent overall and more likely to contain irrelevant information [34, 36, 44]. Glosser and Deser [36] measured local coherence, using a method which focuses on how well each utterance relates to the previous utterance, and found that while older adults produced discourse that was less coherent overall, the coherence relationships between neighbouring utterances were the same in younger and older adults. Taken as a whole, the evidence base suggests that the processes in a discourse which are most vulnerable to the ageing process are likely to be, the amount of information, relevance of information, and overall coherence of information in discourse.

2.3.3. How information is structured is discourse (cohesion)

Cohesion in discourse relates to the extent to which a text 'hangs together', a process which might be vulnerable in ageing. Grammatical cohesion is based on the structural content of language [45], for example, the ways a speaker uses language to create links between characters across more than one sentence (for example, Cinderella…. She… Her). Older adults use more ambiguous and non-specific references than younger adults [34, 46]. For example, Ulatowska et al. [46] focused on the difference in referential cohesion in younger and older adults and found that older adults had a greater quantity of *referential ambiguity*, such as in the utterance 'so the policeman talked to him for a short time, and then, he went on his way', where it is unclear whom the 'he' relates to. Therefore, some degree of incomplete or unclear referential cohesion may be a feature of healthy ageing in the discourse of older adults.

The patterns in discourse produced by healthy children developing and healthy adults ageing are important for clinicians, so that they have a context against which to evaluate the discourse patterns in DLD and aphasia.

2.4. Discourse patterns in DLD and aphasia

2.4.1. Discourse patterns in DLD

Discourses produced by children with DLD are impaired in terms of their language content. Children with DLD produce shorter, less cohesive stories that are syntactically simple and contain frequent errors of syntax, semantics and morphology [47, 48]. Botting [49] compared the narrative discourse of children with DLD (n = 5) to children with autism. She found that children with DLD produced less 'socio-cognitive' and 'affective' vocabulary (which included mental verbs such as 'think' and 'know'). In terms of information content and information structure, some authors report a relative lack of difficulty with discourse production by children with DLD. For example, there is evidence of unimpaired cohesion (as measured by accurate referencing [50]). However, this finding is not unanimous, and the other research suggests that cohesion is a key factor distinguishing children with DLD and their typically developing peers [50]. With regard to global discourse structure, the evidence regarding children with DLD is also contradictory. Merritt and Liles [51] found that older children with DLD produced fewer elements of story structure than their age-matched peers; however, Liles et al. [48] found that global organization factors did not distinguish children with DLD from typically developing controls after local structure (i.e. cohesion) was accounted for. So while the evidence for language difficulties in DLD discourse is clear, the picture regarding communicating information is less so. This pattern is echoed in the evidence base about the discourse of people with aphasia (PWA).

2.4.2. Discourse patterns in aphasia

Speakers with aphasia produce discourse that is impaired in terms of syntax [52–55]. Evidence from retellings of the Cinderella story is a particularly rich source of information about syntactic difficulty for PWA [9, 55, 56]. Analysis of this fairy tale narrative discourse has revealed that aphasia reduces the proportion of narrative words, the elaboration of noun and verb phrases and complex syntax [9, 55, 56]. Whitworth [56] found that speakers with aphasia used a preponderance of semantically light verbs, such as 'go' and 'make', which lack semantically rich information. Cruice et al. [57] explored the language used by PWA in their responses to questions about their quality of life. Similar to the Cinderella discourses, in their quality of life discourses, PWA produced syntactically less complex sentences than healthy people. Turning to information content and information structure, there is some disagreement in the evidence base. There are a group of studies which suggest that PWA produces the *same* amount information in the discourse as healthy speakers; however, there is a larger body of evidence indicating that PWA produces *less* information that they and also that PWA link information *less clearly* to the overall topic (see the review by Pritchard et al. [58] for an evaluation of the quality of these studies). There is also evidence suggesting PWA produce varying amounts of information and that they structure it differently in different discourse types (narrative, procedural, expository, etc.) [58].

In summary, both PWA and children with DLD tend to produce discourse that is shorter, with fewer complex sentences and less diverse vocabulary, that may contain less core information and which may include fewer overt markers of informational structure when compared with the discourse produced by neurologically healthy adults and typically developing children. These characteristics of communication impairment indicate that all three central components of discourse *can* be affected (language, information, information structure). However, these components will not always be affected in impaired speakers, and there is evidence to suggest that abilities in the three components are not always correlated.

2.5. Discourse assessment and therapy

Discourse is a popular way to elicit language for the assessment of communicative skills for a broad range of reasons. Oral discourse provides a rich source of data about language use in a comparatively natural context and allows researchers and clinicians to assess multiple linguistic and discourse elements using relatively short language samples—elements that can be assessed in this way include how language is used, what information is included and how the information is structured. Discourses occur cross-culturally, both within conversation and in stand-alone contexts. We focus on monologic discourse because even though discourse and conversation are not entirely distinct entities, conversation is subject to additional processes (notably the input from the conversation partner). The assessment of discourse is recommended in many best practice guidelines for both adults with aphasia and children with DLD, numerous assessment tools and methods exist, and many of these methods are transferrable across client groups. However, there is little information to guide the clinician about how to choose between them. In the next sections, we outline a core set of the most common methods and indicate of the theoretical framework and/or evidence base underpinning them. It is important to consider the theory and evidence base for assessment tools because the codes of practice governing speech and language pathology (therapy) worldwide state that clinicians should base intervention on the best available theory and research evidence.

2.5.1. Discourse assessment for children with DLD

2.5.1.1. Assessment approaches and informal assessment methods

The discourse abilities of children with DLD have been analysed in two different ways: (1) focusing on the information content and information structure in the discourse and (2) focusing on the language content in the discourse. Approach (1) is sometimes referred to in the clinical literature as macrostructure analysis and approach (2) referred to as microstructure analysis. The two most widely used models of macrostructure are story grammar and high point analysis. Story grammars represent the speaker's knowledge of the elements that constitute a well-formed story [29]. These elements can be related to the early stage in the Sherratt's model (referred to at the beginning of Section 2) in which the choice of a particular discourse type constrains the choice of information included, as well as the structuring of that information. For example, if a speaker was choosing a narrative discourse, they would require some story grammar elements, while in procedural discourse, they would require different elements. Stein and Glenn's story grammar [29] is the most widely cited source and is based on evidence from an empirical study of school-aged children. These authors suggest that well-structured narrative discourses should contain a setting and one or more episodes (linked sequentially, temporally or causally), and that each episode has the potential to include an initiating event, an internal response, a plan, an attempt, a consequence, and a reaction. Other story grammars also include information about characters, place and time; and character responses, including internal states (emotions and mental states). Story grammar approaches are popular clinically to judge the quality of a discourse and this approach underpins many published clinical tools (see **Table 2**). Although the story grammar approach does not provide detailed developmental information, Stein and Glenn reported that the percentage of story grammar elements in a discourse increases with child's age (between US Kindergarten and third grade; UK pre-school and the beginning of key stage 2; between the ages of 5 and 9) and that the majority of the children of all ages used causal relations in their discourses, although older children use more. There are, however, no standardised norms for which elements of story grammar to expect at particular stages of development. High point analysis is broadly parallel to story grammar and is derived from Labov and Waletzky [28]. The elements used in high point analysis include information about setting and events but focus in particular on evaluation. Evaluation reflects these aspects of the discourse that the narrator highlights, including references to characters' internal states, use of dialogue and stress and intonation, which signal the story's climax or 'high point' and reveal which events are salient or meaningful to the narrator.

In children's discourse microstructure, the most commonly identified aspects of language in discourse assessment include vocabulary, grammar and cohesion—a term for the linguistic devices used to link sentences to one another, such as different noun phrases linked to each other or pronouns linked to noun phrases (e.g. the links between 'the poor servant girl', 'the beautiful girl in the blue gown', 'Cinderella', 'she' and the pronoun 'her' in the phrase 'her

http://dx.doi.org/10.5772/intechopen.69894

Assessment	Type of discourse	Scoring	Norms	Age range
Bus story [10]	Narrative retell From heard story with pictures	*Macrostructure*—scores for (a) information (i.e. key content contained in the story) *Microstructure*—scores for (b) sentence length (c) complexity (i.e. subordinate and relative clauses) *Other*—scores for (d) independence (level of cueing/prompt).	Yes	3–8 years
Squirrel Story [11]	Narrative retell	*Macrostructure*—scores for (a) story structure and (b) story content (follows story grammar framework) *Microstructure*—scores for (c) vocabulary and (d) language level *Other*—scores for (e) listening and attention	Guideline scores based on sample of 100 children	3–6 years
Peter and the Cat [13]	Narrative retell	*Macrostructure*—scores for (a) story structure and (b) story content (follows story grammar framework) *Microstructure*—scores for (c) specific words/vocabulary (conjunctions, adjectives, adverbs) and specific phrases (adverbial prepositional phrases) (d) for reference chains	No	5–9 years
Expression, Reception and Recall of Narrative Instrument [14]	Narrative generation and recall (i) from picture sequence and (ii) recalled after 30 min delay	*Macrostructure*—scores for (a) story content *Microstructure*—scores for (b) mean length of utterance *Other*—scores for (c) story comprehension probe questions (three literal and six requiring inference)	No	4 year-adult

Assessment	Type of discourse	Scoring	Norms	Age range
Narrative subtest of the assessment of comprehension & expression—ACE [59]	Narrative retell, using eight picture cards. Immediate recall	*Macrostructure*—none *Microstructure*—count of (a) the number of target words and phrases the child includes in the story retell; and (b) the number of syntactic forms and discourse features, such as tense, direct speech and questions, a child uses in the story retell	Y: Standard scores calculated from raw scores	6–11 years
the discourse analysis profile—DAP [60]		*Macrostructure*—(a) topic maintenance; (b) informativeness; (c) event sequencing (d) referencing. *Microstructure* (e) The correctness and range of conjunctions; (f) Fluency (the manner of production, including phrase and word repetitions, abandoned utterances, lexical substitutions, pauses and fillers) For (a)–(f), a subjective judgment of appropriate/inappropriate must be made		

Table 2. Summary of commonly used paediatric discourse assessments.

glass slipper'). The linking of pronouns back to a noun phrase is referred to in the literature as a reference chain. Microstructure is not a feature of either story grammar or high point analysis, and there is no integration between macrostructure and microstructure in these approaches. Clearly, both microstructural linguistic features and macrostructure are of key interest in a clinical evaluation because both are essential for creating a coherent, meaningful discourse. The existing models of discourse production support this contention that integration is key to coherent discourse production.

2.5.1.2. Clinical assessment tools

There are a number of widely used published clinical tools for assessing discourse, each with clear and structured scoring protocols relating to some or all of the macrostructural and microstructural elements of discourse outlined above. In **Table 2**, we provide a detailed description of each. The most widely used tools in **Table 2** assess only narrative discourse, and so clinical assessment of other types of discourse must be done using informal means.

2.5.2. Discourse therapy for children with DLD

In the paediatric field, there is a growing body of literature about interventions to both improve elements of discourse macrostructure and to facilitate the microstructural linguistic components (i.e. words and sentences) used in discourse. Petersen [61] completed a systematic search for *narrative* discourse intervention for children with language impairment, reviewing nine studies published since 1980. We ran a search in 2017, expanding the criteria to all discourse types, not just narrative discourse. In both reviews, the search terms used were intended to capture studies in which discourse therapies were described. In other words, we were looking for studies describing interventions using *discourse techniques* rather than interventions which aimed to improve discourse but which used *language techniques*. While there are a large number of studies that work on language with the ultimate goal of improving discourse, there are fewer studies that work directly on discourse. Our own review identified seven studies, three of which overlapped with the Petersen review. Therefore, the coverage of the combined reviews includes 13 interventions. This means that there are only 13 studies published in the past 40 years that outline intervention programmes aimed at improving the information content and structure of children's discourse. This is despite the fact that discourse is the basis for the vast majority of everyday communication, such as talking about your day or sharing an opinion.

The combined review of the literature captured a broad range of therapy approaches including both classroom-based intervention and individualized therapies. There was some overlap in the use of materials across the reviewed intervention studies, with the majority using single photos or pictures to elicit narratives and around half using a wordless picture book and/or role playing. Perhaps surprisingly, there was little overlap between the intervention protocols of the studies. Procedures included the modelling of narrative discourses to the child, for them to practise and re-tell [62, 63]. Other interventions required the child to generate their own narrative discourse, either spontaneously or from a stimulus such as a picture cue [62]. Another procedure involved asking the child 'probe questions', to elicit missing discourse information (missing story grammar components), such as asking 'What happened then?', 'Why?' and 'How did that make her feel?' [63]. And finally, there were interventions in which children were given key sentences to repeat and then use in a discourse [64]. These combined reviews also uncovered important evidence that narrative discourse intervention for children with DLD is effective. The vast majority of the reviewed studies resulted in positive discourse outcomes for the child [62–67]. In particular, the evidence suggests that there are two key components to successful discourse intervention with this group of children: (1) interventions should involve encouraging a child to repeatedly retell targeted discourse and (2) interventions should emphasise discourse information content elements. The evidence base indicates that such an approach will facilitate improvement in both discourse macrostructure and some aspects of language because it will improve the child's ability to use language for discourse purposes. These findings should encourage clinicians to treat narrative discourse as a functional language target as well as a format through which language can be remediated.

2.5.3. Discourse assessment for adults with aphasia

A large field of literature explores the discourse of adults with aphasia (see review by Linnik et al. [18]), with speakers experiencing challenges at single word and sentence levels as well as with cohesion, coherence and general discourse organisation. Difficulties with information content and organisation may be related to difficulties with language [68]. For example, a speaker with anomic aphasia may be unable to find the specific words required for the discourse and so may leave information gaps. A number of different clinical aphasia batteries each includes a discourse component, which is commonly a task requiring a speaker to describe a black and white line drawing: the Western Aphasia Battery [16], for example, has a scene depicting people having a picnic, some children and a house beside water. Where an overall aphasia profile is available from such assessment batteries, performance on the discourse task is often a substantial component of this overall score. The weight given to discourse in the batteries underlines the fact that discourse production is likely to be a core difficulty for speakers with aphasia. In the aphasia batteries, picture description tasks are generally scored in terms of the language a speaker uses, and the information they are able to communicate. To take the Western Aphasia Battery as an example, for the 'spontaneous speech' task, a 1–10 scale is used for rating a speakers' fluency, grammatical competence and paraphasias, and a 1–10 scale is used for information content (yielding a maximum 'spontaneous speech' score of 20). The aphasia test batteries provide a useful starting point for describing discourse in speakers with aphasia and for identifying a difficulty with information content or language. However, further assessment or analysis will be required to pinpoint the source of a speaker's difficulty or to measure change as a result of therapy. The research literature offers an extensive catalogue of methods for assessing discourse, including discourse-language measures (e.g. assessments of syntactic complexity and counts of narrative words) [69] and discourse-information measures (e.g. story grammar and ratings of coherence) [58]. Although the psychometric properties of discourse measures are still under investigation [58], it is likely that such measures will provide a finer grained evaluation of discourse impairment than will aphasia batteries. Discourse elicitation methods for PWA in the research literature include picture descriptions, narrative discourse retelling (from memory or wordless picture books), personal narratives (e.g. the story of when they had their stroke), procedural discourses (e.g. how to change a light bulb) and expository discourse (e.g. the reasons for political affiliation). These elicitation methods are likely to produce discourses that are structured differently, for example a descriptive discourse may contain more listing than a fictional narrative. Therefore, it is important to reflect on how we expect different discourse types to appear, before selecting an elicitation method for assessment. For example, if we hypothesise that a client has difficulty with cohesion, we should select a discourse that is likely to use cohesion, such as a narrative discourse with multiple characters, in order to test this hypothesis. Due to the number of aspects of discourse which can be measured, a hypothesis-testing approach is likely to be appropriate for clinical use. There are 58 methods for measuring the information content and information structure in the discourse of speakers with aphasia [58] and 565 methods for measuring language used in discourse by speakers with aphasia [69]. The sheer number of different

http://dx.doi.org/10.5772/intechopen.69894

methods for measuring how language, information and information structure is measured increases the importance of using clinical judgement.

2.5.4. Discourse therapy for adults with aphasia

In the field of aphasia, as in the paediatric literature, there is a much larger evidence base about discourse assessment methods than about discourse intervention approaches. We reviewed the literature and identified studies that described both discourse treatment and discourse-based outcomes of interventions (as opposed to those studies in which a language intervention is evaluated with a discourse-based outcome, of which there are many more). The studies on discourse intervention that we found comprised three distinct approaches to the improvement of discourse (in some studies, more than one approach is used). One approach targets word and sentence production (simple and complex clauses) within discourse [56, 70–74]; another involves massed practice of whole discourses, using AphasiaScripts [75–77] and a third focuses on supporting participants to improve their discourse macrostructure using story grammar [56, 64, 68, 78]. Overall, the findings from these studies were positive, with clients' improving in language use, the amount and quality of information conveyed, and how the information was structured, although it was not the case that all three elements improved in every case. Specifically, intervention improved those areas which were focused upon in intervention. This suggests that to make an impact on discourse, specific targeting of challenging features is likely to be appropriate.

2.6. Summary and conclusions

This chapter has outlined how speakers construct discourse in everyday situations in terms of the language used; the information included; and the way the information is structured. Current methods for discourse analysis were outlined and key developments in narrative discourse production therapy were reviewed. Currently, there is sufficient evidence to be sure that certain elements are crucial to consider in the assessment and treatment of discourse. First, it is likely that discourse type affects the skills that speakers are able to demonstrate. Second, macro and microstructure are likely to differ, and assessment and therapy should target both. Third, clinical judgement should be used to select from the myriad of published assessments in the field. Finally, emerging multi-level therapies are proving to be successful and are likely to be the best approach to addressing difficulties with discourse. There is some consensus beginning to arise from the evidence base on essential targets for intervention and effective methods for improving discourse, and overall discourse is a promising area for speech-language pathology and therapy.

Author details

Lucy T. Dipper* and Madeleine Pritchard

*Address all correspondence to: l.t.dipper@city.ac.uk

City University of London, London, United Kingdom

References

[1] Tannen D, Hamilton HE, Schiffrin, D. The Handbook of Discourse Analysis. Vol. 1. John Wiley & Sons, Chichester, UK; 2015

[2] Department for Education. Statutory Framework for the Early Years Foundation Stage [Internet]. 2014. Available from: https://www.gov.uk/government/publications/early-years-foundation-stage-framework--2 [Accessed: 7th April 2017]

[3] World Health Organization. International Classification of Functioning, Disability and Health (ICF). Geneva: World Health Organization; 2001

[4] World Health Organization. International Classification of Functioning, Disability, and Health: Children & Youth Version: ICF-CY. World Health Organization, Switzerland; 2007

[5] Royal College of Speech and Language Therapists. Available from: https://www.rcslt.org/clinical_resources/docs/catalise [Accessed: 5th May]

[6] Frederiksen CH, Bracewell RJ, Breuleux A, Renaud A. The cognitive representation and processing of discourse: Function and dysfunction. In: Joanette Y, Brownell H, editors. Discourse Ability and Brain Damage: Theoretical and Empirical Perspectives. New York: Springer Verlag; 1990

[7] Sherratt S. Multi-level discourse analysis: A feasible approach. Aphasiology. 2007;**21** (3-4):375-393

[8] Bishop DVM, Edmundson A. Language-impaired 4-year-olds: Distinguishing transient from persistent impairment. Journal of Speech and Hearing Disorders. 1987;**52**(2):156-173

[9] Saffran E, Berndt R, Schwartz M. The quantitative analysis of agrammatic production: Procedure and data. Brain and Language. 1989;**37**(3):440-479

[10] Renfrew C. Bus Story Test. Milton Keynes: Speechmark; 2010

[11] Carey J, Hensen A, Rippon H. Squirrel Story Narrative Assessment. Keighley, West Yorkshire: Black Sheep Press; 2006

[12] Mayer M. Frog, where are you? New York: Dial Books; 2003

[13] Leitao S, Allan L, Phillips M. Peter and the Cat: Narrative Assessment. Keighley, West Yorkshire: Black Sheep Press; 2004

[14] Bishop D. Expression, Reception and Recall of Narrative Instrument (ERRNI). London: Pearson Assessment; 2004

[15] Goodglass H, Barresi B, Kaplan E. The Boston Diagnostic Aphasia Examination. Lippincott Williams & Willkins; 1983. Currently in its 3rd addition (2001) published by Pearson Clinical, Oxford, UK

[16] Kertesz A. Western Aphasia Battery–Revised (WAB-R). Austin, TX: Pro-Ed; 2006

[17] Nippold MA, Mansfield TC, Billow JL, Tomblin JB. Expository discourse in adolescents with language impairments: Examining syntactic development. American Journal of Speech-Language Pathology. 2008;**17**(4):356-366

[18] Linnik A, Bastiaanse R, Höhle B. Discourse production in aphasia: A current review of theoretical and methodological challenges. Aphasiology. 2016;**30**(7):765-800

[19] Berman RA. Trends in research on narrative development. In: Foster-Cohen S, editor. Language Acquisition. Palgrave Macmillan, London, UK; 2009. pp. 294-318

[20] Applebee A. The Child's Concept of Story: Ages Two to Seventeen. Chicago: University of Chicago Press; 1978

[21] Bamberg M. The Acquisition of Narratives. Berlin: Mouton de Gruyter; 1987

[22] Berman RA, Slobin DI. Relating Events in Narrative: A Crosslinguistic Developmental Study. New Jersey: Lawrence Erlbaum Associates; 1994

[23] Peterson C, McCabe A. Developmental Psycholinguistics: Three Ways of Looking at a Child's Narrative. New York: Plenum Press; 1983

[24] Karmiloff-Smith A. A Functional Approach to Child Language: A Study of Determiners and Reference. Vol. 24. Cambridge University Press, Cambridge, UK; 1981

[25] Hunt KW. Grammatical Structures Written at Three Grade Levels. National Counters of Teachers of English Research Report #3. Champaign, IL: National Council of Teachers of English; 1965

[26] Loban W. Language Development: Kindergarten through Grade Twelve. Research Report 12. Urbana, IL: National Council of Teachers of English; 1976

[27] Labov W. Language in the Inner City: Studies in the Black English Vernacular. Philadelphia, PA: University of Pennsylvania Press; 1972

[28] Labov W, Waletzky J. Narrative analysis. In: Helm, J. editor. Essays on the Verbal and Visual Arts: Proceedings of the 1966 Spring Meeting of the American Ethnological Society. Seattle: University of Washington Press; 1967. pp. 12-44

[29] Stein NL, Glenn CG. An analysis of story comprehension in elementary school children. In: Freedle RO, editor. New Directions in Discourse Processing. Norwood, NJ: Ablex; 1979. pp. 55-120

[30] Wetherell D, Botting N, Conti-Ramsden G. Narrative in adolescent specific language impairment (SLI): A comparison with peers across two different narrative genres. International Journal of Language & Communication Disorders. 2007;**42**(5):583-605

[31] Sankoff D, Lessard R. Vocabulary richness: A sociolinguistic analysis. Science. 1975; **190**:689-690

[32] Nicholas M, Obler L, Albert M, Goodglass H. Lexical retrieval in healthy aging. Cortex. 1985;**21**(4):595-606

[33] Botwinick J, West R, Storandt M. Qualitative vocabulary test responses and age. Journal of Gerontology. 1975;**30**(5):574-577

[34] Juncos-Rabadán O, Pereiro AX, Rodríguez MS. Narrative speech in aging: Quantity, information content, and cohesion. Brain and Language. 2005;**95**(3):423-434

[35] Ulatowska HK, editor. The Aging Brain: Communication in the Elderly. College-Hill London, UK; 1985

[36] Glosser G, Deser T. A comparison of changes in macrolinguistic and microlinguistic aspects of discourse production in normal aging. Journal of Gerontology. 1992;**47**(4):P266–P272

[37] Walker V, Hardiman C, Hendrick D, Holbrook A. Speech and language characteristics of an ageing population. In: Lass NJ, editor. Speech and Language: Advances in Basic Research and Practice. Vol. 6. New York: Academic Press; 1981. pp. 143-202

[38] Kynette D, Kemper S. Aging and the loss of grammatical forms: A cross-sectional study of language performance. Language & Communication. 1986;**6**(1-2):65-72

[39] Kemper S. Geriatric psycholinguistics: Syntactic limitations of oral and written language. In: Light, L.L. and Burker, D.M. editors. Language, Memory, and Aging. Cambridge University Press, Cambridge, UK. 1988. pp. 58-76

[40] Kemper S, Kynette D, Rash S, O'Brien K, Sprott R. Life-span changes to adults' language: Effects of memory and genre. Applied Psycholinguistics. 1989;**10**(01):49-66

[41] Labov W, Auger J. The effect of normal ageing discourse: A sociolinguistic approach. In: Brownell H, Joanette Y, editors. Narrative Discourse in Neurologically Impaired and Normal Ageing Adults. San Diego: Singular Publishing Group; 1993

[42] Chapman SB, Ulatowska HK, King K, Johnson JK, McIntire DD. Discourse in early Alzheimer's disease versus normal advanced aging. American Journal of Speech-Language Pathology. 1995;**4**(4):124-129

[43] Capilouto GJ, Wright HH, Maddy KM. Microlinguistic processes that contribute to the ability to relay main events: Influence of age. Aging, Neuropsychology, and Cognition. 2016;**23**(4):445-463

[44] Ellis C, Henderson A, Wright HH, Rogalski Y. Global coherence during discourse production in adults: A review of the literature. International Journal of Language & Communication Disorders. 2016;**51**(4):359-367

[45] Halliday M. An Introduction to Functional Grammar. London: Edward Arnold; 2004

[46] Ulatowska HK, Hayashi MM, Cannito MP, Fleming SG. Disruption of reference in aging. Brain and Language. 1986;**28**(1):24-41.

[47] Norbury CF, Bishop DV. Narrative skills of children with communication impairments. International Journal of Language & Communication Disorders. 2003;**38**(3):287-313

[48] Liles BZ, Duffy RJ, Merritt DD, Purcell SL. Measurement of narrative discourse ability in children with language disorders. Journal of Speech and Hearing Research. 1995;**38**:415-425

[49] Botting N. Narrative as a tool for the assessment of linguistic and pragmatic impairments. Child Language Teaching and Therapy. 2002;**18**(1):1-21

[50] Van der Lely HKJ. Narrative discourse in grammatical specific language impaired children: A modular language deficit? Journal of Child Language. 1997;**24**:221-256

[51] Merritt DD, Liles BZ. Story grammar ability in children with and without language disorder story generation, story retelling, and story comprehension. Journal of Speech, Language, and Hearing Research. 1987;**30**(4):539-552

[52] Fergadiotis G, Wright HH. Lexical diversity for adults with and without aphasia across discourse elicitation tasks. Aphasiology. 2011;**25**(11):1414-1430

[53] Fergadiotis G, Wright HH, Capilouto GJ. Productive vocabulary across discourse types. Aphasiology. 2011;**25**(10):1261-1278

[54] Pritchard M, Dipper L, Morgan G, Cocks N. Language and iconic gesture use in procedural discourse by speakers with aphasia. Aphasiology. 2015;**29**(7):826-844

[55] Webster J, Franklin S, Howard D. An analysis of thematic and phrasal structure in people with aphasia: What more can we learn from the story of Cinderella? Journal of Neurolinguistics. 2007;**20**(5):363-394

[56] Whitworth A. Using narrative as a bridge: Linking language processing models with real-life communication. Seminars in Speech and Language. 2010;**31**(01):064-075

[57] Cruice M, Pritchard M, Dipper L. Verb use in aphasic and non-aphasic personal discourse: What is normal? Journal of Neurolinguistics. 2014;**28**:31-47

[58] Pritchard M, Hilari K, Cocks N, Dipper L. Reviewing the quality of discourse information measures in aphasia. International Journal of Language and Communication Disorders. 2017 (Epub ahead of print available at https://www.ncbi.nlm.nih.gov/pubmed/28560767)

[59] Adams C, Coke R, Crutchley A, Hesketh A, Reeves D. Assessment of Comprehension and Expression 6-11. NFER-Nelson Slough, UK. 2001

[60] McCabe A, Bliss LS. Patterns of Narrative Discourse. Boston: Allyn & Bacon; 2003

[61] Petersen DB. A systematic review of narrative-based language intervention with children who have language impairment. Communication Disorders Quarterly. 2011;**32**(4):207-220

[62] Swanson LA, Fey ME, Mills CE, Hood LS. Use of narrative-based language intervention with children who have specific language impairment. American Journal of Speech-Language Pathology. 2005;**14**(2):131-141

[63] Munro N, Lee K, Baker E. Building vocabulary knowledge and phonological awareness skills in children with specific language impairment through hybrid language intervention: A feasibility study. International Journal of Language & Communication Disorders. 2008;**43**(6):662-682

[64] Fey ME, Finestack LH, Gajewski BJ, Popescu M, Lewine JD. A preliminary evaluation of Fast ForWord-language as an adjuvant treatment in language intervention. Journal of Speech, Language, and Hearing Research. 2010;**53**(2):430-449

[65] Adams C, Lloyd J. The effects of speech and language therapy intervention on children with pragmatic language impairments in mainstream school. British Journal of Special Education. 2007;**34**(4):226-233

[66] Hayward D, Schneider P. Effectiveness of teaching story grammar knowledge to preschool children with language impairment. An exploratory study. Child Language Teaching and Therapy. 2000;**16**(3):255-284

[67] Petersen DB, Gillam SL, Spencer T, Gillam RB. The effects of literate narrative intervention on children with neurologically based language impairments: An early stage study. Journal of Speech, Language, and Hearing Research. 2010;**53**(4):961-981

[68] Andreetta S, Marini A. The effect of lexical deficits on narrative disturbances in fluent aphasia. Aphasiology. 2015;**29**(6):705-723

[69] Bryant L, Ferguson A, Spencer E. Linguistic analysis of discourse in aphasia: A review of the literature. Clinical Linguistics & Phonetics. 2016;**30**(7):489-518

[70] Hickin J, Mehta B, Dipper L. To the sentence and beyond: A single case therapy report for mild aphasia. Aphasiology. 2015;**29**(9):1038-1061

[71] McCall D, Virata T, Linebarger MC, Berndt RS. Integrating technology and targeted treatment to improve narrative production in aphasia: A case study. Aphasiology. 2009;**23**(4):438-461

[72] Milman L. An integrated approach for treating discourse in aphasia. Topics in Language Disorders. 2016;**36**(1):80-96

[73] Murray L, Timberlake A, Eberle R. Treatment of underlying forms in a discourse context. Aphasiology. 2007;**21**(2):139-163

[74] Whitworth A, Leitao S, Cartwright J, Webster J, Hankey GJ, ZachJ, Howard D, Wolz V. NARNIA: A new twist to an old tale. A pilot RCT to evaluate a multilevel approach to improving discourse in aphasia. Aphasiology. 2015;**29**(11):1345-1382

[75] Cherney LR, Halper AS. Novel technology for treating individuals with aphasia and concomitant cognitive deficits. Topics in Stroke Rehabilitation. 2008;**15**(6):542-554

[76] Cherney LR, Halper AS, Holland AL, Cole R. Computerized script training for aphasia: Preliminary results. American Journal of Speech-Language Pathology. 2008;**17**(1):19-34

[77] Lee JB, Kaye RC, Cherney LR. Conversational script performance in adults with non-fluent aphasia: Treatment intensity and aphasia severity. Aphasiology. 2009;**23**(7-8):885-897

[78] Carragher M, Sage K, Conroy P. Preliminary analysis from a novel treatment targeting the exchange of new information within storytelling for people with nonfluent aphasia and their partners. Aphasiology. 2015;**29**(11):1383-1408

Chapter 2

Formulaic Language: The Building Block of Aphasic Speech

Annamária Győrfi

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.70038

Abstract

Aphasia is a condition that may appear when parts of the brain (Broca's or Wernicke's area) responsible for language production and processing are damaged. In most cases, patients have the left side of their brain affected. Thus, formulaic language remains intact in most cases. During speech therapy, this can be a solid base to build on. Formulaic language consists of formulas that are fixed phrases, stereotypes that behave as a single-unit lexical item. They have a significant role in language acquisition and fluent discourse production. These ready-made parts of speech are stored in the long-term memory. Studies suggest that the processing of formulaic language engages right hemisphere areas of the brain. Due to their language impairment, people with aphasia often have a lower quality of life, consequently social and professional integration for them being problematic. The investigation of preserved patterns, such as formulaic language and impairments related to different aspects of discourse, may provide insights both for clinical practice and for cognitive science, therefore, facilitating a more efficient approach to treatment.

Conclusion: This comprehensive review assesses what we know so far about the use of formulaic language in aphasic speech to get a more complex view on how to benefit from this knowledge during evaluation and speech therapy to facilitate recovery. These findings may also have implications for future research.

Keywords: aphasia, formulaic language, recovery, left and right brain hemisphere damage, speech therapy

1. Introduction

Referred to as automatic speech in the past, formulaic language incorporates fixed verbal utterances that are often metaphorically presented. Formulaic utterances on average can make up one-third to one-half of discourse production. As they represent an important part of everyday communication, it is necessary for the speech-language pathologist to focus on the scope of formulaic language in human communication [1, 2]. Portrayed in the forms of idioms, proverbs, expletives, collocations and so on, formulaic language is part and parcel of everyday speech [3]. These verbal forms of formulaic language are relevant in the acquisition of languages as well as the development of speech fluency. Owing to their importance regarding speech, these utterances are registered in one's long-term memory (LTM). For this reason, researchers have established a relationship between formulaic language and brain disorders and impaired speech [4].

Formulaic language describes a well-defined set of words, closely knitted in a lexical pattern to facilitate communication. Formulaic language plays an instrumental role in the acquisition, production and the overall use of language. Sources term the language as a prefabricated set of words and phrases found in the long-term memory of the brain to enable communication regardless of language disorders and similar linguistic problems. Language is majorly deployed by people with language and memory impairment, including dementia patients, older persons and individuals with psychoneurological disorders [1, 5]. It is important to note that what makes formulaic language a special focus for this study is that it represents an alternative communication model and therefore instrumental in enhancing the quality of life for persons excluded from the rules-based structure of communication used by other people of the society. Aphasia, on the other hand, is a linguistic problem that occurs when the Broca and the Wernicke areas of the brain are damaged. Aphasia patients have the left section of the brain damaged, but the effect does not tickle to the more delicate areas, particularly the section responsible for the storage of the long-term memory. This study offers a review of the existing body of research, particularly secondary literature, to identify the capacity of the formulaic language and its application in discourse formulation and application in clinical practices and cognitive science [3, 6].

2. Overview of aphasia in the context of formulaic language

Aphasia is a communicative complication and disorder that is experienced by individuals whose half left of the brain is affected in most cases. Since the half left side retains the language, it is inevitable for individuals to experience speech and language issues [7]. When the damage extends to one's right side of the brain, the damage is emphasised and surpasses the basic speech and language complications. It not only causes speech difficulties but also interferes with their reading, listening and writing skills. Since their intelligence is not affected, aphasia also causes problems of swallowing and motor speech complications (apraxia), among others. Insofar as formulaic expressions are incorporated into daily speech, they are more prominent in aphasic speech because of their role in language impairment. Linguists reckon that formulaic language is stored in the right side of the brain, and in most of the cases, a part of it can be retrieved immediately as the patient restarts producing verbal output again, which acts as a feasible channel in speech recovery [1].

Formulaic language was observed and mentioned by clinicians as a characteristic of aphasic speech long before linguists started researching it. Studying the language output of aphasic speakers can reveal the nature of formulaic utterances more than studying the output of normal speakers. Inasmuch, it is assumed that formulaic expressions, as they behave like single-unit lexical items, are stored and retrieved from the long-term memory engaging the right hemisphere areas of the brain. Hence, it is essential to understand their function in the different types of aphasia [5].

A survey conducted in a larger group of people with aphasia revealed that formulaic language is more frequently used in Broca's (non-fluent) aphasia than in Wernicke's aphasia [5].

To delve further into the concept of aphasia, we will discuss Broca's aphasia (expressive) and global aphasia. Expressive aphasia (non-fluent aphasia) was described by Paul Broca during the nineteenth century. Broca's patient exhibited symptoms such as strenuous speech, lack of comprehension, affected morphology and unstable prosody, among others. It is a disorder that affects the production of words, phrases and speech delivery, as a whole. There are similarities while exploring global aphasia because it also deals with both written and spoken language apropos of speech deficiencies. The inclusion of repetitive and insensible structures, limited formulaic utterances and neologism is an independent characteristic in the exploration of aphasic speech [2]. Amidst their indistinguishable nature, it is important to survey the disparities between global aphasia and Broca's aphasia. They both struggle with comprehension difficulties but the former, in comparison to the latter, is well versed with these skills of comprehension [6]. Deficiency of formulaic utterances in Broca's aphasic speech interferes with the ability to achieve proper and substantial communication. Seeing as repetitive utterances were more prevalent in Broca's aphasia, linguists and researchers have proved their recent existence in global aphasia. The relationship between lyrics and formulaic language is evident while probing the scope of aphasic speech. The former, despite their ordinary musical exhibition, can also be spoken in a rhythmical manner. These lyrics are often stored and secured in the brain's long-term memory [6]. For this reason, studies have affirmed the hypothesis apropos of fluent singing and aphasic patients. When there is an in-depth examination, individuals conclude that the existence of long-term memory is, in fact, the determinant of speech acquisition. There should be a distinction between these lyrical forms and long-term memory in rectifying aphasic speech [8].

3. Role of formulaic language in aphasic speech formulation

Another study discusses the role of formulaic language not only to persons facing linguistic problems but also to people who may encounter settings where the language is needed. The first role is the ability to retrieve significant expressive chunks from the long-term memory and consequently slot the phrases, ideas and expressions. Through the constant retrieval of linguistic items and components, the speaker is in a position to build a coherent structure of communication and hence facilitate the conveyance of information and language between speakers. Corpus linguistics observes that formulaic language has a certain complexity, which makes it limited than the conventional form of communication [3].

Another role of formulaic is the ability to smoothen understanding as a result of reduced cognitive burden [1]. Scholarly literature establishes that closely knit lexical items and the use of familiar and culturally embedded phrases ease understanding. For persons experiencing the aphasic condition, formulaic language minimises the complexity of the conveyed message, and it is not a surprise that conventional forms of language like apologies, making excuses, requests and greetings rely fundamentally on formulaic expressions [9]. Scholars like Wood agree that 'there is a strong facilitative role of formulaic units in language fluency which enables aphasic patients to run communication amid the constraints of attention and time found in real-life communication' [10].

4. The acquisition of formulaic language to build aphasic speech

Scholarly sources discuss the acquisition of formulaic language and the ability to apply it as an aphasic-oriented language. A major premise of the formulaic expression is to draw knowledge from long-term memory and in the process achieve a streamlined communication model. Sources note that aphasic patients struggle with communication challenges, which affect their social and professional lives due to lack of formal and informal integration with the society [4]. Acquisition of key formulaic expressions is tantamount in building constructive relationships and in the process enhancing the quality of life through aphasic speech. The primary ways of building a block of formulaic language are through interactional goals and inclination to social domain [11].

The literature further establishes that in L2 learners, formulaic expressions relied mainly on the ability to be communicative although in a limited way. The capacity to apply a set of lexical terms enables L2 speakers to integrate into peer groups as a result leading to a higher language input. Researchers conducted a study in a group of Mexican students targeting the evaluation of discourse expressions. In relation to the acquisition of formulaic language, they established the following:

- Giving an expression that you speak a certain language with a well-chosen set of words.
- Identify expressions familiar with you and begin communicating.
- Looking for repetitive and recurring phases of speech you are familiar.

Similarly, the strategies mentioned above, although primarily applicable to L2 learners, may be employed in building a solid block of aphasic speech. Formulaic expressions used by native adults can appear during the language acquisition and production of young children and L2 learners. These expressions may be native-like or idiosyncratic. In the case of people with aphasia, we can experience the same phenomenon [9, 12].

The acquisition of well-known phrases can further be established by paying attention to facial expressions, body movement and non-verbal cues [13]. This means building an aphasic speech formed primarily from formulaic expressions and culturally accepted linguistic items requires the observation of speakers [14]. For older patients, it is important to use formulaic sequences in the facilitation of language formation and application.

The level of social integration by the use of formulaic expressions is identified to rely on the need to be communicative, and hence proper acquisition demands an equal need to be expressive. Above implies that building a functional and applicable block of aphasic speech different from the natural language but compatible with both the speaker and the hearer demand a high level of integration. Persons facing aphasic conditions or linguistic challenges may enhance acquisition by interacting and engaging with members of the society. Building constructive relationships that address communication gaps, appreciate idioms and support non-verbal expressions is paramount in aphasic speech formulation [7]. To rectify these speech difficulties brought about by aphasia, reiterate the necessity of speech management techniques. It supports the grasping of formulaic utterances so as to eradicate any deficiencies of speech. Their research informs individuals about the role of formulaic speech in improving one's speech production and delivery [15].

5. Mastery of formulaic expression and aphasic speech

The mastery of formulaic expressions is further examined by scholarly literature to establish the link between comprehensive input and overall acquisition. Scheffler is the one author who implies that the acquisition of an aphasic speech borrowed from formulaic expressions cannot be developed purely from a class set up. The learning environment fails to encompass a broad range of elements, which form the formulaic language like positions in utterances, meanings, grammatical patterns and collocates. Another scholarly observation is that conscious noticing is central in the acquisition and application of formulaic language. Significant learning comes from consciously tracking, identifying and applying the concepts, ideas and patterns of thought [11].

The development of a block of language to meet aphasic needs relies solely on conscious listening and comprehensible input by the hearer. Poor performance in the utilisation of a broad range of formulas comes as a result of poor understanding of language forms, which consequently affects the correct interpretation and application. The above means that viewing formulaic language from the context of language comprehension is significant in the overall acquisition. Further, there are links that a good knowledge of a language, grammar and similar formulations is crucial in advancing the understanding of facial cues, ideas and general patterns of thoughts to meet aphasic speech [3].

6. Underlying characteristics of formulaic language

Literature gives a critical overview of formulaic language noting that it is a system of prefabricated unit languages and phrases creatively knit together. The linguistic units making up the formulaic structure can holistically be retrieved by the person talking or speaker and understood by the hearer. A major feature of this particular language is the arbitrary nature, which means there is no particular expression preferable among other systematic expressions to fulfil a specific communication function [16]. The language borrows from commonly understandable and expressive idioms, phrases and proverbs to fulfil a range of communication objectives. These various conceptual links and items encompassed in the formulaic language include ideas, lexical items, notions and expressions that contribute to the formation of a purely independent form of language. Hence, formulaic language, unlike the normal structure of natural language (also called novel communication), is seen as a set of units, expressions and idioms holistically retrieved by the speaker and understandable to the hearer [10].

Another literature identifies the defining features of the formulaic language and what makes the expression different from novel communication. The features include stereotyped form, used in specific conditions, known status and conventional meaning [3]. First and foremost, formulaic expressions are stereotyped as they are an abstract creation and formulation by a community of persons with similar challenges. For example, in nursing homes or care centres, formulaic language is formed through a combination of commonly known and well-acceptable cultural norms. Other than being a stereotype language, formulaic expressions apply to specific conditions in the attainment of defined communicative purposes. Moreover, formulaic language features a known status in that it is easily identifiable and well known. Still in the 'widely known' aspect, what facilitates the familiarisation of aphasic speech (borrowed from the formula) is the fact that the brain is conditioned to store information in the long-term memory. This means that brain damage affects the lower faculties but still allow the brain to preserve a significant content for information conveyance. Finally, conventional meaning refers to the general way of life in a typical society meaning that formulaic expressions allude to ideas, practices and activities understandable by many [10].

Research on the pragmatics of formulaic language shows that unlike novel sentences that are independent of context formulaic expressions are sensitive to social conditions like discourse styles, formality index, social register and the structure of communication [4]. The idea that further makes formulaic utterances special is the narrowed outlook on topic, speaker and the overall purpose of communication. For example, novel ideas like 'The cats rest on the sofa' and 'Travelling across Europe costs time and money' [9] are not closely tied to contextual particulars. Also, a greeting like 'Good Morning' is said at a specific time before noon. Formulaic expressions are, therefore, more narrowed with a specified application that suits social conditions. Given the growing research on formulaic language in tailoring clinical solutions for aphasic victims, the social dimension of formulaic expressions is a key feature. This review agrees with scientific literature that building an input-and-output cycle to support communication throughout the continuum of life will demand a good understanding of the defining features. More clearly, building an inclusive framework of policies for the application of formulaic treatment for aphasic patients demands a good knowledge of the thematic underlying of formulaic articulations [17].

It is important to note that a major significance of formulas is to expand the speaker's choice of words when the brain is under pressure. The human memory has an impact on performance (using language in speech) as it controls the major faculties including information processing and retrieval. Hence, as much as formulas play a critical role in communication, the memory cannot be ignored as it sends impulses and signals to ease interactions [4].

7. Dual model of processing language: towards a formulaic communication

Another literature evaluates the dual process model for processing language. Novel and formulaic expressions, although they occur in different principles, manage to standout during spontaneous communications. More clearly, these two are disconnected at the cerebral. Each of the two can be selectively impaired and preserved from mental conditions like *aphasia, schizophrenia, Parkinson's disease* and *dementia*. Research continues to point out neurological results on the existence of a dual mode of operation: novel and formulaic forms [3]. During mental stress and severe accidents, one assumes over the other—meaning that mental impairment does not purely render the victim speechless.

The dual process model of processing language supports communication regardless of the nature of the damage and hence allowing for the continuity of social life for victims. Further studies where underlying neurological conditions are known suggest that formulaic expressions are formed at a hemisphere-subcortical section that regulates the design of formulaic expressions. Another study postulates that the knowledge of formulas is disconnected, meaning that there is a gap between natural knowledge and the context of formulaic expressions. For L2 aphasic victims, one may possess a higher knowledge but remain unable to make an accurate interpretation of formulaic expressions [3].

8. The settings for the establishment of formulaic language and aphasic speech

Studies dealing with the teaching of formulaic language suggest that existing literature and academic works have not developed a recognisable formulaic discourse. There are gaps in knowledge between what is needed to build a functional and effective aphasic speech and what is offered in teaching formulaic language through clinical and psychosocial interventions. One word phrases and comprehensible formulas provide a basis for aphasic speech—meaning those facing mental pressures can tap into a single pool of formulaic expressions. Research on formulaic language holds the promise of casting light into a broad range of knowledge on the underlying principles of the discourse. Disparate modes of language are further instrumental in the creation of a solid framework for the aphasic speech [15].

The social setting, the surrounding and the immediate neighbourhood are equally instrumental in nurturing formulaic discourses. Sources establish that patients remaining in a stagnant position for a relatively longer time usually learn by means of observation. While there is evidence that constant learning occurs by observing the surrounding, drawing from the social learning theory, it is important to note that aphasic speech can be attained by mere interaction [10]. This review, therefore, agrees that formulaic expressions are a product of social settings and a replica of real-life events that illicit communication and conveyances throughout. Previous knowledge before mental attacks like aphasia is equally instrumental in the production of speech. This knowledge refers to the general understanding of life through lived experiences by the patient, knowledge that offers the person awareness of the social surroundings, acceptable cues and the ability to interpret subtle cues to understand and to communicate. Personal understanding is a key requisite in building a foundation for formulaic expressions. Indeed, combined with the social setting, institutions are in a position to design interventions consistent with the needs of patients. Acquisition of formulaic utterances is essential in the clinical sciences because therapists utilise them as building blocks for dealing with aphasic difficulties accrued from preservation [3].

9. Preservation of formulaic language

There are formulaic expressions that are preserved in aphasic speech. According to Van Lancker Sidtis and Yang, production of fluent speech often occurs as a result of distortions or strokes in one's left hemisphere [18]. In addition to mundane expressions, such as greetings, swear words and interjectory words (which are part of routine speech) are preserved while tackling aphasic speech [3]. Van Lancker Sidtis's study also reiterates the relevance of nouns in showing these preservative ideas affiliated with formulaic language. There is a close focus on proper nouns and their role in assisting therapists to create the building block of rectifying these symptoms of aphasic speech [3]. Newly acquired speech is often distorted when there is an interference with one's brain. Therefore, there are close chances of aphasic individuals being forced to deal with over-acquisition of utterances and speech, as a whole. These newly learned words, according to Van Lancker Sidtis, differ in each individual. They are among the formulaic expressions that are preserved in attempting to realise a building for therapists to eradicate the symptoms of aphasia. Despite the pattern in some formulaic expressions, it is necessary to understand these aphasic preservations are not constant. Therefore, Van Lancker Sidtis, in her research, posits the unavailability of practical (or theoretical explanations) for the loss or preservation of formulaic language in various forms of aphasia [3]. Everyday language is detailed articulately under the bracket of formulaic language preservation. Therapists dealing with speech difficulties in both adults and children require these formulaic expressions as a building block for dealing with aphasic complications. Unlike swear words (or curse words), greetings, mundane words and routine language, most of the utterances by human beings are lost. Van Lancker Sidtis's study affirms that brain damage, which causes speech and language difficulties, accentuates the preservation of formulaic language in aphasic patients [3].

10. Research and study implications

Formulaic language and aphasic speech review draw cross-cutting concepts drawn from psychology, sociology, medicine and ethics. The use of a structured language with idioms, proverbs, lexis and sayings stands as an important area in facilitating communication functions. Rising rates of diseases like *Alzheimer*, *AD*, *Parkinson's* and *Aphasia* pose a significant risk to populations, particularly the older groups. Nursing homes, care facilities and elderly centres are settings established to facilitate the care, therapy and overall well-being of patients and victims. Research on formulaic language shows the significance as establishing a set of concepts and principles that will build a solid body of research. The principles will further contribute to a contextual framework to guide the behaviour of clinicians, caregivers and practitioners. Formulaic research is further fundamental in care centres that handle clients with a diverse range of aphasia conditions from anomic to the transcortical types [3].

Finally, the growing body of linguistic literature on formulaic language helps to support social cohesion by making aphasia patients part of the equation. Language impairment lowers the quality of life particularly when victims are segregated from the mainstream society. Patients suffer from insecurity, lowered self-esteem, emotional and psychological disconnect. The brain damage affecting language processing continues to impair the actions of victims, and hence taints their interaction and association with others. For example, aphasia relates to slurred speech, limited choice of words and failure in literacy skills including reading and writing. Building knowledge through research often in the form of scholarly literature leads to the realisation of inter-related principles to guide decision-making on recognisable formulaic expressions.

In discussing the formulaic language and its relationship with aphasic speech, there is need to delve into native languages and its speakers [5]. Through such an approach, the linguists manage to probe into the scope of both native and non-native speakers, deciphering their competence in formulaic expressions. There should be a controlling nature while dealing with multiple words and units in native languages and speech [4]. Whether in writing or verbal utterances, they should be monitored especially due to their affiliation with nativity. The availability of utterances like these is a non-issue without the incorporation of broken down meanings of notions that can be understood by natives. From the perspective of Van Lancker Sidtis, individuals learning second languages often experience difficulties while grasping formulaic expressions. Dealing with understanding both the second language and formulaic expressions at the same time proves challenging to the non-native speakers [19].

Undoubtedly, delving into lexical content should be explored so as to understand the importance of pragmatics while dealing with language comprehension. From an aphasic point of view, since formulaic language is detailed in its effectiveness in academia, linguists reiterate its relevance in improving comprehension of both written and spoken ideologies [11]. Affiliation with formulaic expressions in another language also improves the ability to express oneself despite the speech difficulties accrued from aphasia. To avoid poor judgements associated with inadequacies in writing as a building block of aphasia, formulaic utterances and expressions ensure that language is comprehended, accordingly. There is the possibility of attracting falsified conclusions when there is no incorporation of formulaic language and sequences. Since linguists and other researchers have focused on language that is not fluent. It is not only speech complications, such as aphasia that interfere with fluency, but it is also affected by impromptu interruptions or interferences. From the linguist point of view, both speakers and listeners have a role to play in the issue of disfluent speech. Inaccurate pronunciation of words, in addition to the interruptions and hesitant delivery of words, exhibits a handful nature while dealing with comprehension capacities [17].

Without a doubt, it is impossible to produce and acquire language without utilisation of formulaic language [17]. Their storage in the long-term memory and large quantities reiterates the necessity of multi-wordiness in comprehension skills. These utterances are present in both children and adults because of their susceptibility to aphasic speech. Written and spoken speech is moulded from childhood, and therefore, there is a great relationship between childhood and adulthood experiences apropos of speech deficiencies [6]. Acquired from in-depth research, it is evident that formulaic expressions and language have taken up an important place apropos of research in linguistics [4]. Both first and second language learners are keen to delve into a formulaic language as a way of improving their speech. They are essential for language fluency because they do not focus on the content of one's short-term memory. Educators and teachers are specifically affiliated with the use of formulaic expressions in an attempt to improve (both first and second) language acquisition [5]. Their demarcated parts that are inclusive of proverbs, idioms and expletives are relevant in sharpening the language skills of both aphasic and non-aphasic individuals [4].

Evaluating the patterns of formulaic language and the impairments to discourses will provide insight into cognitive science and clinical practice. Most importantly for the above scholarly contribution is the ability to enhance social integration while supporting the victims of aphasia. Speech is integral in daily life as it defines relationship and cuts across cultures. Mental and brain conditions impair speech functions, derail communication gradually leading to frustrations and discomforts from speakers. In severe cases, the conveyance of information is cut short and performances inhibited. Research on formulaic language with particular emphasis on aphasic speech provides insight on best practices. Most importantly is the need to design a recognisable and respected set of formula that cuts across age and gender—and supports communication. The literature discussed above offers overarching information on formulaic language and aphasic speech. The scholarly literature is evaluated based on themes like the features, characterisation, acquisition and utilisation of formulaic expressions. The review further examines the scope of aphasia including types and manifestations. The literature review surmises that a standard set of language is crucial in the fulfilment of aphasia, meaning that universal formulas will add insight on fields in cognitive science and clinical care.

11. Conclusions

The discussion is comprehensive and addresses the demarcated parts of formulaic language as a building block in aphasic speech. Apart from understanding its scope, there is enlightenment on the role of formulaic language in improving one's speech through therapy. Without proper evaluation of one's speech difficulty, it is impossible to conclude the necessity of these formulaic utterances in assisting therapists to realise the preserved and non-preserved words. Most of the preserved words, according to formulaic language, are mundane and used on a daily basis. The ability or inability of aphasic patients to comprehend these words makes it easier for therapists to utilise them as avenues for rectifying these speech problems. The role of formulaic language should be explained thoroughly so as to pay close attention to its effects on aphasic speech. In lyrical and musical forms, also there is better production of words in aphasic individuals because of proper use of one's long-term memory. The research and implications of this study delve into other disorders such as Alzheimer and Parkinson's, which, like aphasia, affects one's communicative abilities. Despite its numerous roles, however, formulaic language has ascertained its plausibility in speech therapy as well as the recovery process, further research is necessary to understand the functioning of these stereotyped formulas in the different types of aphasia.

Author details

Annamária Győrfi

Address all correspondence to: departament.profex@umftgm.ro

University of Medicine and Pharmacy, Tîrgu Mureș, Romania

References

[1] Conklin K, Schmitt N. The processing of formulaic language. Annual Review of Applied Linguistics. 2012;**32**:45-61. DOI: 10.1017/S0267190512000074

[2] Lindholm C, Wray A. Proverbs and formulaic sequences in the language of elderly people with dementia. Dementia: The International Journal of Social Research and Practice. 2011;**10**(4):603-623. DOI: 10.1177/1471301211413338

[3] Van Lancker Sidtis D. Formulaic language and language disorders. Annual Review of Applied Linguistics. 2012;**32**:62-80. DOI: 10.1017/S0267190512000104

[4] Ellis N, Simpson-Vlach R, Römer U, O'Donnell M, Wulff S. Learner corpora and formulaic language in second language acquisition research. In: Granger S, Gilquin G, Meunier F, editors. The Cambridge Handbook of Learner Corpus Research. Cambridge, UK: Cambridge University Press; 2015. pp. 333-356. DOI: 10.1017/CBO9781139649414.016

[5] Wray A. Formulaic Language and the Lexicon. Cambridge UK: Cambridge University Press; 2002. 348 p. DOI: 10.1017/CBO9780511519772

[6] Stahl B. Treatment of non-fluent aphasia through melody, rhythm and formulaic language [dissertation]. Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig: MPI Series in Human Cognitive and Brain Sciences; 2013. 177 p. Available from: http://hdl.handle.net/11858/00-001M-0000-000E-EE06-E

[7] Van Lancker Sidtis D, Postman WA. Formulaic expressions in spontaneous speech of left- and right-hemisphere-damaged. Aphasiology. 2006;**20**(5):411-426. DOI: 10.1080/02687030500538148

[8] Stahl B, Van Lancker Sidtis D. Tapping into neural resources of communication: Formulaic language in aphasia therapy. Frontiers in Psychology. 2015;**6**(1526):1-5. DOI: 10.3389/fpsyg.2015.01526

[9] Schmitt N. Formulaic language and collocation. In: Chapelle C, editor. The Encyclopedia of Applied Linguistics. London, UK: Blackwell Publishing Ltd; 2012. pp. 2190-2200. DOI: 10.1002/9781405198431.wbeal0433

[10] Wood D. Formulaic language acquisition and production: Implications for teaching. TESL Canada Journal. 2002;**20**(1):1-15. DOI: 10.18806/tesl.v20i1.935

[11] Jones C. In defence of teaching and acquiring formulaic sequences. ELT Journal. 2015;**69**(3):319-322. DOI: 10.1093/elt/ccv013

[12] Wray A, Perkins MR. The functions of formulaic language: An integrated model. Language & Communication. 2000;**20**(1):1-28. DOI: 10.1016/S0271-5309(99)00015-4

[13] Van Lancker Sidtis D. Two-track mind: Formulaic and novel language support a dual-process model. In: Faust M, editor. The Handbook of the Neuropsychology of Language. Vol. 1&2. Oxford, UK: Wiley-Blackwell; 2012. pp. 342-368. DOI: 10.1002/9781118432501.ch17

[14] Wray A. Formulaic Language: Pushing the Boundaries. Oxford: Oxford University Press; 2008. 305 p. ISBN 978-0-19-442245-1

[15] Fischer K, Brandt-Pook, H. Automatic disambiguation of discourse particles. In: Stede M, Wanner L, Hovy E, editors. Workshop on Discourse Relations and Discourse Markers at COLING-ACL98; 1998; Montral. Quebec, Canada. 1998. pp. 107-113. PUB-ID 2619030

[16] Schmitt N, Carter R. Formulaic sequences in action: An introduction. In: Schmitt N, editors. Formulaic Sequences: Acquisition, Processing and Use. Amsterdam/Philadelphia: John Benjamin Publishing Company; 2014. pp. 1-22. DOI: 10.1075/lllt.9.02sch

[17] Corrigan R, Moravcsik E, Ouali H, Wheatley K. Introduction. Approaches to the study of formulae. In: Corrigan R, Moravcsik E, Ouali H, and Wheatley K, editors. Formulaic Language. Vol. 2. Acquisition, Loss. Amsterdam/Philadelphia : John Benjamin Publishing Company; 2009. p. Xi-297. DOI: 10.1075/tsl.83

[18] Van Lancker Sidtis D, Yang SY. Formulaic language performance in left- and right-hemisphere damaged patients: structured testing. Aphasiology. 2017;**31**(1). DOI: 10.1080/02687038.2016.1157136

[19] Van Lanker Sidtis D. Formulaic language in an emergentist framework. In: MacWhinney B, O'Grady W, editors. Handbook of Language Emergence. West Sussex, UK: Wiley-Blackwell; 2015. pp. 578-599. DOI: 10.1002/9781118346136

Chapter 3

Russian Scientific Trends on Specific Language Impairment in Childhood

Tatiana Tumanova and Tatiana Filicheva

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69932

Abstract

In Russia, there are many decades of experience in the scientific study of the problem of impaired language development in children. Today, the term "Systemic speech-and-language underdevelopment (SLU)" has firmly established in Russian science and practice, implying a complex developmental disorder of speech and language in children with a primary normal hearing and a conserved intellect, in which the main components of the language system are violated: vocabulary, grammar, phonetics, and, as a consequence, dialogic and monologic speech. Traditionally, a differentiated level-by-level analysis of the speech and language abilities of children is used. The variability of the manifestations and severity of speech-and-language disorders were initially systematized and characterized in four levels of underdevelopment: from the complete absence of phrase speech to the availability of simple and complex sentences with lexico-grammatical errors. Effective algorithms of speech therapist work with SLU are introduced. The effectiveness of the application of these models and algorithms on the material of various language groups is proved.

Keywords: systemic speech-and-language underdevelopment, specific language impairment, childhood, Russian scientific trends

1. Introduction

In Russia, there is a decade of experience in the scientific study of the problem of impaired language development in children. Traditionally, a differentiated level-by-level analysis of the speech and language abilities of children is used. Effective models and algorithms of work of the speech therapist with children having violations of language development are introduced. The effectiveness of the application of these models and algorithms on the material of various language groups is proved.

2. How did Russia develop the concept of systemic speech-and-language underdevelopment (SLU) in children

In the middle of the last century, the concepts of the psychological school, laid by Lev Vygotsky, were reflected in the development of Russian speech therapy. The psychological approach to the study of verbal disorders, defined by the student and follower of the ideas of Lev Vygotsky, Professor Rosa Levina, and a team of research associates in Research Institute of Defectology (now Institute of Special Pedagogy), allowed in the 50–60 years of the last century to develop a psycho-pedagogical classification of speech/language disorders in childhood. Within its framework, a separate category of children with a general language underdevelopment was singled out and characterized. It was then for the first time that this condition was described as a systemic disordered development of speech/language and encompassing all components of the language and mechanisms of speech activity. Today, the use of the term "Systemic speech-and-language underdevelopment in childhood (translation, close in meaning to the Russian national term)" has been firmly established in Russian science and practice, implying a complex developmental disorder of speech and language in children with a primary normal hearing and a conserved intellect, in which the main components of the language system are violated such as vocabulary, grammar, phonetics, and, as a consequence, dialogical and monologic speech [3, 5, 6].

3. Reasons of systemic speech-and-language underdevelopment in children

The causes of systemic speech-and-language underdevelopment (SLU) in childhood are unfavorable factors affecting both in the intrauterine period of development and during labor (birth trauma, asphyxia), as well as in the early years of the child's life. Among the causes of these injuries or underdevelopment of the brain, the most frequent are infections or intoxications of the mother during pregnancy, birth trauma, asphyxia, maternal and fetal blood incompatibility by the Rh factor or blood grouping, blood grouping, brain trauma in the early years of the child. There can be various biological causes such as neuroinfections, inflammatory brain diseases that arise as complications in various infectious childhood diseases, rickets, metabolic disorders, craniocerebral trauma, organic damage to the central nervous system, general physical weakness of the child caused by severe and somatic diseases, and other. It is proved that the use of alcohol, nicotine, and drugs during pregnancy can also lead to violations of the child's physical, nervous, and mental development, one of which is SLU. The socio-pedagogical factors that give rise to SLU include emotional deprivation, the need for intensive early and preschool child uptake of two or more language systems simultaneously with a pronounced common neurological problem; excessive stimulation of the child's speech development; social and pedagogical neglect, manifested, for example, in the absence of proper attention to the development of the child's speech, in the wrong education of the child, in the tendency toward social disadaptation, and so on [10]. To date, the most frequent reason for SLU is not so much one single factor, but the aggregate of several factors of biological and socio-psychological-pedagogical order [1, 3, 6].

http://dx.doi.org/10.5772/intechopen.69932

4. The variability of the manifestations and severity of systemic speech-and-language underdevelopment

The variability of the manifestations and severity of speech language disorders was initially systematized and characterized by Professor R. Levina in the form *of three levels* of speech development [3].

The first is the absence of a commonly used speech, embracing children who do not know the phrase themselves, who have difficulties in understanding the speech addressed to them, and who carry out verbal communication in a sharply limited volume. The *second level*—the beginnings of common speech—characterizes children who have basic skills in constructing simple agrammatic sentences but have noticeable difficulties in understanding the speech of others, using only primary lexical, grammatical, and other means of verbal communication. The *third level* is characterized by a detailed speech with pronounced elements of phonetic-phonemic and lexical-grammatical underdevelopment [3]. This testifies, in turn, to the increased speech and language abilities of children who reached the third level of speech development, while still significantly reduced compared to ontogenesis data. In 1999, Professor Filicheva was supplemented with a description of children with SLU, in connection with which the periodization was supplemented with one more—the *fourth level* of speech development [8, 9, 11].

It encompasses children with undeveloped residual manifestations of underdevelopment of each of the components of the language system. The opportunities for transition from one level of the speech development to the next level are determined by the appearance in the child of new linguistic means and ways of using them, increasing speech activity, strengthening the motivational basis of speech, expanding its subject-semantic content, phrase development, mobilizing the compensatory background, etc.

A correct understanding of the structure of the SLU and the reasons underlying it, for example, different ratios of primary and secondary violations, is necessary for the practitioner, as it provides the basis for competent differential diagnosis; selection of children in special groups for training with them; and determining the most effective ways and content of working with children. All this makes it possible to plan an optimal warning of anticipated difficulties during school education. The individual rate of progress of a child in speech development depends on the severity of the primary defect and its form, timeliness and correctness of correction work, and compensatory mechanisms.

5. Common features inherent in all children with SLU

It is possible to single out a number of common features inherent in all children with SLU as follows:

- Decreased intensity and delayed prenatal development (babbling).
- Late appearance of the first words (including babbling words and amorphous root words).
- Delay in mastering the skills of constructing simple phrases.

- Inaccurate understanding of the meaning of words and a limited amount of vocabulary.
- The broken understanding and use of grammatical categories of words and prepositional constructions.
- Insufficiency of sound reproduction.
- Difficulties in the reproduction of complex in terms of syllabic structure and sound filling of words, reduction of phonemic hearing, and perception.

At the same time in everyday practice, there are rare clearly defined levels because new elements gradually supplant the previous forms. Such children can be fixed combinations of gross gaps in linguistic development with simultaneous manifestations of fragmented dynamics of the development of linguistic possibilities of the previous ones. According to the majority opinion, the general hypoplasia of speech can be an independent defect, and, besides, it is combined in the structure of the most complex disorders [2, 3, 8, 7]. Since the last century, research has been conducted in Russia on the ability of a speech therapist to work with children with SLU. Mutual connections in the development of speech, language, motor, and cognitive abilities of children with SLU are proved.

6. Psychological and pedagogical characteristics of children with SLU

While characterizing children with SLU, we can note a number of features that distinguish them from normally developing peers [1, 4, 9]. Incomplete speech activity leaves an imprint on the development of the sensory, intellectual, and affective-volitional sphere. There is a marked instability of different types of perception, a decrease in the stability of attention, and a limitation in the amount of memory. With a relatively conserved semantic logical memory, the memory efficiency suffers. Children with SLU find it difficult to remember three- to four-step verbal instructions and the sequence of the task. All of the above does not exclude a fairly critical attitude of children with the SLU to their abilities. At the same time, the connection between speech disorders and other aspects of mental development causes specific features of thinking. Possessing, on the whole, full-fledged prerequisites for mastering mental operations accessible to their age, children can demonstrate slowness and a certain lack of verbal-logical thinking. Without special training, they hardly master the sound analysis and synthesis. Children with SLU inherent some lag in the development of the motor sphere—uncertainty in the performance of metered movements, reduced speed, amplitude, as well as the dexterity of their implementation. It is important to correctly assess the state of not only the expressive, but also the impressive, side of speech of such children. Thus, Zhukova singled out five possible degrees of development of understanding speech in these children [12] as follows:

- Zero—the child responds only to emotional intonation, its name.
- Situational—responds to the names of friends and close relatives, is guided in the display of favorite toys, household items.

- Nominative—shows the subjects that he encounters in everyday life, correlates them in pictures, but does not understand the questions of indirect cases (to whom? with whom? with what?).
- Predicative—understands the names of many everyday objects and actions, differentiates issues related to indirect case constructions, including prepositional ones. It is not enough to distinguish grammatical forms of words.
- Dismembered perception—understands the meanings of words expressed by different prefixes, suffixes.

Thus, the complex approach put forward by R. Levina to the analysis of the structure of impairment in children with SLU was further developed, which made it possible to depart from describing only certain manifestations of speech insufficiency and present a picture of the abnormal development of the child with respect to a number of parameters reflecting the state of linguistic means, mechanisms of speech activity, and communication processes.

7. Detailed description of the speech-language abilities of children with systemic speech-and-language underdevelopment

The first level of the speech development by the definition of R. Levina is "the absence of common speech." A vivid feature of the dysontogenesis of speech is the complex and lengthy absence of verbal imitation. It is possible that in some children, with the help of parents, the ability to repeat individual sounds for adults is developed with complete inability to combine them into the lightest words. Often a child can repeat only the words he has initially acquired (five to ten titles), but new concepts and their verbal designations are not formed.

A similar phenomenon can occur during several years of the child's life. People around him often create the erroneous impression of sufficient understanding of speech by such a child, because he performs simple verbal instructions: can show the called object, action, etc. In reality, children with the first level of the SLU in the perception of speech are guided by the suggestive, well-known situation, intonation, and facial expressions of the adult, whereas for understanding of the meanings of words, their grammatical form is violated very roughly. Regardless of whether the child began to pronounce the first words entirely or only some of their parts, it is necessary to distinguish between speechless children according to the levels of their understanding of someone else's speech. In some children, impressive speech includes a rather large vocabulary, which provides an understanding of the names of many subjects, the most frequently used actions, and even individual characteristics of objects. Other children are able to more or less adequately perceive only the names of close people, the name of objects often encountered in everyday life. Only a detailed speech therapist examination will help to reveal the degree of underdevelopment of the impressive side of speech.

Children are able to reproduce, basically, one-two syllable words, while words that are more complex are subject to abbreviations. Along with individual words, paralinguistic means of communication also appear in the child's speech: accompaniment of speech facial expressions, gestures, and different intonations. At this level, for understanding the grammatical categories of the number of nouns and verbs, the kind and the tense of verbs is practically inaccessible. In independent speech, blur and diffusion in the reproduction of the sonic appearance of words are traced.

The second level of speech development—the "Initial development of phrase speech"—is characterized by the increased speech activity of the child with the use of a constant, albeit very distorted, limited supply of commonly used words. A distinctive feature of their speech is the presence of two- to four-word phrase: in the speech of such children, as a rule, even simple prepositions, noun, and a verb can be with wrong endings, or without them. There is a polysemy of words when the same word denotes several different objects, phenomena of the type of monotonous lexical substitutions, for example, the word "beetle" serves to indicate not only the beetle itself but also the ant, the butterfly. Insufficient possession of the morphological system of language prevents the assimilation of word-building operations. Children are significantly affected by understanding the meanings of many derived words. In connection with this, the use of these words in a narrow sense is noted. Word-forming actions and operations are still not very accessible to children, and word-making at this level is not observed. Using simple phrases, children admit in them the omissions of both main and secondary members, violate the order of words (inversion). Complex sentences for these children are not widely available for understanding and use, because they do not absorb those logic-temporal and cause-effect relationships that are embedded in such constructions. Self-preparation of stories for them is still difficult, but with the help of an adult child, they try to cope with the simplest types of text. In this case, as a rule, children are limited to enumerating the objects of action with them and do not transmit cause-effect relationships. The phonetic side of speech is not formed, and all kinds of violations of sound reproduction occur.

The third level of speech development is characterized by the presence of unfolded phrase speech with pronounced elements of lexico-grammatical and phonetic-phonemic underdevelopment. Children use simple sentences. Attempts to use structures of complex sentences (compound and complex) are noted. It improves understanding of speech and reaches a low age norm. At the same time, the understanding of complex two- to three-step speech instructions, complicated by the inclusion of semantically difficult words, words with a portable and abstract meaning, is still difficult for children to access. The volume of lexical and grammatical categories used and the words of different syllabic structure and sound-completeness, including the correct pronunciation of vowels and the simplest consonant sounds, are expanding. At the same time, the results of specially selected assignments demonstrate a marked lag in the formation of each of the components of the language system: violations of the lexical, grammatical, and phonetic norms of the language are noticeable. The very nature of agrammatism testifies to the incompleteness of the formation of the grammatical system. The presence of lexical errors is illustrated by such substitutions: the name of the part of the subject, the name of the object itself (tree roots, tree branches, teapot at the teapot), replacement of the names of the subject with the name of actions, etc. In the speech of the child, there are no names of many words denoting the animal and vegetable world, the phenomena of nature, the profession of people, and the attributes of professions. The lack of morphological possibilities is expressed in the difficulties of understanding grammatical relations, the meaning of derivative words,

http://dx.doi.org/10.5772/intechopen.69932

the operation of morphemic elements, their construction in the structure of a word, and so on. This confirms that children do not yet have the necessary cognitive, linguistic, and speech capabilities to fully use the lexical and grammatical means of the language in communication. Analysis of the above errors indicates that the substitutive words, most often, are those that children mostly use to strengthen themselves in everyday speech practice. When assessing coherent speech, difficulties in programming one's own statements, missing members of the sentence, and violations in them of the order of words are noted. When using constructs of complex-subordinate sentences, their structure is violated: the absence of a principal or secondary member of the sentence.

While characterizing the deficiency of the phonetic side of speech, it is important to note the presence of different types of errors in the reproduction of hissing and whistling, sonorous, hard and soft, and sonorous and deaf consonants. Omissions, replacements, and distortions of sounds are the typical factors. The most negative is mixed or unstable pronunciation of sounds; when the child speaks in isolated or simple words, he sounds correctly, but in a speech, context confuses them.

The fourth level of speech development is characterized as residual manifestations of underdevelopment of the elements of the lexical-grammatical and phonetic-phonemic components of the language system. The speech of such children only at first glance produces a relatively favorable impression. With careful examination using specially selected tasks, it became possible to identify the incompleteness of the formation of all language systems. Thus, the need to reproduce words that are complex in meaning or sound-descriptive design leads to the appearance of typical childish difficulties such as missed sounds and violation of the filling of syllables and words. Typical for children at this level will be somewhat sluggish, blurry articulation, inadequate expressiveness, and international poverty of speech. These phenomena, along with the difficulties of differentiating phonemes, indicate the incompleteness of the processes of phonemes as a whole. Because of this, it is possible with a high degree of probability to predict the corresponding difficulties in mastering the phonetic principle of Russian writing.

When composing a narrative and retelling a text, there is often a mixture of main and minor events. Typical is the inaccuracy, limited narration of the storyline, the broken relationship of parts of the text, the omission of elements of the narrative, and the disrupted use of linguistic means. Disproportion in the formation of lexical and syntactic systems lead to the fact that the structure of a complex sentence is acquired later than it occurs in peers, even if there is a sufficient vocabulary. Inadequate knowledge of word formation skills is manifested in a variety of mistakes in the formation and explanation of derived words, especially in cases where such words are not often used in everyday life. Typical for these children is that they are not as effective as peers, they use the help of adults: a sample of the correct answer, one-time support does not give the proper result, the phenomenon of transferring grammatical models to a new language material is very difficult. It takes a whole series of training exercises, additional conditions, so that children adopt the normative grammatical form or category.

The violation of the understanding of sentences and texts, in turn, turns out to be closely related to the limited possibilities for owning a dialogical and monologic speech. Children are inclined to stereotypical statements, cannot adequately convey the outset, the culmination and the semantic denouement of the storyline.

Many children with four levels of speech development in a number of cases have low motivational readiness for schooling, lack of optic-spatial relations, instability of attention, a limited amount of memory, reduced efficiency, and fast fatigue.

8. Examination in children with SLU

Overcoming of diagnosed in children disorders requires a competent comprehensive examination of speech and non-speech functions. Taking into account the variability of the pathological manifestations of the disrupted development of all components of the language in such children, the strategy adopted in Russia for carrying out the speech therapist examination is determined by a number of principles formulated by leading Russian scientists (L Vygotsky, R Levina, V Lubovsky, S Zabramnaya, O Usanova, and others) [1, 3, 6, 7].

8.1. Methods and content of examination of children

Before starting the examination of the child, the speech therapist needs to analyze the preliminary data on his development. In this regard, the Russian speech therapist studies the information recorded and available to him, including ethical standards, in the available medical documentation. As a rule, these are the conclusions of the following specialists: a neurologist or neurologist (on the state of speech and intelligence), an otorhinolaryngologist (on the condition of the hearing and speech organs), an ophthalmologist (about the condition of the eyes), a surgeon, a pediatrician, etc. In order to clarify the information on the nature of early speech, mental and physical development, the speech therapist conducts a preliminary conversation with the parents of the child. In its course, it turns out whether there were any features of the course of pregnancy, childbirth; whether there were pathological factors that influenced their course; and whether the originality or lag in development of speech and motor functions of the child was observed. The information on the status of the social and psychological environment in which the child was from early childhood is detailed: whether the family is complete, what is the attitude towards the child, whether there are people with bilingualism in the family or close circle, or having speech disorders, etc.

The examination with the participation of a speech therapist begins with an introductory conversation, the purpose of which is not only to establish a positive emotional contact with the child, but also to determine the degree of his willingness to participate in speech communication, the ability to adequately perceive questions, give answers to them (one-word or expanded). In addition, the introductory conversation makes it possible to form an idea of the general sounding of the child's speech, the presence or absence of pronounced difficulties in the sound, lexico-grammatical or syntactic formulation of the speech utterance. The content of such a conversation is determined by the circle of cognitive and age-related possibilities and interests of the child of preschool age: my family, favorite toys, summer vacations, pets, my hobbies, favorite books, favorite cartoons, and even "Computer games" (for children 6–7 years old). Samples of speech statements of the child, received during the introductory conversation, are recorded in the speech card, filled in by the speech therapist. The survey methodology presented below covers all potentially possible directions in their extended version. When examining children with any specific level of speech development, the volume and quality of the spoken language options are differentiated based on the prospective potential of the child and the survey schemes that are variable in degree of difficulty, developed in the Russian education system (T. Filicheva, T. Tumanova).

8.2. Vocabulary examination

The content of this section is aimed at identifying the qualitative parameters of the state of the lexical system of the native language of children with speech therapist. The nature and content of the tasks assigned to the child are determined in accordance with the age of the child and his speech-language capabilities, including an examination of the skills of understanding, the use of words in different situations and activities. As examination methods, you can use the display and naming of pictures depicting objects, actions, objects with pronounced signs; objects and their parts; parts of the human body, animals, and birds; professions and related attributes; animals, birds, and their young; actions that denote emotional reactions, natural phenomena, the selection of antonyms and synonyms, the explanation of the meanings of words, the addition of sentences with the necessary word meaning, etc.

8.3. Examination of the grammatical structure of the language

The examination of the state of the grammatical structure of the language is aimed at determining the possibilities of a child with SLU to adequately understand and implement in the speech and various types of grammatical relations. In connection with this, children are offered tasks related to understanding simple and complex prepositions, using different categorical forms, word forming of different parts of speech, constructing sentences of different constructions, etc. In tasks, you can use techniques such as composing a phrase based on a question, on demonstrating actions, on a picture, a series of pictures, by reference words, by a word given in a certain form, transforming a deformed sentence, etc.

8.4. Verification of dialogical and monological speech

The examination of the state of the coherent speech of the child with SLU includes several directions. One of them, learning the skills of dialogue, is realized at the very beginning of the survey, during the so-called introductory conversation. To determine the degree of formation of the monologic speech, tasks are proposed, aimed at compiling the child various types of stories: narrative, descriptive, creative, etc. An important criterion for assessing coherent speech is the ability to compose a narrative in the native language, the ability to build a storyline, to convey all important parts of the composition, the primary and secondary details of the story, the richness and diversity of linguistic resources used in narrating, and the ability to compose and implement monologic statements with support questions, pictures, and without it. Children's stories are also analyzed according to the parameters of the presence or absence of facts missing the parts of the narrative, the members of the sentence, the use of complex or simple sentences, the acceptance of the help of the teacher and the adult native speaker, the presence in the narrative of direct speech, literary turns, the adequacy of the use of the lexical and grammatical means of the language, and the correctness phonetic speech in the process of telling.

8.5. Examination of phonetic and phonemic processes

An introductory conversation with a child gives an initial impression of the features of pronunciation of the sounds of the native language. In order to have a complete picture of the phonetic side of speech, it is necessary to present a number of special tasks, having first ascertained that the instructions to them and the lexical material are clear to the child with SLU. The sound composition of the words corresponding to these pictures is the most diverse: a different number of syllables, with a concourse of consonants and without it, with different sounds (whistling, hissing, affricates, etc.).

Realization of such tasks allows to reveal the possibilities of correct pronunciation of sounds by children, belonging to different phonetic groups (in comparison with the data of normative development). It checks how the child pronounces the sound in isolation, in the composition of syllables (direct, inverse, with the confluence of consonants), in words in which the test sound is in different positions (in the beginning, in the middle, and in the end of the word), in the sentence, and in the texts.

To determine the degree of mastery of children by the syllabic structure of words, subject and subject pictures are chosen according to thematic cycles, familiar to the child, for example, indicating the various types of professions and activities associated with them. The examination includes both reflected pronouncing of words and their combinations by the child, and independent. Particular attention is paid to the repeated reproduction of words and sentences in a different speech context. To determine the degree of mastery of children by the syllabic structure of words, subject and subject pictures are chosen according to thematic cycles, familiar to the child, for example, indicating the various types of professions and activities associated with them. The examination includes both reflected pronouncing of words and their combinations by the child, so in phrase too.

Particular attention is paid to the repeated reproduction of words and sentences in a different speech context. When examining phonetic processes, various methodical techniques are used: independent naming of lexical material, conjugate and reflected pronunciation, naming based on visual and demonstrational material, etc. The results of the survey record the nature of the violation of the sound, the replacement of sounds, omissions, distortion of pronunciation, mixing, unstable pronunciation of sounds, the nature of violations of the sound-syllabic organization of words, etc. Examination of phonemic processes of a child with speech disorders is carried out by generally accepted methods aimed at revealing the possibilities of differentiating the phonemes of the native language by ear with the possible application of adapted information technologies.

The readiness to learn at school for children with speech impairments is determined by the formation of a whole set of prerequisites, knowledge, skills, and skills of their practical application.

Mastery of them is determined by sufficient maturation of the functions of the central nervous system, anatomical and physiological factors, as well as speech and non-speech components, which include the usefulness of development:

- All systems of the language in which the training will be conducted
- Operations of language analysis and synthesis
- Higher mental functions (thinking, attention, perception, memory)
- Activity maturity
- Spatial-visual orientations
- Emotional-volitional maturity
- Motor-graphic skills and so on.

As part of the examination, the speech therapist analyzes the degree of formation of all components of the language, communicative, and speech skills, as well as operations of language analysis and synthesis.

The analysis of the survey results in accordance with the content of these sections makes it possible to comprehend the readiness of the child with the SLU to master the requirements of the school curriculum in the future. All of the above is a generalized unified algorithm for examining a child with speech disorders. However, depending on the age and basic communicative and speech skills, it is advisable to apply several differentiated schemes for examining the speech-language capabilities of children.

9. The work of the speech therapist for overcoming SLU

In Russia, the main directions and content of the speech therapist's work with children who have a general hypoplasia of speech were laid in the studies of R. Levina, L. Spirova, N. Nikashina, G. Chirkina, A. Yastrebova, T. Filicheva, T., R. Lalaeva, T. Tumanova, N. Zhukova, L. Efimenkova, and others [6, 12]. Educational institutions in Russia have created complex conditions for working with children with disrupted speech development. In accordance with this, specialists perform their professional functions within the framework of several blocks:

- Diagnostic unit (clinical, speech therapist, psychological, and psycho-pedagogical study of children) in the structure of which it is appropriate to include neuropsychological studies of children adapted for preschool age.
- Treatment-and-prophylactic unit (medicinal treatment, physiotherapy exercises, massages and hydromassages, physiotherapy, computer-hardware technologies, phytotherapy, and other areas of rehabilitation).
- Educational and correctional-developing unit (pedagogical and speech therapist work, psychological correction).

- Social block (psychological and pedagogical assistance to parents and optimization of macrosocial conditions).

  In Russia, there are such tendencies in the work of the speech therapist, in which the following are taken into account:

- structures and manifestations of disrupted development;
- patterns of development of children's speech in conditions of ontogeny;
- analysis of objective and subjective conditions for the formation of the speech function of the child, identifying the leading speech defect, and the resulting shortcomings of mental development;
- early impact on speech activity for the purpose of;
- prevention of secondary violations;
- the interconnected formation of phonetic-phonemic and lexico-grammatical components of the language system;
- a differentiated approach to the directions, and receptions speech therapist work with children of different ages, having a different structure of speech disturbance;
- taking into account the relationship of speech with other aspects of mental, as well as motor development [3, 12].

Given the manifestation and structure of the defect in the general underdevelopment of speech, work with children of different ages is built on an alternative combination of traditional, special pedagogical and adapted to the needs of children rehabilitation technologies.

9.1. Teaching children with SLU who do not know the phrase (the first level of speech development)

Teaching children with SLU who do not know the phrase (the first level of speech development) involves the development of understanding speech and the development of active imitative speech activity. First of all, we teach children to recognize, understand display objects, actions, signs, understand the general meaning of the word, differentiate between "who?", "where?", from where?, understand the appeal to one and several persons, grammatical categories of the number of nouns, verbs, guess subjects by their description, to determine the elementary cause-effect relationships. In the second direction of work, active imitative speech activity develops (in any phonetic design, parents, close relatives, imitating animal and bird cries, sounds of the surrounding world, musical instruments, giving orders—sleep, eat, go.) Making the first sentences of amorphous root words, Transform the verbs of the imperative mood into the verbs of the present time of the singular, formulate sentences for the mode: Noun plus verb, noun plus verb plus addition. For example, Tata (mom, dad) sleep; Tata, eat the soup. At the same time, exercises are carried out to develop verbal memory, attention, logical thinking (memorization of two to four subjects, guessing of a cleaned or added object, memorization and selection of pictures two to four parts). As a result of work at this stage of

http://dx.doi.org/10.5772/intechopen.69932

formation of speech development, children learn to relate objects and actions to their verbal designation, to understand the general meaning of words. The active and passive vocabulary should consist of the names of objects that the child often sees; actions that he or others are doing themselves, some of their states (cold, warm). Children need to communicate with the help of elementary two-three-word sentences. Verbal activity can be manifested in any speech sound without correction of their phonetic design. Throughout the whole period of training, the correctional and developmental work involve encouraging the child to perform tasks aimed at developing the processes of perception (visual, spatial, tactile, etc.), attention, memory, thought operations, and optical-spatial orientations. The content of the correction-developmental impact includes the directions of work related to the development and improvement of motor-spatial (with respect to the possibilities of general, minor and articulatory motility), the formation or correction of personality development disorders, and emotional-volitional spheres.

9.2. Teaching children with the beginnings of phrasal speech (with a second level of speech development)

Teaching children with the beginnings of phrasal speech (with a second level of speech development) suggests several directions mentioned below:

- Development of understanding of speech includes the formation of the ability to listen to speech, highlight the names of objects, actions, and certain characteristics; formation of an understanding of the general meaning of words; Preparation for the perception of dialogical and monologic speech.
- Stimulation of speech activity and development of the lexical and grammatical means of the language. Teaching the naming of words from 1 to 3 syllables, to teach the original skills of word-change, then word-formation.
- The development of an phrase speech; the assimilation of models of simple sentences; a noun plus a coordinated verb in the imperative mood, a noun plus an verb in the indicative inclination of the single number of the present tense, a noun plus an verb in the indicative inclination of the single present date plus a noun in the oblique case ("Vova sleep," "Tolya is asleep," "Olya is drinking juice").

  The assimilation of simple prepositions (on, under, in, out, etc.). Combining simple sentences into short stories. To consolidate the skills of drawing up proposals for demonstrating actions based on questions. Learning short couplets and nursery rhymes. Moreover, any child's available phonetic design of independent statements is allowed, while attention is paid to the correctness of the sound of grammatical elements (endings, suffixes, etc.).
- Development of the pronunciation of speech: to learn to distinguish between speech and non-speech sounds to determine the source, strength and direction of sound. Clarify the correct pronunciation of sounds available to the child. Automate the delivered sounds at the level of the syllables of the sentences, form the correct sound and syllabic structure of the word. Learn to distinguish and reproduce clearly syllabic combinations from the stored sounds with different emphasis, voice power, and intonation. Reproduce syllables with a

concourse of consonants. Work on the syllabic structure of words ends with the assimilation of a rhythmic-syllabic drawing of words from two to three syllables. Violations of sound reproduction are permissible.

Correction and development work with children includes areas related to the development and harmonization of the child's personality with SLU, the formation of moral, moral, willful, aesthetic, and humanistic qualities. The systemic approach to overcoming speech violation provides for a comprehensive correction-development work that integrates the aspects of speech-language work with the purposeful formation of the psychophysiological capabilities of the child with SLU, namely, the processes of attention, memory, perception, thinking, motor and optical-spatial functions according to age guidelines, and personalized opportunities for children with SLU. By the end of this stage of education, children should have a simple phrase, learn to align the main members of the sentence, understand and use simple prepositions, certain categories of case, number, time, and gender. The understanding of some grammatical forms of words, simple stories, and short fairy tales is expanded.

9.3. Teaching children with unfolded phrase speech with elements of lexico-grammatical underdevelopment (the third level of speech development)

Teaching children with unfolded phrase speech with elements of lexico-grammatical underdevelopment (the third level of speech development) provides the following:

1. The development of understanding speech (the ability to listen to speech, to differentially perceive the names of objects, actions of signs, to develop an understanding of the finer values of generalizing words, to prepare for mastering monological and dialogical speech)
2. Development of the ability to differentiate by ear and in speech opposition sounds of speech
3. Fixing the pronunciation of words from 2 to 4 syllables with different variants of concurrence of consonant sounds. Use these words in spontaneous speech.
4. Strengthening the skills of sound analysis and synthesis. The differentiation of sounds at all stages of training is given great attention. Each sound, once its correct pronunciation is achieved, is compared by ear with all articulatory or acoustically close sounds (1st stage of differentiation). Later, after the assimilation of the articulation of the second of a pair of interchangeable sounds in speech, differentiation is made not only by hearing, but also by pronunciation (the second stage of differentiation).
5. Teaching elements of literacy. Acquaintance with letters corresponding to correctly pronounced sounds. Learning the elements of sound and letter analysis and synthesis when working with syllable and word patterns. Reading and printing of individual syllables, words, and short sentences.
6. Development of the lexical and grammatical means of the language. This section includes not only an increase in quantitative, but primarily qualitative indicators: the expansion of

the meaning of words; formation of the semantic structure of the word; and the introduction of new words and phrases into independent speech with changing grammatical forms of words. The ability to explain the figurative meaning of words, to choose synonyms and antonyms, and so on.

7. Compilation of narrative based on events of a given sequence, composing sentences with different kinds of subordinate clauses, fixing skills to compose stories on a picture, a series of pictures, on presentation, on demonstrating actions, transforming a deformed text; inclusion in the stories of the beginning and end of the plot, elements of fantasy.

The complex correction and development work are aimed at the formation and improvement of the speech-language capabilities of children with SLU, on the further development of higher mental functions, emotional-volitional status, harmonization of the personality structure, enrichment of motor skills, skills and experience of their application in socially significant situations in accordance with age requirements, and the personified abilities of children with SLU.

As a result of education, children must learn the skills of using simple and complex sentences, be able to make a story on a picture and a series of pictures, retell the text, master grammatically correct conversational speech in accordance with the basic norms of the language; phonetically correctly formulate statements, transferring the syllabic structure of words, to own some certain elements of reading and writing (reading and typing individual letters, syllables, and short words). However, their detailed speech can have some lexical, grammatical, phonetic inaccuracies, the elimination of which must be combined with the teaching of children to complex forms of speech, which is suggested to be done at the next stage of the training.

9.4. The education of children with residual manifestations of an imperfectly expressed underdevelopment of all components of the linguistic system (the fourth level of speech development)

The education of children with residual manifestations of an imperfectly expressed underdevelopment of all components of the linguistic system (the fourth level of speech development) prescribes the following directions of work connected with the comprehensive preparation for the school:

- Improving the lexical and grammatical means of the language: expanding the lexical stock in the process of learning new words and lexical groups, stimulating word-forming processes, practicing synonyms and antonyms, explaining them, explaining the figurative expression of words and whole expressions, transform one grammatical category into another.
- Development of an expanded phrase speech: to consolidate the skill of using sentences for basic words, to expand the scope of proposals by introducing homogeneous members of sentences, to consolidate the skills of the story, retelling with elements of fantasy and creative plots.

- To improve the pronunciation of speech: to consolidate the skills of clear pronunciation and distinction of the delivered sounds, to consolidate their correct pronunciation in polysyllabic words and statements, to bring up the rhythmic intonation and melodic coloring of speech.
- Preparation for mastering primary basic skills of writing and reading: fixing the concepts of "sound," "syllable," "word," "sentence," learning to analyze and synthesize backward and direct syllables and monosyllabic two or three complex words, slit alphabet, syllables, words and read them, develop optic-spatial and motor-graphic skills, prepare for reading with awareness of the meaning of what has been read.

Throughout the entire period of training, the correctional and developmental work envisages a purposeful and systematic implementation of a general corrective action strategy aimed at overcoming/compensating for the shortcomings of speech, emotional-volitional, personal, motor development, imperfection of mental, spatial-oriental, motor processes, and memory, attention, and so on. This systematic approach provides for mandatory preventive work aimed at preventing potentially possible, including delayed, consequences and complications resulting from a violation of the speech-language development of a child with SLU.

10. Conclusions

With the competent work of the speech therapist and all the members of the multidisciplinary team of specialists, the result of the corrective-developmental impact is expressed in the fact that the speech of preschool children is as close as possible to the age norms.

The above-mentioned Russian experience in planning and implementing, a strategy for working with pre-school children with THP has a proven effectiveness for many decades. At the same time, the possibility of an optimal variational combination of different methods, technologies, and methods of work of the speech therapist with such children in the general "space" of the chosen pedagogical strategy has been proved.

It is important to note that the Russian trends and strategies for overcoming language abnormalities in childhood have fully confirmed the effectiveness of application in other language groups (Belarusian, Lithuanian, Latvian, Ukrainian, Armenian, Azerbaijani, and other languages).

Author details

Tatiana Tumanova* and Tatiana Filicheva

*Address all correspondence to: tumanova-t-v@yandex.ru

Moscow State University of Education, Moscow, Russia

References

[1] Benilova S. L. (2014). Logopedia. Systemic speech disorders in children. P.536. Moscow:MPSI 2014, Russia (in Russian)

[2] Filicheva T., Tumanova T., Chirkina G. (2014). Correction of speech disorders. Programs of preschool educational institutions of compensatory type for children with speech disorders. P.210. Moscow: Prosveshenie 2014, Russia (in Russian)

[3] Levina R. (2008). Fundamentals of the theory and practice of speech therapy. P.189. Moscow: Aliance 2008, Russia (in Russian)

[4] Glukhov V. (2012) . The method of forming the skills of coherent utterances in preschool children with a general speech underdevelopment. P.286. Moscow: V.Sekachev 2012, Russia (in Russian)

[5] Gromova O. (2003). Methods of Forming the Primary Children's Lexicon. P.220. Moscow: Sphera 2003, Russia (in Russian)

[6] Volkova L. (2007) Methodical heritage. Book 5. Phonetic-phonemic and general underdevelopment of speech. P.406. Moscow:Vlados 2007, Russia (in Russian)

[7] Chirkina G. (2008). Methods of examining speech in children. P.238. Moscow: Arcti 2008, Russia (in Russian)

[8] Spirova L. (1980). Features of speech development of students with severe speech disorders. P.192. Moscow: Pedagogika 1980, Russia (in Russian)

[9] Tseitlin S. (2000). Language and Child. P. 240.St. Petersburg: Vlados 2000, Russia (in Russian)

[10] Filicheva T, Tumanova T, Chirkina G. (2010). Education and teaching of preschool children with general speech underdevelopment. P.190. Moscow: Prosveshenie 2010, Russia (in Russian)

[11] Filicheva T, Chirkina G. (2008). Elimination of general underdevelopment of speech in preschool children. P.207. Moscow: Prosveshenie 2008, Russia (in Russian)

[12] Zhukova N, Mastyukova E, Filicheva T. (2011). Speech therapy. Fundamentals of theory and practice. System of speech therapy. P.260. Moscow: Exmo 2011, Russia (in Russian)

Chapter 4

Phonological Problems in Spanish-Speaking Children

María Mercedes Pavez and Carmen Julia Coloma

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69681

Abstract

Phonological development in some children does not follow the typical trajectory. This may affect their communication processes. The primary aim of this chapter is to characterize the phonological development of Spanish-speaking children with phonological problems. The characterization is based on the Theory of Natural Phonology, which poses that children with phonological problems produce phonologically simplified words resulting from the application of strategies known as phonological simplification processes. Phonological development implies the progressive elimination of these strategies. It has been observed that children with phonological problems produce phonologically simplified words until advanced age. This chapter focuses on studies involving Chilean children with phonological problems, in an attempt to characterize their phonological performance. Overall, the point can be made that Chilean children with phonological problems have a trajectory of phonological development of their own, with phonological simplification processes equally affecting syllable structure and word structure. Also, these processes tend to consistently decrease with age at a steady rate. Once 5 years of age, however, processes tend to become more persistent and decrease becomes slower. They are also prone to have problems both with the phonological representation of words and lexical comprehension. Finally, they seem to be challenged by phonological awareness and grammar.

Keywords: phonology, development, Spanish-speaking children, impairments

1. Introduction

Children with phonological alterations have problems when uttering words (they omit elements, alter syllables, substitute phonemes, etc.), difficulties that cannot be explained by articulatory disorders. These children's productions are hardly intelligible, similar to younger peers'. This lack of intelligibility makes communication difficult; these productions are usually associated to problems in language development.

This chapter reviews a series of studies on phonological problems (PP) in Spanish-speaking children, specifically Chilean monolingual children. The studies are based on the Theory of Natural Phonology (TNP). The primary aim of these studies is to contribute to the characterization of the phonological development in Spanish-speaking children with PP. This might provide valuable insights to understand the phonological challenges faced by these children. It may be considered as a glimpse into an impairment which has not been studied in depth among Chilean children. Conclusions can be useful in two ways. First, they can help better understand the problem in general and, consequently, improve related therapeutic interventions. Second, characterizing this particular group of children might be of use to compare Chilean children with Spanish-speaking children from other countries to determine both commonalities and differences. Studying phonological performance in children with phonological problems (PP), however, necessarily requires research on normal development, which also relies on the model used to study PP.

The chapter is organized in four sections: (a) review of phonological development from the point of view of the Theory of Natural Phonology, which advances the progressive elimination of the strategies used by children to produce phonologically simplified words; (b) phonological development in Spanish-speaking children. In this section, studies on the progressive elimination of simplification strategies in typically developing Spanish-speaking children are presented; (c) phonological problems in Spanish-speaking children. This section focuses on phonological development in children with phonological problems; finally, section (d) Phonological awareness in Spanish-speaking children with phonological problems.

2. Phonological development from the theory of natural phonology

The study of phonological development is a complex task that requires explaining the discrepancies in linguistic production between adults and children, establishing phonological development patterns in infants and determining the basic unit (phoneme or word) that will be deemed important in the future [1, 2].

The complexity of this topic generates many different perspectives that seek to capture it accurately. Some have focused on the sequence of the appearance of phoneme and the features that they characterize (behavioral and structuralist theories). Other approaches, like the Theory of Natural Phonology, focus on the acquisition of phonology of the word. Still, when discussing the psychological reality and the explanatory power of their postulates phonology [3], one must recognize its usefulness in describing the relationship between adult and infantile productions to better understand the phonological difficulties for young people and to design programs for intervention [1, 3].

Theory of Natural Phonology (TNP) states that a child possesses a phonological representation of a word that is equal to that of an adult, even though they produce the word with errors. A child hears a word from an adult, processes it, and then reproduces it in a phonologically simplified manner. The simplification of the word consists that the child applies strategies, known as the Phonological Simplification Processes (PSP), which are mental operations that constitute an innate system. Another way to understand the PSP is as error patterns commonly found in children language outputs [3] that modify phonological representations of words. PSP facilitate the linguistic production of children [4]. Additionally, it has been suggested that the simplifications can occur in the word, in the syllable or in the phoneme. At the word level, one could find the assimilations and alterations in the number of syllables in the word. In contrast, the reduction of the consonant group and the omission of the coda are processes that affect the syllable. The substitutions correspond to the phoneme level [5]. From another perspective, PSP are classified as systemic or structural. They are considered systemic when they affect the system of phonological oppositions, as it occurs in substitution processes. Contrastingly, they are structural processes when they simplify the word or syllable structure and when phonemes are assimilated inside words [6, 7].

In the proposal of TNP, a distinction is built between the three types of PSP: those related to the structure of the syllable and the word, those from substitution and those from assimilation. The PSP related to the structure of the syllable and the word are procedures in which the child reduces its syllables to "consonant (C) + vowel (V)," a basic structure [8] that most commonly occurs in the Spanish language [9]. This simplification can suppress codas (/pata_lón/ for "pantalón," pant), reducing consonant groups (/páto for "plato," plate) and diphthongs (/áto/ for "auto," car), among other strategies. As well, this tends to simplify the word structure, reducing them to the sequence CV + CV. This occurs, for example, when the amount of syllables of a word is reduced by the omission of unstressed syllables (/_pósa/ for "mariposa," butterfly).

The PSP of assimilation consist of replacing phonemes to make them similar or identical to other phonemes present in the model word or in the word produced by the child (/núna/ for "luna," moon). The PSP of substitution is a strategy that change phoneme groups for members from another groups (fricatives for stop /kiráfa/ for "jirafa," giraffe) or for a phoneme within the same group (liquid together /pélo/ for "perro," dog) [10]. **Table 1** summarizes relevant PSP (**Table 1**).

According to TNP, the phonological development implies the progressive elimination of the PSP until the child achieves word production like that of an adult. Certainly, the decrease in PSP occurs alongside the acquisition of the system of phonemes. As well, studies about PSP suggest that PSP are strategies that children use, especially at the period of lexical explosion around 18 to 20 months. The increase in new words demands finer phonological representations that allow children to distinguish similar words [11, 12]. Therefore, phonological development is favored because of the lexical increase that contributes to a permanent reorganization of the phonological representation of the words for children [13].

PSP	Definition	Examples
Structure of the syllable and the word		
1. Consonant-group reduction	1. Omission of /l/ o /r/ of a homosyllabic consonant group	1. /p_áto/ for /pláto/ (plate) /t_en / for /tren/ (train)
2. Diphthong reduction	2. Omission of a diphthong vowel	2. ./á_to/ for /áuto/ (car)
3. Coda suppression.	3. Omission of consonantal phoneme at the end of syllable	3. /pa_talón/ for /pa*n*talón/ (pant)
4. Coalescence	4. Merging of two adjacent phonemes originating a different consonantal phoneme	4. /*k*én/ for /*tr*en/ (train)
5. Omission of unstressed elements	5. Omission of unstressed syllables or any of the phonemes that constitute it	5. /pósa/ for /mariposa/(butterflay)
6. Addition of phonemes or syllables	6. Addition of phonemes or syllables	6. /*n*índio / for /indio/ (Indian) / kaperu*tu*sita/ for /kaperusita/ (Little Red Riding Hood)
7. Inversion of phonemes or syllables	7. Two phonemes or syllables switch their position	7. /*u*áto/ for /*áu*to/ (car) /te*n*éfo*l*o/ for /te*l*éfo*n*o/ (phone)
Assimilation		
1. Identical	1. A phoneme becomes identical to another one in a word	1. bu*b*ánda/ for /bu*f*ánda/ (scarf)
2. Labial	2. A phoneme becomes similar to a labial phoneme (/p/, /b/, /m/) or a labiodental (/f/) phoneme	2. /*p*láta*m*o/ for /pláta*n*o/ (banana)
3. Dental	3. A phoneme becomes similar to a dental phoneme (/t/, /d/, /s/)	3. /ma*d*ípósa/ for /maripósa/ (butterfly)
4. Velar	4. A phoneme becomes similar to a velar phoneme (/k/, /g/, /x/,/o/,/u/)	4. /*gu*fánda/ for /*b*ufánda/ (scarf)
5. Nasal	5. An oral phoneme becomes similar to a nasal phoneme (/m/, /n/)	5. /a*n*fó*m*bra/ for /a/fómbra/) (carpet)
6. Syllabic	6. A syllable becomes identical to another one within a word	6. /*lili*kóptero/ for /*eli*kóptero/ (helicopter)
Substitution		
1. Posteriorization	1. A phoneme articulated in anterior areas is replaced by another one articulated in posterior areas	1. /e*k*ifísio/ for /e*d*ifício/ (building)
2. Frontalization	2. A phoneme articulated in posterior areas is replaced by another one articulated in anterior areas	2. /*b*uánte/ for /*g*uánte/ (glove)
3. Stopping	3. A fricative phoneme is replaced by an occlusive or affricated phoneme (similar articulation zones)	3. /*p*óka/ for /*f*óka/ (seal)
4. Fricativization	4. An occlusive or affricated phoneme is replaced by a fricative (similar articulation zones)	4. /mari*f*ósa/ for /mari*p*ósa/ (butterflay)

PSP	Definition	Examples
5. Semiconsonantization of liquid phonemes	5. A liquid phoneme ((/l/, /r/) is replaced by yod (j) or wau (w)	5. /tjen/ for /t*r*en/ (train)
6. Within-category liquid substitution	6. A liquid phoneme is replaced by a different liquid phoneme	6. /kape/usita/ for /kape*r*usita (Little Red Riding Hood)

Table 1. Most frequent phonological simplification processes.

In the following section, we will explore phonological development in Spanish-speaking children within the context of the TNP. Specifically, this section will discuss a study undertaken with children in Chile.

3. Phonological development in Spanish-speaking children

Phonological development has been widely studied in children who speak English with no preexisting language problems and in children with linguistic difficulties [3, 8, 14, 15]. In Spanish, studies on this topic are scarce. The ones that exist have explored descriptions of the acquisition of phoneme at different age ranges in Mexican children between 3 and 6 years old by using denomination tasks [16] and in Spanish children between 3 and 7 years old by word repetition tasks [17].

In addition to the acquisition of phonemes, phonological development based on the TNP has been studied in different groups of Spanish-speaking children [4, 7, 18–24].

In Spanish children between 3 and 6 years old, researchers have corroborated that the PSP disappear as age increases and that the PSP are less frequent around 6 years of age [7, 18, 20]. As well, it has been noted that variability of PSP decreases in spontaneous speech in Spanish children between 3 and 5 years old as age increases [4].

In Argentinean children between 2 and 5 years old, it was found that the decrease in PSP occurs specifically between 4 and 4 years and 6 months old. In addition, it was found that the more frequent types of PSP are related to syllable and word structure [24].

The previous results have permitted researches to note the decrease in PSP along with age, which agrees with the proposal of the TNP. However, there are few studies in the Spanish language that detail gradual decreases in the different types of PSP in distinct age ranges, like what occurred in the studies by Bosch with Spanish children [7] and the studies by Storti with Argentinean children [24].

A study performed with Chilean children between the ages of 3:0 and 6:11 years old is presented in more detail. The principle research questions were: Do PSP decrease as age increases? How do PSP decrease in different age ranges? [25]. Different age ranges were 3:0 to 3:11 years old (90 children, 41 girls and 49 boys); 4:0 to 4:11 years (90 children, 45 girls and 45 boys); 5:0 to 5:11 years (90 children, 45 girls and 45 boys); 6:0 to 6:11 years (90 children, 45 girls and 45 boys). The PSP were elicited in 37 words used to complete sentences through deferred imitation. The words presented distinct levels of phonological complexity, which are different amounts of syllables, accentuation and syllabic complexity.

The results obtained from statistical analysis demonstrated that the use of PSP significantly reduced between 3 and 6 years old, corroborating previous evidence [7, 24]. Additionally, it established a negative correlation between this correlation and age, or that with age one uses less processes. PSP decrease by almost half when they move from each age range to another.

As well, it determined that the distinct types of PSP were eliminated in different ways at the ages studied.

The PSP related to syllable and word structure are the most frequent in all of the groups and significantly decrease in each subsequent age group. In other words, they appear as foundational processes in phonological development through which one begins to gradually incorporate distinct syllable structures in words of high syllable count between the ages of 3 and 6.

The PSP of assimilation, in contrasts, are significantly more common in children aged 3 years old, which agrees with the results found in Argentinean children where these processes were the most commonly employed in children between 2:5 and 3:0 years old [24]. This also coincides with the phonological profile presented by Bosch [19] for Spanish children aged 3:0 years old in which the presence of assimilations was considered normal while they began to decrease noticeably at 4:0 years old until they no longer appeared in children between 5:0 and 6:0 years old. This idea implies that the assimilation of phonemes is an early strategy to simplify the emission of words in early-stage phonological development.

As for the PSP of substitution, it warns that children 5:0 years old used them scarcely, like children 6:0-year olds. This type of processing is related to the construction of the phonological system. For this reason, it is feasible that between 5 and 6 years old the use of PSP of substitution is so infrequent that these children already possess an almost complete phoneme system only missing some of the more rhotic phonemes [7, 16, 26].

Additionally, socioeconomic status was relevant in the phonological development of Chilean children in this study. It coincides with what was already suggested in previous studies, that differences in economics groups in the use of PSP can affect word emission and master of phonemes [3, 27]. Upon studying socioeconomic level in each age range, it was observed that the difference between children from middle-low class backgrounds and middle-high class backgrounds always maintained itself for children between 3 and 6 years old. This corroborates that belonging to a certain socioeconomic class clearly influences the phonological development in a way that favors children from more upper class backgrounds. This fact expands and affirms the previous assumption that Chilean children aged 3 years old from higher socioeconomic backgrounds employ less PSP than children from a lower socioeconomic background, in particular in processes related to syllable and word structure [28].

In summary, the studies of Spanish-speaking children demonstrate that the PSP decrease as age increases. Additionally, they warn that the more common PSP are related to syllable and word structure and that they can be understood as foundational PSP in phonological development.

PSP of assimilation, it could affirm that they are very common in younger children and that they tend to disappear around age 4. Finally, the PSP of substitution are almost eliminated between the ages of 5 and 6.

The TNP can also be utilized to explain the phonological problems that generally arise in children. They point to language development not much different from that of an even younger child, even if that child can articulate the phonemes well. This can be attributed to the fact that some children conserve the PSP even when they should no longer exist. These children present a problem known in the speech pathology world as phonological problem [8, 2, 26].

In the following section, we will explore the phonological disorders in Spanish-speaking children from the perspective of the TNP.

4. Phonological problems in Spanish-speaking children

Phonological development, considering the elimination of PSP with age, remains unclear for children with phonological problems (PP) and has few studies relating to the matter, especially in the Spanish language. Certainly, the PP is a complex topic since it affects factors in a different way. Regardless, children have difficulty in the emission of words that cannot be explained by problems with phoneme articulation. For this reason, a child can produce /la *n*úna/ for "la luna" (moon), adequately emitting the phoneme /l/ only once. This problem is clearly demonstrated through an increase in the amount of syllables and the phonological complexity of a word, therefore suggesting that it is not surprising that polysyllables presented a unique challenge. The problems with phonological emission of a word also appear in the varied production of the same word. For example, a child, while telling a story, may say the word "entonces" (so) so like /entóne/; /tónse/ o /intóse/.

In this section, we will present various studies performed with Spanish-speaking children with PP centered on their use of PSP. Specifically, we will illustrate in detail studies of Chilean children.

A study of PSP in Catalan and Spanish-speaking children between 3:0 and 4:0 years old with specific language impairment (SLI) observed changes in their phonological profile [29]. The most significant PSP at 3 years old were syllable omissions, especially when compared against a control group of the same age. In contrast, the same children at 4:0 years old more commonly used the PSP associated with the reduction in consonant sequences and the omissions of consonants (equally in the onset as in the syllabic coda), in addition to an absence of the multiple rhotic phoneme /r/. In this sense, the PSP at 3:0 years old involve the word level, whereas those at 4:0 years old affect the syllabic level and begin to appear at the phoneme level. This suggests a tendency in development to advance from the word toward the syllable to finalize the phoneme system.

A different study performed with Spanish-speaking children in Puerto Rico with PP between the ages of 3:0 and 4:0 demonstrated, at each age group, PSP with a percentage of occurrences exceeding 10%. In the 3:0–3:11 years old group, these processes were cluster reduction

(/*pl*ato/ /páto/, plate), stopping (/*f*río/ /*p*ío/, cold), liquid simplification (/p*l*áto/ /pwáto/, plate), and initial consonant deletion. In the 4:0–4:11 years old group, they used the same process without initial consonant deletion. In the same way, they suggested that to diagnose a suspected PP in Spanish-speaking children, speech-language pathologists can look at three specific markers: (1) the use of initial consonant deletion, (2) a moderate percentage-of-occurrence of liquid simplification and stopping, and/or (3) a high percentage-of-occurrence for cluster reduction [21].

Following, it presents studies with monolingual, Spanish-speaking Chilean children with PP. First, it approached the phonological development of these children by characterizing their emission of PSP in distinct age ranges. Later, it supplemented their understanding of the PP through a study on the production of polysyllables and a different study on the phonological representation of a word.

Studies of children were performed by eliciting the PSP through the test to evaluate processes of phonological simplification, revised version, known as the TEPROSIF-R [10]. This instrument evaluates PSP in Spanish-speakers between 3 and 6 years old. It was used in the studies to be described here. First, it will present the test and later we will explore the studies.

The TEPROSIF-R consists of 37 words of a different length, stress and syllabic complexity that facilitate the issuance of PSP. Deferred imitation is supported with flashcards. Showing the child a picture on the top of a sheet, the child is told, for example, "Look, here is a duck and now look here (pointing to the picture on the bottom of the page): On the water there is a… (and the child is expected to complete the sentence with the target word)." The child's responses are recorded and then phonologically transcribed in a log sheet, where the PSP issued in each word are identified and each assigned 1 point each. The total score is interpreted according to the norms corresponding to their age.

The test was administered to 620 children between 3:0 and 6:0 years old, grouped in four age ranges: 3:0–3:11, $n = 137$ (67 girls and 70 boys), 4.0–4.11, $n = 182$ (82 girls and 100 boys), 5.0–5.11, $n = 157$ (79 girls and 78 boys), 6.0–6.11, $n = 144$ (70 girls and 74 boys). The participants were identified by three social classes: lower-middle class children (31% of the sample), middle-class children (30% of the sample), and upper-middle class children (39% of the sample). In addition, participants were selected from five regions in Chile.

The statistical analysis found that, first, there is significant correlation between the score of the TEPROSIF and the age of the child ($r = -0.64$, p.000, the index is negative because a much younger age corresponds to a greater number of PSP). Second, it discriminates between different age ranges (ANOVA and Tuckey). It also discriminates between children with typical language development (TLD) and children with specific language impairment, SLI (Mann Whitney). Finally, it presents a high level of reliability (Alpha Cronbach 0.90).

An initial study was performed with Spanish-speaking Chilean children 4:0-year-olds with SLI. The research question posed was: Do 4:0-year-old children with SLI emit PSP similarly to 4:0-year-old children with Typical Language Development (TLD) or are they more like 3:0-year-old children with TLD? [30].

It worked with 21 children 4:0-year olds with SLI and two groups of children with TLD, one group of 4:0-year-olds (n = 90) and another group of 3:0-year-olds (n = 90). Each child was evaluated with the TEPROSIF-R.

The analysis of the results found that 4:0-year olds with SLI had significantly more PSP than 4:0 and 3:0-year-old children with TLD, a difference that was observed in all three types of PSP (according to ANOVA and Tuckey).

As well, it was noted that 4:0-year olds with SLI used the PSP differently than 3:0 and 4:0-year-old children with TLD. A large percentage of children with SLI use PSP, which are rarely used by children with TLD. This is to say, these children not only have more PSP but use processes that are less used by children with TLD.

The wide usage of less common PSP by children with SLI is seen especially in the use of the following processes:

a. Processes related to syllable and word structure: the addition of phonemes or syllables (/plátano/ /plá*n*tano, banana), coalescence (/tren/ /*k*en/, train) and metathesis (/bufánda/ /*f*u*b*ánda/, scarf)

b. Assimilation processes: velar (/bufánda/ /*g*ufánda, scarf), nasal (/alfómbra/ /a*n*fómbra/, carpet); labial (/plátano/ /pláta*m*o/, banana)

c. Substitution processes coda aspiration (/dúlse/ /dú*h*se/, candy) and substitution of liquid phonemes for non-liquid phonemes (/xáula/ /xáu*b*a/, birdcage)

Therefore, 4:0-year-old children with SLI present a distinct profile from similarly aged or younger children with TLD. These problems specifically arise with structural process (syllable and word structure and assimilation). In this respect, it is remarkable that the assimilation PSP exist in 4:0-year-old children with SLI, something that does not occur in 4:0-year olds with TLD.

In a different study, we approached how children with PP at ages 4:0, 5:0 and 6:0 manage PSP [31]. The research questions were as follows: Does the use of PSP in children with PP change between the ages of 4:0 and 6:0? If they do change, how do these changes reveal themselves?

This study worked with a group of 34 children distributed in three age ranges: 4:0 years (n = 12); 5:0 years (n = 11) and 6:0 years (n = 11). All the children presented PP and their performances in the TEPROSIF-R were poor. Comparing the quantity of PSP from the groups with ANOVA, the results showed that: (a) 4:0-year-old children with PP present significantly more PSP than the 5:0 and 6:0-year-old children, (b) 5:0 and 6:0-year-old children with PP do not differ in the number of PSP.

A qualitative analysis of the evidence revealed that the 4:0-year-old children with PP use certain PSP related to syllable structure (omission of the coda: /pantalón/ /pa_talón/, pant); reduction of the diphthong (puénte/ / pénte/, bridge); reduction of the consonant group (tren/ / ten/, train);

and coalescence (/tren/ /ken/, train). As well, PSP that affected word structure were observed, specifically in the omission of pretonic syllable (/mariposa/ ma_pósa/, butterfly).

In contrast, the 5:0 years old used significantly less PSP in relation to the 4:0 years old. This implies a higher phonological development, even though their performance levels are still considerably low. Additionally, they demonstrated better control of syllable structure with codas and diphthongs. Regardless, the reduction of consonant groups and coalescence remained with no significant changes. No observable progress was made in the control of word structure whereas the omission of non-tonic syllable remained stable.

Finally, the 6:0 years old did not demonstrate any significant changes in phonological development in comparison to the 5:0 year olds. Consequently, their phonological characteristics were very similar to the 5:0-year olds. It is also notable that the reduction of the diphthong originally observed at 4:0-years old persisted.

This shows that the elimination of simplification processes in children with PP occurs between 3:0 and 5:0 years old, but it slows down between 5:0 and 6:0 years old where no significant changes were observed in the study. This could indicate that phonological development somehow stalls in these later stages and that PP tends to be more persistent.

Notably, children's development is most visible in their progressive suppression of processes affecting syllable structure and word. This suppression, however, becomes slower once around 5 years of age.

PSP of substitution, which are linked to the management of the phonological system, do not differ in the three age groups studied here. In respect to the PSP of assimilation, which usually are considered structural [5, 6, 7, 32], there as well were no observable differences. If one emphasizes that the assimilations serve to harmonize the phonemes in a word, it could signal that the PSP most related with the phonemes maintain themselves with no relevant changes.

In this manner, children with PP probably improve their control at a structural level better than they do at the phoneme level at around 5:0 years old, as compared to children under 4:0 years old.

The fact that children with PP conserve the simplifications that affect word structure, specifically the omission of pretonic syllable, can relate to their difficulties with polysyllabic words. Another study with 4:0-year-old Spanish-speaking Chilean children with PP attempted to explore the capacity of use of polysyllables, or words with three or more syllables [33]. The principles research questions in this study were as follows: How is the emission of polysyllabic words in 4:0 years old children with PP? How do they perform in relation to the quantity of syllables and rhythmic structure of the word organized based on the tonic syllable?

The study was performed with 36 children from 4:0 to 4:11 years old separated into two groups, one consisting of children with PP (*n* = 18) and one of children with TLD (*n* = 18). Each child was asked to say, through deferred imitation and with the support of drawings, the following polysyllabic words from the TEPROSIF-R. These words were presented orally by the examiner in this sequence: mariposa (butterfly), bicicleta (bicycle), helicóptero (helicopter), teléfono (phone), Caperucita (Little Red Riding Hood), refrigerador (fridge) y edificio (building).

The words have different syllable counts and distinct rhythmic structures. The rhythmic structure was described identifying the syllables with a number according to the accenting in the word. The tonic syllable, the most intense, longest, and the highest in tone, was identified as a3. The initial unstressed syllable, with a secondary accent, was identified as a2. Finally, the rests that precede and follow a tonic syllable were labeled a1. In this way, four words presented the rhythmic structure 2131 (mariposa, edificio, dinosaurio, bicicleta) and the rest followed the sequences 2311 (teléfono), 21131 (Caperucita), 21113 (refrigerador) y 21311 (helicóptero). Consequently, the rhythmic structures of most of the words were different.

The statistical comparison of the words emitted correctly by both groups of children corroborated that children with PP present significantly fewer correct responses. This was demonstrated in their difficulties to emit polysyllabic words.

In respect to the individual performance of each child, 55.5% of the children with PP did not correctly emit any of the polysyllables and only two children achieved the maximum performance for the group, correctly emitting four words (out of a total of seven). In contrast, in the control group 55.4% of the participants correctly produced five or more polysyllables, with one child correctly producing all seven words with no errors.

Their incorrect responses were also analyzed to consider their capacity of use over syllable quantity and accented syllables.

The most common error in children with PP was the alteration of syllable quantity in polysyllabic words. As well, some children incorrectly produced words by conserving the tonic syllable. Finally, a less frequent error consists of children wrongly uttering a particular word, although accent and rhythmic structure are correct (/misiséta/ por /bisikléta/ "bicicleta", bicycle). The children with TLD, in contrast, demonstrated different behavior, often committing the same errors but in similar frequencies. Additionally, they produced much fewer errors than children with PP.

The most common errors in children with PP correspond to alteration in the quantity of syllables and are predominantly reductions in the length of the polysyllable. In order to obtain more precise information for this performance, the average of the syllables used were calculated. It finds that in words longer than four syllables children did an average of 3.4 syllables, while in five syllable words the average was 3.5. This is to say, the length of their emissions consistently maintained itself around three syllables. The simplifications used to achieve such length were diverse and depended on each word. For example, in the word "mariposa," there was a tendency to use a diphthong to omit the onset of the accented syllable (/meliósa/; /miniósa/) along with the omission of unstressed syllables or some of their elements, like with the word Caperucita (/kaperusíta/, pronounced as /pusíta/ or /kausíta/).

In reference to the rhythmic structure of a word, it was suggested that with a word like "mariposa," with the structure 2131, subjects reduced the word to /meliósa/ or /miniósa/ with the structure 231. Something similar occurred in Caperucita (21131), which was emitted as /kausíta/ (231) or /pusíta/ (231). This suggests a metric structure of three syllables with a rhythmic pattern of 231.

In contrast, children with TLD, when they committed errors with four syllable polysyllabic words, used an average of 3.9 syllables and 4.6 syllables for five syllable words. They used a closer number of syllables to the original polysyllabic word.

In summary, children with PP commit significantly more errors in the production of polysyllables, tend to reduce the quantity of syllables in the word and conserve the tonic syllable. Their simplifications demonstrate a strategy that fundamentally supports the tonic syllable, an important element in the rhythmic structure of the word. Regardless, they are unable to emit the word in all its length, and tend to produce around three syllables, where they have eliminated elements. This suggests a depleted phonological representation that makes this type of task even more complex.

The previous studies on the topic focused on the production of words in children with PP. It is clear that these children have problems with word emission, but it remains unclear if this implies difficulty with the internal phonological representation of a word (that one cannot infer certainty through errors production of words). A different study was performed with Chilean children to explore the phonological representation of words through *receptive tasks* that did not require verbal responses [34].

The phonological representation can be understood as a system of superimposed strata, each one with information of a distinct nature (according to the proposal by Ref. [35]. Therefore, in the process of codification (where lexical-syntactical representation serves as the entrance point for a word), the phonological representation arises to recuperate the metric and rhythmic structure of the word, thereby identifying the sequence of accented and unaccented syllables in the word.

The research questions posed in this study were as follows: Is this performance in phonological representation in children with PP similar or different than in children with TLD? Is the phonological representation related to the emission of PSP and to the lexical comprehension of children with PP?

The study was performed with 30 Spanish-speaking Chilean children between the ages of 4:0 and 4:11. In total, 15 of these children had PP and 15 had TLD.

The phonological representation was evaluated with an instrument specifically designed for this study. It measures the identification of phonological representation in a word alluded to in picture reference. There were 36 color drawing that represented 12 words of three syllables or more. The words were modified according to Claseen's proposal [36] and the child was presented with each word three separate times during the evaluation: one time without modification (hipopótamo, hippopotamus; zapatilla, sports shoes); one time modified with the tonic syllable (hipo*pé*tamo, zapalla); and one time modified with the pretonic syllable (hi*pe*pótamo, zatílla). The syllable modifications occurred in the omission of a syllable (like in zapa_lla, in which the "ti" is omitted) or in the substitution of a vowel (like in hipop*é*tamo, in which the /e/ is substituted for /o/).

The stimuli were recorded in a soundproof booth using the program Praat. The children were presented with the stimuli through headphones in which they were told they would hear a person that "did not know how to speak very well and needed help knowing when they made mistakes." The child was instructed to identify if the stimulus he/she heard was well or poorly emitted by responding with a smiley face or a sad face.

The emissions of PSP were evaluated with the TEPROSIF-R and the lexical comprehension with the vocabulary test in images (TEVI-R [37]. This test evaluated the level of passive vocabulary comprehension in Spanish-speaking subjects between the ages of 2:6 and 19:11. It resembles the Peabody Picture Vocabulary Test, but differs in the way that it does not establish any correlation with the intelligence coefficient. The examiner orally presents a child with a word telling the child, "We are going to play, look at these drawings (4), I'm going to say a word and you point to the drawing for that word."

Upon comparing the statistical performance of both groups of these children, it was noted that children with PP performed significantly worse than children with TLD in phonological representation and lexical comprehension. As well, they emitted significantly more PSP than children with TLD, which is in line with their phonological problem. Additionally, the correlation analysis revealed that children with PP did not demonstrate a correlation with any of the evaluated aspects. Essentially, phonological representation, lexical comprehension, and the production of PSP are not related. Contrastingly, the children with TLD demonstrated significant correlations between these three aspects.

In conclusion, the children with PP present a decreased ability in phonological representation and lexical comprehension in addition to their increased use of PSP. However, there is no relationship between these three aspects. This fact demonstrates that they have a decreased linguistic system and that the aspects that are related in children with TLD appear to be dissociated in children with PP.

In summary, previous studies suggest that, consistent with TNP, Spanish-speaking children with PP are more prone to produce PSP than children with TLD. Moreover, not only they produce more PSP than children with TLD in their same age-level but also produce more PSP than younger typical children.

Their performance corresponds to a distinct profile, suggesting that even though they use the same PSP as children with TLD, children with PP tend to use, with increased frequency, the less commonly used processes. Their increased difficulty is heightened with the structural PSP (those related to syllable, word, and assimilation structure). Researchers observed significant phonological development specifically between the ages of 4 and 5, while during the ages of 5 and 6 they observed less pronounced changes, which could imply that the phonological problem of word organization is persistent. Additionally, it especially corroborates the difficulty of words with three syllables or more, since in these words children with PP tend to decrease the quantity of syllables and conserve the tonic syllable. Finally, it was observed that children with PP also demonstrate problems with the phonological representation of a word and a decreased performance in lexical comprehension. Even though these aspects are associated in children with TLD, they are not correlated in children with PP. This fact also shows that children with PP present a unique phonological profile.

Studies discussed were performed with Spanish-speaking Chilean children. Therefore, results cannot be readily generalized to other populations. However, since they were all conducted within the same theoretical framework, they are an interesting body of work that helps both characterizing Chilean children in detail and providing empirical results for future comparisons. Research on children from other Spanish-speaking communities might benefit from the reference points provided by literature reviewed here.

The verification that children with PP also present difficulties with phonological representation of a word suggests that these children probably demonstrate lower performance in phonological awareness. In the following section, we will explore the theme of phonological awareness in children with PP through two studies performed with Chilean children.

5. Phonological awareness in Spanish-speaking children with phonological problems

Phonological awareness is a metalinguistic ability that enables speakers to manipulate and explicitly identify the syllables and phonemes in a word [38]. The development of this ability plays a fundamental role in decoding letter patterns in words, which in turn, is essential in the development of reading skills [39].

Two types of phonological awareness have been identified: awareness of the syllable and awareness of the phoneme. Firstly, during the preschool period, awareness of the syllable is developed. Then, in the school period, awareness of the phoneme is built together with the development of reading skills.

The development of phonological awareness requires that children have an analytic and differential representation that enable them manipulate and identify syllables and phonemes. Therefore, it is possible to propose that children with PP also have difficulties with phonological awareness. However, findings are not conclusive [40–42].

It has been observed that children with PP show poorer performance than typically developing children in phonological awareness. Despite this, they show better performance in this metalinguistic ability when compared to children with PP who also have language difficulties [40]. It has been also reported that phonological perception and vocabulary can predict children's performance in phonological awareness. However, phoneme articulation does not affect phonological awareness [42]. Likewise, preschool children with severe PP do not show difficulties with phonological awareness [41]. In the following section, two studies performed with preschool Chilean children with PP and SLI are presented [43, 44].

The first study [43] aimed to answer the following question: Is there a relationship between phonological problems and phonological awareness? For this study, 24 preschool children with SLI and PP (aged 4:2 on average) and 26 preschool children with TLD (aged 4:4 on average) were recruited. Phonological performance was evaluated with the TEPROSIF-R [10].

Children with SLI and PP had a poor performance in the test, that is to say, they produced more PSP than expected for their age. Children with TLD, conversely, perform according to their age. Phonological awareness was evaluated with *Prueba Destinada para Evaluar Habilidades Metalingüísticas de tipo Fonológico* (PDEHMF) [45]. This test evaluates, mainly, phonological awareness at the syllable level, thus its subtests focus on the evaluation of syllabic awareness. Each subtest has eight items and provides an example to ensure comprehension of the task. The first four subtests aim to measure syllabic awareness and the fifth test evaluates the grapheme-phoneme associations. The final subtest deals with phonological awareness at the phoneme level. Pearson's *r* test was used to determine if there was a relationship between these variables. The results obtained showed that there is no correlation between the number of PSP and phonological awareness either in preschool children with SLI or children with TLD. Therefore, the number of Phonological Simplification Processes that children produce is not related with their metaphonological abilities.

This result supports previous findings that state that phonological problems do not necessarily affect these metaphonological abilities [40, 41, 46, 47]. This also corroborates the finding that some children without PP show difficulties in phonological awareness [47, 48].

Normal phonological awareness develops considering other linguistic and cognitive factors. It is argued that vocabulary and working memory play an essential role in its development. For this reason, vocabulary expansion is an important factor since it implies a lexical reorganization that requires a more precise and analytical phonological representation of the word [41]. Working memory, on the other hand, is also relevant to the development of phonological as carrying out phonological awareness tasks requires that acoustic information be processed in its central executive component [49].

In conclusion, the study shows that there is no relationship between phonological performance and phonological awareness. This suggests that a normal phonological development does not ensure a satisfactory performance in this metalinguistic ability. It seems that the development of phonological awareness also requires such other factors as vocabulary and working memory.

The second study aimed to deepen the findings reported in the previous study [44]. For this reason, the following research question was posed: Do children with PP and grammatical difficulties are more likely to have poor phonological awareness skills than children with PP?

A total of 25 preschool children with SLI were recruited for the study: 14 children with PP and 11 children with PP and grammatical difficulties (aged 5:4 on average) and 59 preschool children with TLD (aged 5:5 on average). The phonological ability was evaluated as done in the previous study. Thus, TEPROSIF-R [10] was used to evaluate PP and PDEHMF [45] to measure phonological awareness. Grammatical difficulties were evaluated with the *Test Exploratorio de Gramática Española de A. Toronto* (TEGE) [50]. This test has two subtests: one to measure receptive skills and the other to measure expressive skills. Each subtest has 23 items that evaluate the following aspects: sentences (affirmative, negative and passive), pronouns (personal, interrogative, demonstrative, indefinite and relative), verbs (tense and 3rd person), and adjectives (possessive and interrogative). Student's *t* test was used to compare the performance of children with SLI and children with TLD. The same statistical treatment was used to compare the performance of children with SLI and PP with that of children with SLI, PP, and grammatical difficulties. The results obtained showed that children with SLI had a lower performance in phonological awareness than children with TLD. Children with SLI and PP demonstrated a better performance in this metalinguistic ability than children with SLI, PP, and grammatical difficulties. These findings are consistent with evidence from a previous study that suggest that children with PP show better performance in this metalinguistic ability when compared with children with PP and who also have other language problems [40].

Even though the results obtained indicate that phonological problems do not determine the performance in phonological awareness, it was observed that children with decreased performance in phonological awareness produced a greater number of PSP at syllable level. This type of PSP could imply an important alteration in the phonological representation, due to the fact that it modifies the syllable structure and/or the number of syllables in a word. Thus, it might be supposed that children who produce this type of PSP show a phonological representation that is insufficiently precise and undifferentiated. This suggests that children with PP who produce a great number of PSP related with the syllable could show difficulties with phonological awareness.

In summary, results suggest that children with PP are less likely to have poor performance in phonological awareness. However, when children with PP also have grammatical difficulties, it is possible that phonological awareness be affected.

The two studies above suggest that in children with PP, understood as the production of a great number of PSP, no relationship between phonological performance and phonological awareness can be found. On the other hand, when children show phonological problems and grammatical difficulties, a lower performance in phonological awareness has been observed. Finally, findings suggest that children that produce a great number of PSP at the syllable level tend to have a poorer performance in phonological awareness.

6. Conclusions

Reviewed studies were all conducted within the Theory of Natural Phonology framework. Consequently, they provide a valuable point of view when describing children with PP, especially when considering that there are indeed other studies conducted within the same theoretical framework in other populations

Firstly, it has been demonstrated that phonological development in typically developing Spanish-speaking children, particularly, Chilean children, implies the elimination of the Phonological Simplification Processes as they get older. This supports the Theory of Natural Phonology.

As for phonological development in Spanish-speaking children with phonological problems, it is possible to conclude that these children:

http://dx.doi.org/10.5772/intechopen.69681

a. produce phonologically simplified words until advanced age as compared to children with typical language development, that is to say, they frequently produce phonologically simplified words until 6 years of age. They also produced more phonologically simplified words as compared to younger typically developing children (chronological age).

b. show their own developmental trajectory of phonological development. Children with phonological disorders and typically developing children produce the same types of phonological simplification processes. However, some Phonological Simplification Processes are produced more frequently by children with phonological disorders than typically developing children.

c. show more difficulties with structural process (syllable and word structure). This is also observed in typically developing children. These processes have a central role in phonological development.

d. produce a fewer number of phonological simplification processes between 4:0 and 5:0 years of age. However, between 5:0 and 6:11 years of age the number of Phonological Simplification Processes remains numerically the same. Phonological development seems to slower down between 5:0 and 6:11 years of age. This is not observed in typically developing children, as the elimination of the phonological simplification processes in these children occurs more rapidly and usually between 3:0 and 6:0 years of age.

e. show severe phonological difficulties in producing words with three or more syllables. Children with phonological disorders produce words in which some syllables are omitted, whereas the tonic syllable remains stable. Patterns commonly found in these children include elements with three syllables.

f. present a decreased ability in phonological representation and lexical comprehension. However, no significant statistical correlation was found between these difficulties.

g. no correlation was found between phonological awareness and phonological performance. Children with phonological problems show difficulties with phonological awareness when they have grammatical problems or when they produce a high number of Phonological Simplification Processes that equally affects syllable structure as it does word structure.

The conclusions above contribute to gain deeper understanding of phonological development in Spanish-speaking children with phonological problems, in particular, Chilean children. However, it is important to highlight the fact that these conclusions are drawn from studies carried out based on a specific theoretical perspective; thus, other issues concerning phonological development and disorders may not be covered.

Finally, phonological disorders found in the production of words can be related to other difficulties for instance phonological representations and phonological awareness. It is also interesting to mention that phonological disorders also occur together with grammatical and lexical problems. Future research should, therefore concentrate on this relationship in Spanish-speaking children.

Author details

María Mercedes Pavez[1]* and Carmen Julia Coloma[2]

*Address all correspondence to: mmpavez@hotmail.com

1 University of Chile, Pontifical Catholic University of Chile, Santiago, Chile

2 University of Chile, Santiago, Chile

References

[1] Galeote M. Adquisición del Lenguaje. Madrid: Pirámide; 2002. p. 288

[2] Acosta V, León S, Ramos V. Dificultades del habla infantil; un enfoque clínico. Málaga: Ediciones Aljibe; 1998. p. 197

[3] Dodd B, Holm A, Hua Z, Crosbie S. Phonological development: A normative study of British English-speaking children. Clinical Linguistics & Phonetics. 2003;**17**(8):617-643. DOI: 10.1080/0269920031000111348

[4] Martínez V, Diez-Itza E, Miranda M. Detección de alteraciones fonológicas a partir de índices de error en el habla espontánea. In: XXIV. Congreso Internacional Asociación Española de Logopedia, Foniatría y Audiología (AELFA); 23-25 junio, 2004. Madrid, pp. 449-464

[5] Serra M, Serrat E, Solé R, Bel A, Aparici M. La adquisición del lenguaje. 2ª ed. Barcelona: Ariel; 2008. p. 605

[6] Bosch L. Trastornos del desarrollo fonético y fonológico. In: Puyuelo M, Rondal J, editors. Manual de desarrollo y alteraciones del lenguaje. 2a ed. Barcelona: Masson; 2005. pp. 189-204

[7] Bosch L. Evaluación fonológica del habla infantil. Barcelona: Masson; 2004. p. 107

[8] Ingram D. Trastornos fonológicos en el niño. Barcelona: Médica y Técnica; 1983. p. 193

[9] Alcina J, Blecua J. Gramática española, Barcelona: Ed. Ariel; 1975. p. 1244

[10] Pavez MM, Maggiolo M, Coloma C. Test para evaluar procesos de simplificación fonológica, versión revisada (TEPROSIF-R). Santiago de Chile: Ediciones Universidad Católica; 2008. p. 83

[11] Werker J, Tees R. Influences on infant speech processing: Toward a new synthesis. Annual Review of Psychology. 1999;**50**(1):509-535

[12] Swingley D, Aslin R. Spoken word recognition and lexical representation.in very young children. Cognition. 2000;**76**(2):147-166

[13] Sutherland D, Guillon G. Assessment of phonological representations in children with speech impairment. Language. Speech & Hearing Services in Schools. 2005;**36**(4):294-307

[14] Roberts J, Burchinal M, Footo M. Phonological process decline from 2 ½ to 8 years. Journal of Communication Disorders. 1990;**23**(3):205-217

[15] Leonard L. Children with Specific Language Impairment. 2nd ed. Cambridge: MIT Press; 2014. p. 496

[16] Melgar M. Cómo detectar al niño con problemas del habla. 5a ed. México: Trillas; 2007. p. 49

[17] Serra M. Normas estadísticas de articulación para la población escolar de 3 a 7 años del área metropolitana de Barcelona. Revista de Logopedia, Foniatría y Audiología. 1984;**III**(4):232-235

[18] Bosch L. El desarrollo fonológico infantil: una prueba para su evaluación. Anuario de Psicología. 1983a;**28**(1):86-114

[19] Bosch L. Identificación de procesos fonológicos de simplificación en el habla infantil. Revista de Logopedia, Foniatría y Audiología. 1983b;**III**(2):96-102

[20] Bosch L. Los trastornos fonológicos en el niño. Revista de Logopedia, Foniatría y Audiología. 1987;**VII**(4):195-200

[21] Goldstein B, Iglesias A. Phonological patterns in normally developing spanish – speaking 3- and 4- Years- olds of puerto rican descent. Language, Speech and Hearing Services in Schools. 1996;**27**:82-90

[22] Goldstein B, Swasey Washington P. An initial investigation of phonological pattern in 4-year-old typically developing Spanish-English bilingual children. Language, Speech, and Hearing Services in Schools. 2001;**32**:153-164

[23] Goldstein B, Fabiano L, Swasey Washington P. Phonological skills in predominantly English-speaking, predominantly Spanish-speaking, and Spanish-English bilingual children, language. Speech, and Hearing Services in Schools. 2005;**36**:201-218

[24] Storti P. Estudio descriptivo sobre los Procesos fonológicos de simplificación en niños de 2 años a 5 años [thesis]. Rosario, Argentina: Universidad Nacional de Rosario; 2002

[25] Pavez MM, Maggiolo M, Peñaloza C, Coloma CJ. Desarrollo fonológico en niños de 3 a 6 años: incidencia de la edad, el género y el nivel socioeconómico. RLA. Revista de lingüística teórica y aplicada. 2009;**47**(2):89-109

[26] Villegas F. Manual de Logopedia. Madrid: Ediciones Pirámide; 2010. p. 192

[27] Burt L, Holm A, Dodd B. Phonological awareness skills of 4-year-old British children: An assessment and developmental data. International Journal of Language & Communication Disorders. 1999;**34**(3):311-335

[28] Pandolfi A, Herrera M. Producción fonológica diastrático de niños menores de tres años. RLA Revista de lingüística teórica y aplicada. 1990;**28**:101-122

[29] Aguilar-Mediavilla E, Serra-Raventós M. Phonological profile of Spanish-Catalan children with specific language impairment at age 4: Are there any changes over time? Folia Phoniatrica et Logopaedica. 2006;**58**:400-414. DOI: 10.1159/000095001

[30] Pavez. MM, Coloma.CJ, Maggiolo M, Peñaloza C. El desempeño fonológico en niños de 4 años con trastorno específico del lenguaje. In: V Congreso de investigaciones lingüístico-filológicas, la enseñanza de la lengua en el tercer milenio; 5 - 11 agosto 2007; Lima, Perú: Academia Peruana de la Lengua, Universidad Ricardo Palma, UNESCO;

[31] Pavez MM, Coloma CJ, Maggiolo,M, Peñaloza C. Procesos de simplificación fonológica en niños de 4,5 y 6 años con dificultades fonológicas 2008. In: XXVI Congreso Internacional Asociación Española de Logopedia, Foniatría y Audiología (AELFA); 9-11 Julio 2008; Tenerife: Universidad de la Laguna

[32] Grunwell P. Phonological Assessment of child speech (PACS). Windsor: NFER-Nelson. 1985. p. 175

[33] Pavez MM, Coloma CJ, Maggiolo,M, Peñaloza C. Producción de palabras polisilábicas en niños con problemas fonológicos y niños con desarrollo típico del lenguaje". In: XXVI Congreso Internacional Asociación Española de Logopedia, Foniatría y Audiología (AELFA); 9-11 Julio 2008. Tenerife: Universidad de la Laguna

[34] Poblete, A.M. Representación fonológica en una muestra de escolares chilenos con trastorno fonológico [thesis]. Santiago de Chile: Pontificia Universidad Católica de Chile; 2014

[35] Belichón M, Igoa JM, Rivière A. Psicología del lenguaje. Investigación y teoría. Madrid: Ed. Trotta; 2000. p. 841

[36] Claessen M, Heath S, Fletcher J, Hogben J, Leitao S. Quality of phonological representations: A window into the lexicon? International Journal of Language & Communication Disorders. 2009;**44**:121-144

[37] Echeverría M, Herrera MO, Segure JT. TEVI-R, Test de vocabulario en imágenes, 3° ed. Revisada, Concepción: Editorial Universidad de Concepción; 2002. p. 161

[38] Clemente M, Domínguez A. La enseñanza de la lectura. Enfoque psicolingüístico y sociocultural. Madrid: Editorial Pirámide; 1999. p. 184

[39] Pérez M, González M. Desarrollo del conocimiento fonológico, experiencia lectora y dificultad de la tarea. Revista de Logopedia, Foniatría y Audiología. 2004;**24**(1):2-15

[40] Nathan L, Stackhouse J, Goulandris N, Snowling M. The development of early literacy skills among children with speech difficulties. Journal of Speech, Language, and Hearing Research. 2004;**47**:337-391

[41] Schuele M. The impact of development speech and language impairments on the acquisition of literacy skills. Mental Retardation and Developmental Disabilities. 2004; **10**:176-183

[42] Rvachew S, Grawburg M. Correlates of phonological awareness in preschoolers with speech sound disorders. Journal of Speech, Language, and Hearing Research. 2006; **49**(1):74-87

[43] Coloma CJ, De Barbieri Z. Trastorno Fonológico y Conciencia Fonológica en preescolares con Trastorno Específico del Lenguaje. Revista de Logopedia, Foniatría y Audiología. 2007;**27**(2):67-73

[44] Coloma CJ, De Barbieri Z, Canales S, Cifuentes P, Guzmán C, Saldías M,Vidal A. La importancia de las dificultades fonológicas en el desempeño de la conciencia fonológica en niños con Trastorno del Lenguaje. Revista Paideia. 2008;**4**:11-22

[45] Yacuba P. Prueba Destinada a Evaluar Habilidades Metalingüísticas de tipo Fonológicas [thesis]. Santiago de Chile: Pontificia Universidad Católica de Chile; 1999

[46] Lewis B, Freebairn L, Taylor G. Follow-up of children with early expressive phonology disorders. Journal of Learning Disabilities. 2000;**25**:586-697

[47] Hesketh A. Early literacy achievement of children with a history of speech problems. International Journal of Language & Communication. 2004;**39**(4):453-468

[48] Bravo L. Lenguaje escrito y dislexia: enfoque cognitivo del retardo lector. Santiago de Chile: Ediciones Universidad Católica; 2005. p. 200

[49] Anthony J, Williams J. Mc Donald R, Corbitt-Shindler D. Phonological processing and emergent literacy in Spanish-Speaking preschool children. Annals of Dyslexia. 2006; **56**(4):239-270

[50] Pavez MM. Test exploratorio de gramática española de A. Toronto. 3ª ed. Santiago de Chile: Ediciones Universidad Católica de Chile; 2010. p. 97

Chapter 5

Swallowing Disorders in Newborn and Small Children

Daniele Farneti and Elisabetta Genovese

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69921

Abstract

This chapter reviews the main aspects of dysphagia in children: epidemiology, etiology, physiopathology, bedside assessment, and instrumental assessment in the perspective of planning treatment. More details will be given on the endoscopic assessment in children of different ages in consideration of the information useful in planning treatment. This chapter offers a review of the literature on the topic and a simple diagram of the main aspects of the management of dysphagia in children. This chapter aims to offer a simple and useful guide for students and professionals working in the field and suggestions for the implementation of clinical steps in daily practice when and where managing children with swallowing disorders is a reality.

Keywords: swallowing, deglutition disorders, children, newborn, feeding

1. Introduction

Swallowing disorders in children is a topic of great interest, from the epidemiological, clinical, rehabilitative, and, not least, cultural perspective. If significant steps forward have been made in recent decades in all aspects of adult swallowing (under normal conditions and for different comorbidities), medical knowledge about aspects of swallowing in childhood (normal, abnormal, and deviant) has not improved at the same speed. This has created a major gap between the more practical aspects of patient care and people requiring specific interventions.

Before proceeding to the discussion of the most typical physiopathological and clinical aspects related with this disorder, a brief epidemiological and etiological framework of the problem is appropriate.

2. Epidemiology

Data about the incidence (new cases) and prevalence (disorder in a given period of time) of swallowing disorders in childhood are not reported separately in the literature. This is mainly due to the heterogeneity of the population studied, in reference to the assumed consistency and the different ways of detection of the disorder. It is estimated that 25–45% of normally developing children can have eating disorders and swallowing problems, and in children with developmental disorders, the prevalence is estimated to be 30–80%. Feeding problems associated with serious sequelae (lack of growth and chronicity) were reported in 10.3% of children with physical disabilities (26–90%), medical conditions, and prematurity (10–49%). This is due to an improvement in survival rates of premature babies with low birth weight and with complex medical conditions [1–3]. **Tables 1** and **2** summarize the main morbid conditions and possible interactions (comorbidities) that are associated with swallowing disorders in children.

	Disease
Neurological	Encephalopathies (cerebral palsy, perinatal anoxia), Traumatic Brain Injury, Neoplasms, Mental delay, Prematurity and developmental delays
Anatomical and structural	Congenital (tracheoesophageal fistula, palatal cleft), Acquired
Genetic	Chromosomal (Down S.), Syndromic (Pierre Robin, Treacher-Collins), Dysmetabolisms
Systemic diseases	Respiratory (chronic lung disease, bronchopulmonary dysplasia), Gastrointestinal (GI dysmobility, constipation), Cardiac
Psychosocial and behavioral	Oral deprivation
Secondary reversible diseases	Iatrogenic

Table 1. Main pathological conditions causing swallowing disorders.

Coexisting diseases
Motor
Sensory and psychic
Perceptual
Praxis
Gnosis
Cognitive
Communicative behavioral

Table 2. Main pathological conditions associated with swallowing disorders.

http://dx.doi.org/10.5772/intechopen.69921

3. Etiology

From the etiological point of view, only a brief reference to the most common causes of dysphagia in children, including conditions associated with developmental abnormalities, that is, early onset conditions, requiring prolonged or chronic measures of medical, rehabilitation, and/or residential support, is necessary.

These conditions (**Table 1**) are mainly associated with neurological disorders (cerebral palsy, meningitis, encephalopathy, pervasive developmental disorders, traumatic brain injury, and muscle weakness): factors affecting neuromuscular coordination (prematurity and low birth weight), complex diseases (heart disease, lung disease, gastroesophageal reflux disease, and delayed gastric emptying), structural anomalies (cleft lip and/or palate, laryngomalacia, tracheoesophageal fistula, esophageal atresia, cervical-facial abnormalities, and choanal atresia), and genetic syndromes (Pierre Robin, Prader-Willi, Treacher-Collins, and deletion of chromosome 22q11).

To these conditions, the iatrogenic conditions related to the use of drugs (reduced reactivity, hypotonus, and decreased appetite), surgery, or medical measures, which require alternative ways of feeding or assisted breathing, and any other conditions that induce sensory deprivation of orofacial and pharyngeal structures, including a limited availability of food, which may be associated with social, emotional, and environmental problems (e.g., difficulty of parent-child interaction) (**Table 2**) [4], must be added.

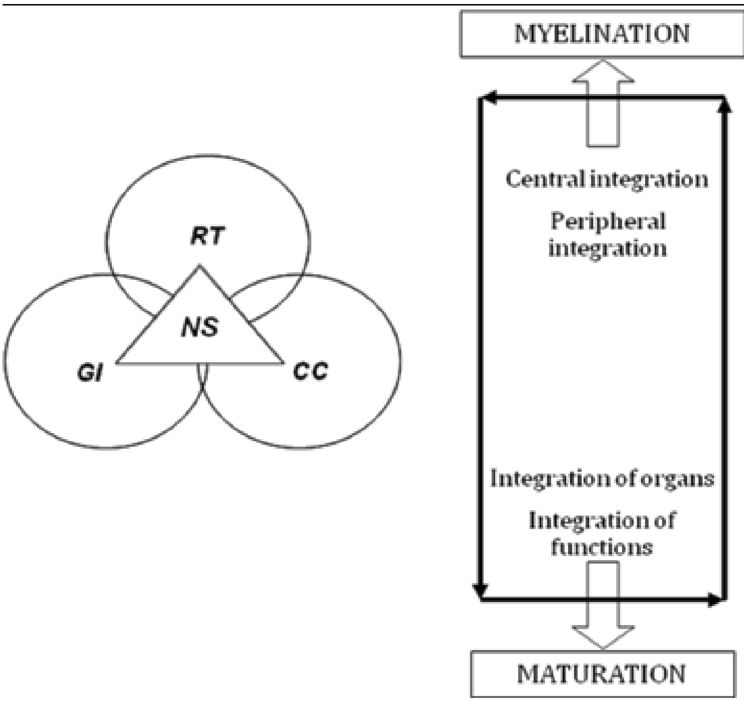
4. Physiopathological premises

The cultural problem that has created such a gap between child and adult dysphagia is represented by the fact that the swallowing act evolves into a continuum that already starts during intrauterine development and continues throughout the lifespan. The passage between these two conditions, therefore, is slow, but the differences between child and adult swallowing and pathophysiological conditions of one and the other make the two realities very different to each other and not comparable. An adequate approach to childhood dysphagia implies, inevitably, a reminder of the pathophysiological aspects, with a short premise that a swallowing act has, in the child, a predominantly nourishing component and a protective action on the lower respiratory tract.

It all rests on the close relationship that exists, even in an evolutionary sense, between structure and function. If an organ evolves (morphologically and topographically), the functions it performs also have to adapt to this evolution. If the functions that the organs perform are vital functions (breathing and swallowing—aimed at nutrition), is it possible that the importance of such functions conditions the structure?

So what is the role of external events, for example, environmental, which are able to affect the relationship between shape and function? These considerations would lead us away from the topic of our chapter. Going back to the initial topic, it must surely be said that the swallowing act, as a complex and integrated neuromotor event, begins "in utero" [5, 6]. The possibility of developing swallowing acts precociously affects the close relationship that exists between the digestive, respiratory, and cardiocirculatory apparatus in the embryo and fetus. Very early on, these apparatus make connections with neural structures, which are themselves evolving and beginning their myelination. All such structures are immersed in a liquid environment, circumscribed by the wall of the uterus. The containment cavity and growing structures are affected by the relationships with the nervous structures: such relationships involve a delicate balance between growth and maturation, which takes place at the organ and apparatus level. So the central and peripheral integration among neural structures is perfected in parallel to the integration with the organs-apparatus integration and the functions they carry out (**Table 3**).

Pharyngeal swallowing appears between 10 and 12 weeks of gestation and a complete suckling appears in the 18–24th weeks: it is between the 34th and 36th weeks that the fetus produces efficient swallowing, able to contribute to volume adjustment of the amniotic fluid. This swallowing activity is also essential to the development of the gastrointestinal apparatus and of the fetus itself [6, 7]. However, after birth, maturation structures and functions do not guarantee an adequate oral feeding, suggesting that extrinsic factors, related to the learning of external inputs, have a significant role in this maturation [8]. This optimization of the organs



NS: nervous system; RS: respiratory system, GI: gastrointestinal tract; CC: cardiocirculatory tract.

Table 3. Organ-function integration between center and periphery.

http://dx.doi.org/10.5772/intechopen.69921

acquires the connotations of their real development toward an efficient and safe swallowing. Such enabling requires a long time: a child develops motor patterns similar to adults, only during adolescence. This underlines the complexity of this function, which, throughout life, is enriched with more and more complex socializing and cultural meanings. The concept of feeding, as an element intimately connected with swallowing, is established very early on. This concept is linked to the set of functions that are linked to oral structures: first of all, neuromotor skills [2] and also communication and social functions, as previously mentioned. As strictly regards feeding, it provides an increasingly sophisticated enabling of the oral structures, which allows the management, in the oral cavity, of increasingly more diversified boluses, in terms of consistency, volume, temperature, viscosity, and elasticity. The feeding activities allow a perfect conformation of the oral cavity to the anatomical adaptations that involve the head and neck fully during growth [9]. These same anatomical adaptations also involve the pharynx, so the interaction between feeding and swallowing, and more properly the interaction between the oral and pharyngeal phase of swallowing, becomes more and more intimate and functional. This adaptation is aimed at creating a neuromotor act that has to be effective (protective of the lower respiratory tract), efficient (complete transport of volumes), and functional (supporting of hydration and nourishment), while maintaining its own individual character and social pleasure. **Table 4** summarizes the oromotor abilities required by a small child (before 2 years) as a function of the consistencies managed [10]. In such a rapidly evolving system, the development of oral motor skills assumes great importance. These skills are being developed within a system that is changing quickly in both the structural and neuromotor sense: this occurs rapidly within the first 3 years of life [5, 10]. During this period, children are engaged in a great variety of oral experiences, sometimes oriented to satisfying

Months	Progression of foods and fluids	Oromotor abilities	Gross motor abilities
0–4	Liquid	Sucking the nipple	Head control
4–6	Purèe	Sucking from spoon	Sitting position, hands forward
6–9	Purèe, soft solid	Drink from glass, vertical mastication (reduced lateral movements)	Hands to the mouth, pincer hands, begins to hold the spoon, and begins to eat with hands
9–12	Ground, coarse purèe	Drink from glass independently	Refined pincer hands and eating with hands
12–18	All consistencies	Tongue lateral movements, drinking from a straw	Greater autonomy at meals, discovering foods and bringing to the mouth
18–24	Research of chewable foods	Lateral chewing	
>24	Harder solids	more mature chewing	Autonomous, manages utensils and glasses without spilling

Table 4. Neuromotor skills and oral management of the bolus within 2 years of age.

their basic nutritional need: this need is associated with the exploration of the surrounding environment, which should always be comfortable and rewarding. From a clinical point of view, a problem exists when a child is "locked" into a specific feeding schedule, when it is anchored to a feeding scheme beyond which they cannot progress. As the oral motor skills represent a sequential progression of increasingly complex skills, any interruption in this progression can limit their development and cause the loss of previously acquired skills [11].

5. Stages of oromotor development

At birth, a child needs to be able to breathe on its own and to feed safely. This implies, as already mentioned, a perfect cooperation of the swallowing effectors, which reflects a state of optimal health (relating to the development of the respiratory, gastrointestinal, and cardiovascular apparatus), optimal nervous integration, and optimal mother-child relationship.

From the anatomo-functional perspective and aimed at sucking activity, it should be remembered that the child, toothless at birth, has a high larynx (at the height of the first two cervical vertebrae), and a high respiratory rate (70–80/min, with minimal thoracic movements) but mostly a large tongue inside a relatively small mouth. Swallowing of milk occurs with a suckling neuromotor pattern, characterized by in-out tongue movements, facilitated by an opening-closing movement of the mandible, miming a squeezing act. During this activity, the face musculature, mainly the lip muscles, is kept hypotonic and the iolaryngeal axis is high and immobile. Swallowing triggers from the valleculae, and the pharyngeal passage is realized with a suction/swallowing ratio equal to 1. **Table 5** summarizes these events in the light of an overall maturation of the child [12–14]. It should be remembered that, at this

Months	Motor activity	Feeding activities	Jaw	Tongue	Lips
0–1	Reflex movements of limbs Raises the head	Sucking of finger (if approached to the mouth)	Phasic bite	Tongue = jaw	Mimic muscles silent
1–2	Circular movements of limbs Raises the head	Hands to the mouth (if lying down)	Phasic bite	Tongue at rest Tongue besides gums	Lip synchronous with other facial muscles
3–5	Trunk control Head control Sitting position	Head-trunk control Objects to the mouth	Phasic bite Stable jaw (head control)	Movements of tip-body-base Gag from mid-third of the tongue Inhibition lingual movements	Development of facial muscles lips control separate lips movements Lips-cheek activities

Table 5. Neuromotor patterns and effectors: sucking.

http://dx.doi.org/10.5772/intechopen.69921

time, swallowing is purely reflex, relegated to the activity of the bulbar swallowing center. At weaning, anatomical changes allow the realization of new swallowing patterns. The tongue tends to flatten out and acquires the ability to perform up/down movements between the mandible and the hard palate. Lips acquire tone to achieve a greater attachment to the nipple. The laryngeal lowering allows the volumetric increase of the pharynx and the realization of a negative pressure inside the mouth. The child is now able to move a greater volume of liquids, reaching a sucking/swallowing ratio superior to 1. These events become possible due to a progressive disappearance of oral reflexes. Swallowing triggers from the valleculae, as above, but the increased flow and the lower position of the larynx can facilitate episodes of penetration. **Table 6** summarizes these events [12]. The myelination of subcortical and

Months	Motor activity	Feeding activities	Jaw	Tongue	Lips
6–9	Sits and turns Objects from hand to hand Manipulates objects Explores with indexes He/she gets up briefly	Sucking of finger (if approached to the mouth) Independent movements of tongue/jaw (trunk control) He/she holds bottle	Phasic bite abolished Stabilized mandible Lateral movements	Up-down movements Gag reduced Perceived consistency (bolus crush) Lateralizes the bolus	Lower lip stabilizer active Use of perioral muscles Bolus between molars: use of the lips and cheeks
10–12	Crawling Gets up Upright position	Fine motor skills development	Controlled pressure of soft foods Opening/closing controlled Circular-rotary movements	Use of all intrinsic tongue muscles (various shapes) All moving angles Combination of movements	Active lips/cheeks used to manage soft foods Contracts lower lip: clearing from teeth and gums Occasional packeting/drooling Rare drooling
13–24	Fast walking Jumps with 2 feet Walking on tiptoe Draws closed forms Makes puzzles	Head-trunk control Objects to the mouth	Circular-rotary movements No turning of head to bite (most mandibular control)	Consistence modifies lingual movements Tongue on right and left Tongue clears the mouth Tongue/mandible: independent movements (12–24) Lips licking (18–20)	Maintaining lip prehension during lingual and mandibular movements

Table 6. Neuromotor pattern and effectors: weaning.

subsequently cortical structures, as previously mentioned, interfere with the bulbar centers (neuromotor control): now swallowing becomes an automatic act, submitted to the sensorial afferents coming from the periphery, mainly from the oral cavity. The growth of orofacial structures allows for more and more precise and refined neuromotor patterns enabling the development of oral skills and the ability to manage boluses of different volume and consistency [15]. **Table 7** summarizes these anatomical variations in young children up to 2 years old and older than 6 years. Between 2 and 6 years of age, swallowing mainly reaches the optimization of the oral activities and the stabilization of the pharyngeal phase. Even the anticipatory phase of swallowing tends to stabilize in this age group. As regards chewing, this activity is enriched by movements of laterality and circularity of the tongue and mandible, with transport of the bolus in the molar region and the beginning of trituration of harder and harder consistencies. The duration and number of masticatory cycles, as well as their efficiency in terms of strength, precision, and coordination, develop progressively. From 6 to 12 years, chewing is further perfected. A reduction in the number and duration of the chewing cycles occurs with a strengthening of the propulsive phase, due to the strengthening of the masticatory muscles. In the meantime, the tone of mentalis and orbicularis muscles decreases. Also in this phase the exposure to different consistencies and volumes is a powerful stimulus to the optimal use of swallowing effectors, all activities that, in the nervous system, are supported by mechanisms of neuronal sprouting (brain plasticity). The correct knowledge of these events and of the time frames mentioned earlier underlies the correct assessment of children with swallowing disorders. The failure to achieve abilities, chronologically expected in an age band, will surely negatively compromise the achievement of further abilities.

	Younger child	**Older child**
Oral cavity	Tongue fills the mouth	Tongue lies on the floor of mouth
	Edentulia	Primary teeth
	Tongue at rest between the lips and against the palate	Tongue behind your teeth and not against the palate
	Cheeks rich in fat	Chewing using buccinator muscles
	Small jaw	Relationship between jaws almost normal
	Sulci important during sucking	Sulci less important during sucking
Pharynx	Oropharynx not well defined	Lengthening of the pharynx with oropharynx defined
	Skull base with obtuse angle to the nasopharynx	Skull base with right angle
Larynx	1/3 of the adult	
	1/2 glottis cartilaginous	1/3 glottis cartilaginous
	Epiglottis vertical and narrow	Epiglottis wider and flattened

Table 7. Growth of structures in the younger and older child.

6. Signs and symptoms

It has previously been said that the alterations of the oromotor development, in one or more associations summarized in **Table 3**, result in an arrest in the development of the child's feeding skills, with the possibility of losing skills already acquired. Dysphagia, which is not properly diagnosed, can result in multiple clinical signs, in various combinations.

First, it can determine weight loss and a failure to thrive so as to require a parenteral or enteral nutritional support. Dehydration, respiratory complications or aspiration pneumonia, food adversion, and rumination (i.e., involuntary regurgitation of undigested food that can be chewed and re-swallowed) are other possible signs of dysphagia.

From these assumptions, the major requests for phoniatric-logopedic evaluation of children with swallowing disorders are derived. Most commonly, children refuse some consistencies or have a difficult approach to meals, with little interest in eating. All these conditions may reflect alterations in the physiology of swallowing such as a slow gastric motility or constipation. A child who refuses new consistencies may suffer from gastroesophageal reflux and other gastrointestinal disorders. A gastroesophageal reflux can cause pain during or after the meal, which children associate with feeding.

This can impede feeding and cause severe behavioral problems that make it difficult, if not impossible, for the parents to feed the baby adequately. As mentioned earlier, a limited taste experience related to oral intake may affect inadequacies in the oral sensorimotor development. Parents can also signal that the child does not show a sense of hunger but rather shows a sense of aversion or avoidance to sensory stimulation, making meal times a real struggle. Every child is different and these conditions may be present in various combinations [16]. **Table 8** summarizes some of the main conditions which lead to a request of consultation. The

Incoordination between sucking and swallowing (shockable rhythm)
Weak feeding
Alterations in breathing or apnea during the meal
Gagging excessive or frequent coughing during the meal
Occurrence of difficulties in supply
Diagnoses associated with dysphagia, malnutrition, or craniofacial anomalies
Shutdown/reduction in body weight gain from 2 to 3 months (malnutrition)
Marked irritability during the meal
History of respiratory diseases and feeding difficulties
Lethargy during the meal
Feeding time more than 30–40 min
Unexplained refusal of food and malnutrition (failure to thrive)
Drooling that persists beyond 5 years
Nasal regurgitation during the meal
Delay in the maturation and development of food habits

Table 8. Sending criteria to phoniatric-logopedic assessment.

table shows conditions referring to a variety of swallowing disorders, some mentioned in the section on etiology. It is obvious that if the baby is born with a craniofacial malformation, the oral and/or pharyngeal phase of swallowing will consequently result as compromised.

7. The bedside evaluation (non-instrumental clinical evaluation)

The clinical approach to children with swallowing disorders does not differ substantially from the approach to other pathological conditions. In children, as in adults, it has to be borne in mind that dysphagia is a symptom, underlying one or more morbid or comorbid conditions. The approach to children is complicated by the inability of the young patients to directly express their discomfort and this is often mediated by caregivers.

To summarize, possible goals of the non-instrumental clinical evaluation are as follows: to identify the possible etiology of dysphagia, to formulate hypotheses about its nature and severity, to estimate functions and their integration (sensory-motor skills and breathing), to induce therapeutic modifications, to investigate safe food options for the child and to raise awareness among family members, to indicate the best instrumental evaluation, and to identify the possibilities of and the patient's ability to cooperate in medical examinations.

Therefore, the clinical approach to children with swallowing disorders is influenced by the age of the child, the main pathology, and the comorbidities. The importance of age has already been emphasized: depending on their age, the children should have specific oromotor skills and there is the gradual disappearance of reflex activities. **Table 9** summarizes the main steps of the non-instrumental clinical evaluation.

In clinical practice, the absence of standardized assessment protocols is a serious concern: the literature offers us different protocols (**Table 10**) [17–22] but their application is not always standardized and verified by an instrumental gold standard. This lack of tools interferes with the collection of information and the comparison of the skills of the young patients.

The non-instrumental clinical evaluation has to provide the proposal of foods in different volumes and consistencies, depending on the age of the child. It will occur with specific modalities depending on whether the child is fed (**Table 11**) or not fed orally [nill per os (NPO)] (**Table 12**).

In children with tracheotomy, non-instrumental evaluation will be conducted in the same way as in children with an intact airway considering that, in children, few data are available about the impact of tracheotomy on swallowing abilities. When possible, the tests with bolus are performed verifying the presence of bolus traces or blue-dyed water in the airway. The use of speaking valves has to be encouraged, allowing phonation, increasing laryngeal reflexivity with a better lower airway protection, and clearing secretions. The use of speaking valves reduces mechanical ventilation dependence time and stay in NICU, and accelerates decannulation and recovery of oral feeding.

http://dx.doi.org/10.5772/intechopen.69921

At the end of the non-instrumental clinical evaluation, with respect to what has been previously reported, it is necessary to identify those children for whom a referral for an instrumental clinical evaluation is worthwhile. **Table 13** summarizes the assessment process up to this point.

Clinical history • Prenatal infections, medications, drugs • Delivery (Apgar) • Peri/neonatal (dietary history)	• Beginning and description of the disorders • Other medical or nutritional disorders • Prolonged hospitalization or surgery • Age of acquisition of food mode • Supply adequacy and behavior at meal		
General observation: • Facies • Muscle tone • Vestibule and the oral cavity • Jaw mobility • Veil mobility • Chest and breathing • Neuropsychological development • Postures and positions	Anatomy • Abnormalities • Malformations • Deformity	Reflexes • Swallowing • Gag • Rooting • Cough • Mouth opening • Tongue lateralization • Biting • Babkin	Behaviour • Postural control of the body • Oral postural control • Voice • Oral praxis and blow
Observation during the meal	• Alert • Activity level: quiet, active, weeping • Receptivity to food		
Swallowing osbervation: • Respiratory signs (cough, apnea, desaturation) • Gurgling voice • Other: bradycardia, pallor, sweating	NPO child • From 1 to 3 ml of liquid • From 1 to 3 ml semi-solid		PO child • Teat: usual liquid bolus • Spoon: viscous semi-solid, dense and grainy, soft solids • Fingers: solid chewable • Spoon: soft solids, soft complex solid, hard solid and dense liquids • Cup: liquid and thickened liquids

Table 9. Steps of non-instrumental clinical evaluation (bedside evaluation).

Neonatal oral motor assessment Scale (NOMAS) (Palmer et al [17]) (Breast feeding/Bottle feeding)
Systematic assessment of the infant at the breast (SAIB) (Association of Women's Health, Obstetric and Neonatal nurses, 1990)
Preterm infant breast-feeding behavior scale (PIBBS) (Nyqvist et al. [19])
Breast feeding evaluation (Tobin [20]) (term infants)
Feeding flow sheet (Vandenberg [21]) (bottle feeding)
Infant feeding evaluation (Swigert [22])

Table 10. Main bedside protocols of evaluation.

- Place the baby in an optimal way to elicit swallowing and coordination:
  - Semi-reclined
- 3–4 months
- After weaning
- Difficulties in oral transport
- Neurological disorders (difficulty with boluses by spoon)
- Seat supporting the head (preferred)
- Behavior during the meal: failure, drowsiness, avoidance or refusal of food, food preferences
- Evaluate praxis with:
  - Teats or tools
  - Bolus: volume, consistency, order of presentation

Table 11. Bedside evaluation and test with bolus in orally fed child (PO).

- Breathing and eating disorders not related to oral intake of foods
- In case of correlation instrumental evaluation (airway protection)
- Clinical judgment on the possibility of oral feeding
- Pooling:
  - Impaired early oral or pharyngeal phase: stop the test
  - Impaired oral preparation:1 cc of liquid back in the mouth (pipette)
  - Adequate oral preparation: bolus to the lips or with a spoon
- Tests: very small bolus (1–3 ml) via pipette or teat
- Proceed to check the appearance of respiratory signs.

Table 12. Bedside evaluation and test with bolus in non-orally fed child (NPO).

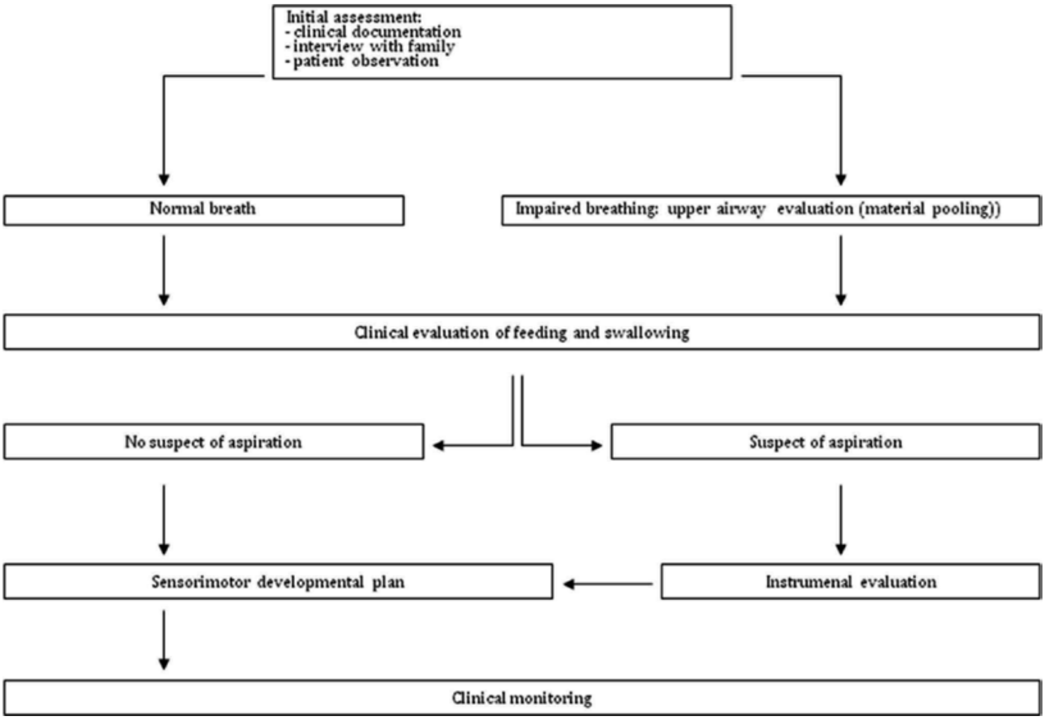


Table 13. Evaluation process: synthesis.

8. The instrumental clinical evaluation

The two main instrumental tools for assessing swallowing in children, as in adults, are represented by the dynamic radiological and the dynamic endoscopic evaluations, respectively, known with the Anglo-Saxon acronyms of VFSS (videofluoroscopic swallowing study) [23] and FEES (fiberoptic endoscopic evaluation of swallowing) [24]. These procedures evaluate the behavior of swallowing effectors during the passage of the bolus, which implies that the child, who is a candidate for such procedures, can be fed orally [25]. During the procedure, the clinician can rely on monitoring the heart activity, breathing, and O_2 saturation, in order to obtain additional information about physical or behavioral changes associated with the swallowing disorder. Similarly, the colorimetric variations of the skin (pallor or cyanosis), nasal regurgitation, and alterations of sucking-swallowing/breathing rhythm may be considered.

Broadly, the instrumental evaluation, compared to the bedside evaluation, has the advantages shown in **Table 14**. It is worth remembering that with regard to the information they provide, FEES and VFSS are not equivalent but complementary. The clinician chooses the procedure most appropriate in relation to the characteristics of the young patient or to the information being sought, in the awareness that the two procedures have both advantages and disadvantages [26] (**Table 15**).

• Display of upper aerodigestive tract (oral cavity, velopharyngeal sphincter, pharynx, larynx, and cervical esophagus) • Evaluate muscular activities (symmetry, force, pressure, tone, range and degree of motion, coordination, and speed) • Evaluate sensation • Evaluate aspiration and cough • Evaluate residue in hypopharynx and larynx • Evaluate the esophageal etiology of dysphagia • Evaluate the safest and most efficient way of nutrition and hydration • Evaluate the efficient protection of postures and maneuvers

Table 14. Advantages of the instrumental clinical evaluation compared to the clinical non-instrumental evaluation.

	Advantages	Disadvantages
FEES	Less invasive Easy to perform Well tolerated Possible for a long time (fatigue viewing) Portable (acute and sub-acute patients) Routine Economic Therapeutic feedback Decision making of oral feeding Natural foods Direct visualization of structures Motor and sensory activities Three-dimensional similar view Optimal pooling evaluation Pooling management viewing	Pharyngeal phase only White-out Indirect consideration about • Oral • Esophageal phase Fear and discomfort Poor vision in repeated swallowing acts Not possible if changes in upper airway
VFSS	Whole deglutition evaluation Time parameterization	Invasive (radiological exposure) Uncomfortable execution Environment and suitable personnel Expensive Bi-dimensional view (under estimation of pooling matter) Motor activity only (reaction to aspiration, if documented) Fatigue evaluation missing

Table 15. Advantage and disadvantage comparison between VFSS and FEES.

http://dx.doi.org/10.5772/intechopen.69921

8.1. VFSS

It is a procedure that uses ionizing radiation and should be used sparingly, especially in very young children. When indicated, the tool verifies the actual usefulness in improving the safety and efficacy of the swallowing act, under different examination conditions: varying the consistency or the viscosity of the bolus, verifying the clearing of the mouth, pharynx, or esophagus; varying the position of the child, implementing postures or maneuvers (when possible); varying the speed of feeding, child position, and changing pacifier or spoon characteristics [27, 28].

8.2. FEES

When performing an endoscopy, the possibility of achieving the maximum collaboration of the child is crucial. Any device useful for making the child and its parents less anxious and for increasing compliance has to be adopted. The family is asked to bring pacifiers, bottles, or utensils commonly used during meals and also to bring the dishes commonly eaten by the child: either the most liked or those that create the greatest difficulties. The choice of endoscope size is based on the age of the child: obviously, the smaller the endoscope, the lower the imagine definition. With a child of over 3 years of age, it is possible to use standard size endoscopes (2.4 mm in diameter), with a younger age group smaller devices are advisable (1.5 mm diameter). To optimize cooperation and minimize discomfort, anesthetic spray puffs or a small amount of cotton, soaked in a 1:1 mixture of 4% lidocaine and oxymetazoline, can be introduced into the nasal cavity [29]. A viable alternative is to lubricate the tip of the endoscope with a 2% lidocaine gel. This is always desirable in patients with airway lability (very young children or of low weight) in compromised general conditions or with tracheotomy. For the endoscopic evaluation, the baby may be supine in a cot or a pram but for the dynamic study of swallowing he/she should preferably have the chest lifted: the baby can be held in the mother's arms or on her knees.

Older children can be seated in a high chair without any help. If the child tends to assume specific postures during the meal (due to a physical impairment, as in cerebral palsy) they will be maintained after the introduction of the endoscope and verified during the test. Similarly, the efficiency of therapeutic postures or maneuvers will be checked. The procedure substantially does not differ from that used for adults [30]: the static, anatomical, dynamic, and non-swallowing assessments are performed with the tip of the endoscope in the naso-nasopharyngeal, high, and low position. The tests with bolus are performed with the tip of the endoscope in the high position.

9. The anatomo-functional evaluation

In the *naso-rhinopharyngeal position*, the clinician will evaluate hypertrophy of the nasal mucosa and turbinate, secretions pooling, septal bumps and other anatomical anomalies, shrinkage or choanal atresia, hypertrophy of adenoid, and the upper surface of the soft palate. During phonation and deglutition, the contraction of the veil, if symmetrical, will be evaluated. While swallowing, a veil incompetence is always pathological and the cause of nasal regurgitation of secretions or bolus.

In the *high position* (beyond the free edge of the soft palate), the clinician evaluates the hypopharyngeal region: base of the tongue, tonsils, and the larynx position, considering that it descends gradually in the neck with age: from C1 to C4 from birth to puberty. Particular attention should be given to material pooling: if present at the beginning and during the evaluation. Its increase not followed by clearing is abnormal [31, 32]. The clearing of secretions is assessed during spontaneous swallowing acts or on request [26, 30]. Secretions that engulf the pyriform sinus must induce a swallow, even if the child cries.

In the *low position*, a careful assessment of the larynx is performed. Particular attention should be paid to abnormalities that may interfere with the sphincterial function: malacia, cleft, and cyst. Mobility is evaluated during respiration, phonation, or crying. Signs of reflux disease have to be evaluated: hyperemia, hypertrophy of the posterior commissure, circumscribed or diffused edema involving the vocal cords, and endolaryngeal secretions.

The delicate touch of the aryepiglottic folds with the tip of the endoscope activates the adduction reflex, mediated by the superior laryngeal nerve: the reflex is essential for an adequate protection of the lower airways during swallowing. For the same purpose, pulsed air can be used, supplied with variations of pulsing or of intensity [flexible endoscopic evaluation of swallowing with sensory testing (FEESST)] [33, 34]. In children who are noncooperative, who have cognitive disorders, or are very young, only the adduction reflex can be appreciated [34].

10. The test with bolus

After the anato-functional assessment and in relation to age, foods of different consistencies and volume will be proposed to the child. The foods preferably have a natural color or are dyed. The child is fed by its parents. It is always advisable to start with pleasing food, in order to increase the compliance to the test, then subsequently, as for adults, to use food which is more difficult to manage in the oral cavity [30, 35]. During the test with bolus, different parameters have to be considered.

The first parameter to evaluate is the *site* and *latency* of the swallowing reflex, in children this is more difficult to define in relation to the small size of the pharynx. Liquid bolus can hesitate in the valleculae before being swallowed, as a normal variant of the swallowing act. If the bolus falls by gravity into the pyriform sinuses before swallowing and remains in this site, the possibility of false route is greater. The delivery of the bolus from the oral cavity into the pharynx without swallowing is referred to as premature spillage. When milk is sucked from a bottle, it is collected up to the pyriform sinuses before being swallowed and only an appropriate rhythm, sucking-swallowing-breathing, prevents aspiration [28]. The datum, however, will be included and considered in the context of a complete clinical assessment.

The progression of the bolus into the laryngeal vestibule is called *penetration*, being possible up to the true vocal cords. Penetration is clearly evaluated using endoscopy [28, 30, 35]. When the valleculae are obliterated with lymphatic tissue, the bolus (in particular liquid) can spill over the free edge of the epiglottis before swallowing: in this case, the risk of penetration remains low. If the general conditions of the baby are serious, penetration can have the same significance as aspiration so, when performing tests, it would be better not to expose the patient to this risk.

Aspiration is the progression of secretions or bolus below the true vocal cords. In FEES, this event can occur before or after swallowing: they are events well evaluated in endoscopy [36]. Pre-swallowing aspiration can be due to a delayed triggering or a late laryngeal valve activation. Post-swallowing aspiration can be due to an overflowing from the pharyngeal containment cavities. At the highest point of swallowing, the white-out prevents the direct visualization of aspiration (intra-swallowing aspiration). In this case, aspiration can be inferred after swallowing, by evaluating residue of food in the larynx or cervical trachea or evaluating the expulsion of streaked secretions by coughing [28, 30, 35].

The evaluation of swallowing abilities with bolus can be quantified by the same test as is available in FEES. The progression of bolus through the upper airway can be quantified using the penetration-aspiration scale [37], and the presence of residue can be quantified with the pooling score (*p*-score) [32, 37] both applied with the same characteristics as seen for adults.

11. The treatment plan

The clinical non-instrumental and instrumental evaluations should enable the clinician and the rehabilitator to set up an ideal treatment plan for the child (**Table 13**).

In general, a treatment plan should (1) guarantee the child an adequate nutritional and water intake, (2) be protective of the respiratory tract, (3) support the child in eating and drinking, (4) guarantee the optimal oral sensory stimulation, (5) improve the QoL of the child and family, and (6) help the family in conceiving new therapeutic strategies [38–40].

All of these respecting the actual clinical condition (morbidity and comorbidities) inside the evolutive temporal windows are linked to age of the child. The treatment plan should also consider all the possible settings of a child's life: home, kindergarten, school, and leisure environments. The treatment plan must consider all the indications aimed at achieving the objectives mentioned earlier, by means of medical, surgical, and nutritional strategies. For example, if the child suffers a major reflux, he/she will be treated pharmacologically or surgically, to prevent the negative feedback that the reflux has on swallowing and feeding. Other general considerations, previously underlined, are the importance of ensuring the child the best sensory oral-pharyngeal stimulation and the best oromotor stimulation. Only in this way will the swallowing abilities of the baby progress through all the steps of a satisfactory development.

In planning treatment, the clinician has to consider if the children can be safely fed orally or not, and the general performance of the child during mealtimes. In practice, useful therapeutic strategies are represented by dietary modifications, such as the food being thickened, diluted, chopped, blended, mixed, and viscosity varied, depending on the functional age and disease of the baby. These changes must guarantee a nutritional and water intake able to ensure the growth of the child. Within the first year of life, the use of commercial thickeners should be limited. Sometimes, it could be advantageous to vary the bolus presentation with a break during the feed. With older children, the same effect is produced by varying consistencies. The same strategies should also be considered in tube-fed children (NGT or PEG/JPEG) when the possibility of assuming per os even a single consistency is verified.

The time windows in the physiological growth of the effectors, previously mentioned, should be considered and respected, as far as possible. The use of devices or adapted utensils has the purpose of fractioning the presentation of the bolus, in terms of volume and speed: with younger children, pacifiers in different shapes and with different holes can be used, while with older ones, utensils with modified handles are more appropriate [41, 42]. The use of maneuvers (forced swallowing, Mendelsohn, supraglottic, super-supraglottic, and Masako) changes the timing and strength of the swallowing act: their implementation requires that the child can learn them and be motivated for their execution. Relatively simpler is the use of postures, which can also be implemented passively, very small children can be held in the arms, or older children can be placed in adjustable seating [43]. The use of oromotor exercises [44] provides active or passive activities of the effectors, always without the use of foods. These exercises are aimed at optimizing the efficiency of the lips, jaw, tongue, soft palate, pharynx, larynx, and respiratory muscles. Sensory stimulations act on the swallowing reflex. These gustatory, thermal, or tactile stimulations can be applied on different effectors: cheeks, lips, and tongue. They are indicated for children with reduced responses or reduced opportunities for stimulation. At other times, it is possible to intervene on children who have an excessive response or aversion to stimulations: in this case, the treatment is expected to reduce the reflexivity of the child.

Author details

Daniele Farneti[1]* and Elisabetta Genovese[2]

*Address all correspondence to: lele.doc@libero.it

1 Audiology and Phoniatry Service, AUSL della Romagna, Infermi Hospital, Rimini, Italy

2 Audiology Service, University of Modena and Reggio Emilia, Policlinico Hospital of Modena, Italy

References

[1] Arvedson JC. Assessment of pediatric dysphagia and feeding disorders: Clinical and instrumental approaches. Developmental Disabilities Research Reviews. 2008;**14**:118-127

[2] Lefton-Greif M. Pediatric dysphagia. Physical Medicine and Rehabilitation Clinics of North America. 2008;**19**:837-851

[3] Kakodkar K, Schroeder JW. Pediatric dysphagia. Pediatric Clinics of North America. 2013;**60**:969-977

[4] Brackett K, Arvedson JC, Manno CJ. Pediatric feeding and swallowing disorders: General assessment and intervention. Perspectives on Swallowing and Swallowing Disorders (Dysphagia). 2006;**15**(3):10-14

[5] Bosma JF. Development of feeding. Clinical Nutrition. 1986;**5**:210-218

[6] Moore KL. The Developing Human: Clinically Oriented Embryology. 4th ed. Philadelphia (NJ): Saunders; 1988

[7] Grassi R, Farina R, Floriani I, et al. Assessment of fetal swallowing with gray-scale and color Doppler sonography. AJR: American Journal of Roentgenology. 2005;**185**:1322

[8] Bingham PM. Deprivation and dysphagia in premature infants. Journal of Child Neurology. 2009;**24**(6):743-749

[9] Buchholz DW, Bosma JF, Donner MW. Adaptation, compensation, and decompensation of the pharyngeal swallow. Gastrointestinal Radiology. 1985;**10**:235-239

[10] Arvedson JC, Lefton-Greif MA. Anatomy, physiology and development of feeding. Seminars in Speech and Language. 1996;**17**:261-268

[11] Mizuno K, Nishida Y, Taki M, Hibino S, Murase M, Sakurai M, Itabashi K. Infants with bronchopulmonary dysplasia suckle with weak pressures to maintain breathing during feeding. Pediatrics. 2007;**120**:1035-1042

[12] Miller AJ. Oral and pharyngeal reflexes in the mammalian nervous system: Their diverse range in complexity and the pivotal role of the tongue. Critical Reviews in Oral Biology & Medicine. 2002;**13**:409-425

[13] Green JR, Wilson EM. Spontaneous facial motility in infancy: A 3D kinematic analysis. Developmental Psychobiology. 2006;**48**(1):16-28

[14] Gibson EJ. Exploratory behavior in the development of perceiving, acting, and the acquiring of knowledge. Annual Review of Psychology. 1988;**39**:1-41

[15] Wilson EM, Green JR, Weismer G. A kinematic description of the temporal characteristics of jaw motion for early chewing: Preliminary findings. JSLHR: Journal of Speech, Language, and Hearing Research. 2012;**55**(2):626-638

[16] Piazza C, Dawson J. The failure to thrive: Pediatric feeding disorders. Paradigm. Fall 2000. pp. 8-9

[17] Palmer MM, Crawley K, et al. Neonatal Oral-Motor Assessment Scale: A reliability study. Journal of Perinatology. 1993;**13**(1):28-35

[18] Shrago LC, Bocar DL. The infant's contribution to breastfeeding. Journal of Obstetric, Gynecologic, & Neonatal Nursing. 1990;**19**:209-215

[19] Nyqvist KH, Rubertsson C, Ewald U, Sjödén PO. Development of the preterm infant breastfeeding behavior scale (PIBBS): A study of nurse-mother agreement. Journal of Human Lactation. 1996;**12**(3):207-219

[20] Tobin DL. A breastfeeding evaluation and education tool. Journal of Human Lactation. 1996;**12**(1):47-49

[21] Vandenberg KA. Behaviorally supportive care for the extremely premature infant. In: Gunderson L, Kenner C, editors. Care of the 24-25 Week Gestational Age Infant (Small Baby Protocol). San Francisco, CA: Neonatal Network; 1990. pp. 129-157

[22] Swigert N. The Source R for Pediatric Dysphagia. San Diego, CA: Singular; 1998

[23] Logemann JA. Evaluation and Treatment of Swallowing Disorders. Austin, Texas: Pro-Ed; 1983

[24] Langmore SE, Schatz K, Olsen N. Fiberoptic endoscopic examination of swallowing safety: A new procedure. Dysphagia. 1988;**2**:216-219

[25] Farneti D, Favero E. Valutazione videoendoscopica infantile, adulta e senile. In: Deglutologia. 2nd ed. Omega; 2010

[26] Farneti D. The Instrumental Gold Standard: FEES. Journal of Gastroenterology and Hepatology Research. 2014;**3**(10):1281-1291

[27] O'Donoghue S, Bagnall A. Videofluoroscopic evaluation in the assessment of swallowing disorders in pediatric and adult population. Folia Phoniatrica et Logopaedica. 1999;**51**:158-171

[28] Newman LA, Cleveland RH, Blickman JG, Hillman RE, Jaramillo D. Videofluoroscopic analysis of the infant swallow. Investigative Radiology. 1991;**26**:870-873

[29] Leder SB, Ross DA, Briskin KB, Sasaki CT. A prospective, double-blind, randomized study on the use of topical anesthetic, vasoconstrictor, and placebo during transnasal flexible fiberoptic endoscopy. Journal of Speech and Hearing Research. 1997;**40**:1352-1357

[30] Farneti D. La valutazione videoendoscopica. In: Schindler O, Ruoppolo G, Schindler A, editors. Deglutologia. Torino: Omega; 2001. pp. 167-188

[31] Murray J, Langmore SE, Ginsberg S, Dostie A. The significance of accumulated oropharyngeal secretions and swallowing frequency in predicting aspiration. Dysphagia. 1996;**11**:99-103

[32] Pooling score: An endoscopic model for evaluating severity of dysphagia. Acta Otorhinolaryngologica Italica. 2008;**28**:135-140

[33] Aviv JE, Martin JH, Debell M, Blitzer A. Air pulse quantification of supraglottic and pharyngeal sensation: A new technique. Annals of Otology, Rhinology, and Laryngology. 1993;**102**:777-780

[34] Link DT, Willging JP, Miller CK, Cotton RT, Rudolph CD. Pediatric laryngopharyngeal sensory testing during flexible endoscopic evaluation of swallowing: Feasible and correlative. Annals of Otology, Rhinology, and Laryngology. 2000;**109**(10):899-905

[35] Leder SB, Karas DE. Fiberoptic endoscopic evaluation of swallowing in the pediatric population. Laryngoscope. 2000;**110**(7):1132-1136

[36] Miller CK, Willging JP, Strife JL, Rudolph CD. Fiberoptic endoscopic examination of swallowing in infants and children with feeding disorders. Dysphagia. 1994;**9**:266

[37] Farneti D, Fattori B, Nacci A, Mancini V, Simonelli M, Ruoppolo G, Genovese E. The Pooling-score (P-score): Inter- and intra-rater reliability in endoscopic assessment of the severity of dysphagia. Acta Otorhinolaryngologica Italica. 2014;**34**(2):105-110

[38] Jadcherla SR, Peng J, Moore R, Saavedra J, Shepherd E, Fernandez S, Erdman SH, DiLorenzo C. Impact of personalized feeding program in 100 NICU infants: Pathophysiology-based approach for better outcomes. Journal of Pediatric Gastroenterology and Nutrition. 2012;**54**(1):62-70

[39] Jadcherla SR, Dail J, Malkar MB, et al. Impact of process optimization and quality improvement measures on neonatal feeding outcomes at an All-Referral Neonatal Intensive Care Unit. JPEN: Journal of Parenteral and Enteral Nutrition. 2016;**40**:646

[40] Fucile S, McFarland DH, Gisel KG, Lau C. Oral and non-oral sensorimotor interventions facilitate suck-swallow-respiration functions and their coordination in preterm infants. Early Human Development. 2012;**8**:345-350

[41] Ross ES. SOFFI: An evidence-based method for quality bottle-feedings of preterm, ill, and fragile infants. Journal of Perinatal and Neonatal Nursing. 2011;**25**(4):349-359

[42] Gosa M, Schooling T, Coleman J. Thickened liquids as a treatment for children with dysphagia and associated adverse effects: A systematic review. ICAN: Infant, Child, & Adolescent Nutrition. 2011;**3**(6):344-350

[43] Thoyre SM, Park J, Pados B, Hubbard C. Developing a co-regulated, cue-based feeding practice: The critical role of assessment and reflection. Journal of Neonatal Nursing. 2013;**19**:139-148

[44] Manno CJ, Fox C, Eicher PS, Kerwin MLE. Early oral-motor interventions for pediatric feeding problems: What, when and how. 2005;**3**:145-159

Reading Disorders and the Role of Speech-Language Pathologists

Ana Luiza Navas, Tais Ciboto and
Juliana Postigo Amorina Borges

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.70234

Abstract

Speech-language pathologists have been actively involved with the assessment and intervention processes of language disorders, especially concerning the child population. Regarding their professional role toward reading disorders, other professionals have been equally involved with the learning process such as educational psychologists, educators, for instance. It is therefore less clear of the involvement and possible role of speech-language pathologists, focused on adolescent and young adults with reading difficulties that may interfere with the learning processes. The aim of this chapter is to discuss the competences of speech-language pathologists and their essential role in the clinical settings with reading disorders, not only with children but also at later stages in the schooling process. Additionally, it will be discussed of the role of these professionals as a part of the school team in order to advice best practices of language-related learning processes, as well as to work with students who need special education adaptations, in all ages.

Keywords: reading disorders, language, intervention, assessment, speech-language pathology

1. Introduction

Reading disorders (RDs) are a major concern in school settings both, in early stages of literacy instruction and further years of schooling, and may probably be the major cause for referral to speech-language therapists for clinical intervention. There are many instances where the reading process may be impaired. A wide range of language disorders are reported to have an impact on reading and writing skills [6]. Furthermore, there is clear evidence both, from research and clinical practice that demonstrates that reading disabilities are language-based [11].

Language deficits associated with reading disabilities are often present since preschool years, and therefore these deficits should be taken as early indicators of risk for reading disabilities [20]. These language deficits are manifested in poor vocabulary, lack of phonological skills both, in perception and production, poor morphology and other abilities proven to be essential for spelling and reading. However, not only in early years of schooling, language disorders may affect writing skills. Reading comprehension deficits in adolescents are strongly related to their word reading skills and lexical and syntactic development [24].

Furthermore, because of the reading and writing complexity, many other primary conditions such as intellectual, auditory, and visual deficits do influence how written language develops and students with these deficits need special attention to this process [35].

In children with the diagnosis of attention deficit and hyperactive disorder (ADHD), reading and writing difficulties are commonly found. Lack of attention has a strong impact in memory skills and in the process of spelling and reading comprehension, which in turn, limits all learning process via written input [1, 22]. The diagnostic of specific language impairment (SLI); there is an asynchrony on the development of linguistic subsystems in such a way that the deviant deficits will have consequences for the development of written language [36].

Finally, reading disorders are the primarily deficit found in the most frequent specific learning disorder, for example, dyslexia. Dyslexia is a neurodevelopmental disorder with a strong genetic predisposition, characterized by specific difficulties in reading and spelling that could not be attributable to cognitive disabilities, lack of educational opportunities, socio-cultural environment, or obvious neurological deficits, as defined by the diagnostic and statistical manual of mental disorders (DSM-V) [4]. It affects around 5% of the population regardless of the writing system and orthographic profile [28].

The main signs of children with dyslexia are identified in word decoding and phonological processing abilities and the diagnosis is possible after at least one school year. Another important aspect of dyslexia and other specific learning disabilities is its pervasive and persistent nature [13]. There is to say, that even though the major impact of dyslexia is in the initial phase of reading acquisition process, some difficulties may resist through adulthood [12].

Although SLI and dyslexia may show similar difficulties, both conditions are considered as different development disorders that have different cognitive and linguistics deficits, and consequently different manifestations in reading and writing [7].

According to Ref. [2], the speech-language pathologist is the professional who engages in clinical services, prevention, advocacy, education, administration, and research in the areas of communication and swallowing across the life span from infancy through geriatrics. The professional roles and activities in speech-language pathology include clinical/educational services (diagnosis, assessment, planning, and treatment), prevention and advocacy, and education, administration, and research. Speech-language therapy should address the underlying language deficits as well on the specific comprehension strategies.

Considering, that in all these instances that affect reading development, the participation of speech-language pathologists is essential, if not mandatory, we should describe clearly, what their role is as clinicians and as members of a multidisciplinary teams.

1.1. The role of speech-language pathology on prevention of reading disorders

Precursors of reading could be stimulated since early in development. Such activities should use emphasize language games, rimes and child music, storytelling, poetry, as well as shared book reading. In the school setting, the speech-language therapies may advise kindergarten teachers to work on children's attention for speech sounds and phonological representations [25].

The promotion of specific activities for the development of phonological awareness skills is effective even if implemented for a short duration [17]. Another study concluded that the stimulation of phonological awareness skills should be part of preschool activities since they are essential for later success in reading acquisition [27].

Because of the genetic basis for dyslexia, pre-reading children may receive early intervention to prevent severe manifestations in reading disorders later on. In an interesting prevention study, children at risk received a 14-week training in phonemic awareness and letter-sound relationships in the context of reading instruction. Families at home performed the training (e.g., a computer-based training). The results showed immediate improvements for both skills trained; however, the effects did not last for long. The authors concluded that in order to promote long-term benefits, the training activities should be delivered both at home and school [29].

The speech-language pathologist has an important role throughout the entire process of school learning, not only when the developmental disorder is already in place. Children at risk for reading disorders should be a major concern of speech-language therapists in order to create favorable conditions for improving language skills and cognitive abilities, consequently an adequate school performance [33, 34].

1.2. The role of speech-language pathology on the assessment and identification of reading disorders

Several skills have to be well developed in order to warrant success in reading and writing. As mentioned before, oral language development is essential for learning to read and all levels of language processing are involved; for example, phonology, morphology, syntax, semantics, and pragmatics [10, 31]. Assessment for reading disorders should include as well cognitive functions such as memory and attention tasks [3].

Phonological processing skills are found to be the most relevant, at least for the early stages of decoding, and among other skills, phonological awareness is an essential ability for reading and spelling. There is enough evidence in the literature that phonological awareness skills are positively related to a good performance in reading [6]. When phonological awareness shows some deficits, reading and writing may fail, regardless of the writing system to which the child is exposed (alphabetic, syllabic, or ideographic writing system). However, some studies showed that the consistency of each alphabetic orthography (e.g., regularity of the phoneme-grapheme correspondences) may determine which level of reading and writing is most affected by poor phonological awareness skills [14].

For all these reasons, it is important to evaluate these skills adequately since poor phonological awareness is considered a good indicator of reading disorders [25]. In order to have a proper assessment of phonological processing skills, the clinician must have good knowledge of the phonemic/phonological level of language to be able to choose an efficient linguistic-based instrument for assessment, as well, to be able to interpret the results [8].

Comprehension difficulties are also largely dependent on the development of language skills, specially vocabulary, morphology, and pragmatics [9]. Even if a child has resolved his or her oral language deficits, it is possible that whenever the complexity of reading material increases, comprehension fails. Speech-language assessment should investigate not only basic language skills, but also higher level language knowledge that is used for a more complex task of reading comprehension.

Depending on the country, professional education of health and education practitioners has very limited language-related disciplines, on their professional training years. However, that is not the case for speech-language therapist training career. The Revised International Association of Logopedics and Phoniatrics (IALP) Education Guidelines [15] states that "*the study of Logopedics is highly dependent (or reliant) on supporting disciplines of psychology and linguistics, behavioral sciences and biomedical sciences. The programme should cover the main context of supporting disciplines*" [15]. Among these disciplines, linguistics is fundamental for speech-language professional training, as the document affirms:

> "*Language acquisition, sociolinguistics, multilingualism, phonetics, acoustics are relevant to linguistic sciences. The study should include the production and classification of speech sounds, phonology, syntax, semantics, lexicons, discourse and pragmatics, with practical work in data collection, transcription, measurement and analysis (including qualitative analysis of oral as well as written language. It should also include discourse analysis, especially in relation to disordered speech and language)*" ([15], p. 4).

In Brazil and in many other countries, the speech-language pathologist is also part of the multidisciplinary team that is required for a correct diagnosis of specific learning disability such as dyslexia and many other neurodevelopmental disorders that have impact on reading and writing.

1.3. The role of speech-language pathology on the intervention of reading disorders

Clinical interventions of reading disorders by speech-language therapists are highly recommended by scientific-based evidence [11]. Intervention should encompass decoding and coding at the word level to improve reading and spelling accuracy, fluency and prosody, as well text comprehension and writing [32].

Once a diagnosis of specific learning disorder, dyslexia, is established, proper instruction and intervention should be offered by a team that includes educators, educational psychologists, and speech-language therapists. *The National Joint Committee on Learning Disabilities* [23] has published some guidelines for an intervention program for children and adolescents with reading disorders related to learning disabilities based on a specially designed instruction, core instruction and interventions within a multi-tiered system of supports (MTSS) for educators developing, improving, and maintaining systems of support for all students.

As described in these guidelines, "*intensive intervention should be implemented by general education teachers, special educators, school based team members and professional support staff who have deep content knowledge and expertise implementing the evidence based interventions*" ([23], p. 9).

1.4. The role of speech-language pathology on the educational advice for learning strategies for reading disorders

Public policies on special education needs have large benefit from multidisciplinary discussions and speech-language pathologist is a professional that has been very active in advocacy for better policies for learning disabilities and other communication disorders. Several countries have specific legislation that warrant specialized support and accommodations in schools or universities for those neurodevelopmental disorders. Such strategies may include (a) allowing audio recording the class content for later transcription, (b) restricting to minimum the amount of written material in slides, and (c) providing extra time for exams [18].

Adolescents with specific learning disorder, and/or attention-deficit/hyperactivity disorder may also experience significant struggles during high school and postsecondary education [21]. Even if they have had effective interventions and treatment, it is in the academic setting that the difficulties appear more intensively and they may seldom need support [26, 30].

An interesting study in Finland reported that environmental protective factors such as high levels of peer acceptance and positive teacher affect, uniquely predicted students' improved reading fluency in Grade 4, after controlling for the risk to have reading disorders, nonverbal ability, level of parental education, and gender [19]. This evidence confirms once more the need for teacher training to support learning disabilities children through schooling. Several specialists but specially speech-language pathologists are prepared to advise school teachers and families on strategies to promote effective learning for children, adolescents, and adults with specific learning disorders, for example, dyslexia.

Some studies that aimed at characterizing dyslexia in adults show that cognitive and linguistics deficits persist in adulthood, however they have different manifestations [5]. The most commonly altered components of reading skills in adults with dyslexia are reading fluency and reading accuracy [13]. Considering these specific characteristics in adults, a reading specialist should participate in the counseling for intervention and adaptations during high school and continuing education.

According to the "*Guide for school and universities about students with dyslexia and other learning disorders*" [16], the accommodations for dyslexics in school in Brazil may be divided in five categories: allow extra time for exams and note taking, tasks development, context, answers, content presentation. It is up to the specialist (e.g., speech-language therapist) to analyze the linguistic and cognitive profile and after that, to propose accommodations, which may have a greater impact for the moment.

The accommodation related to time, is of great importance for these individuals since activities of reading and writing demands a greater cognitive demand, and in consequence, takes considerably more time to accomplish. Additionally, there might be a need for a greater number of revisions before handling in an exam or paper. Therefore, suggestion of extra time not only should be applied for evaluations and exams, but also for deadline for papers and projects, and borrowing books from the library.

Regarding school activities, some adjustments during class like recording the class content and avoiding activities that require copying, should improve the potential for learning. It is also possible to suggest some accommodations in relation to the answers given by the students in all school activities. These individuals with reading and writing difficulties should be able to choose to give oral answers instead of by written form. In some cases, when the speech-language pathologists indicate a low rate for writing, a scribe could be requested to register the answers in and exam.

Finally, adjusting the form and organization of content presentation is a very important accommodation for students with learning disabilities. Regarding the format, audio books, videos, oral instructions, written materials with larger letters, smaller amount of text per page, and visual facilitators (drawings, diagrams, and different colors) can be offered. Regarding the organization, it is suggested to show clearly the objective and new concepts of each class, providing the student with a summary of the main ideas at the end of the lesson. Avoid very long phrases and instructions. Fragmenting tasks into smaller parts, encourage content review. In sum, the speech-language pathologist may help to establish a program of multisensory strategies that involve hearing, vision, and action.

1.5. Concluding remarks

Advances in psycholinguistics, cognitive psychology, and neurosciences have provided enough scientific evidence for the role of language skills for the development of reading and writing. It is therefore only natural that the speech-language therapists be an essential part for prevention, assessment, and intervention of reading disorders.

Author details

Ana Luiza Navas[1]*, Tais Ciboto[2] and Juliana Postigo Amorina Borges[3]

*Address all correspondence to: analunavas@gmail.com

1 Faculdade de Ciências Médicas da Santa Casa de São Paulo, São Paulo, Brazil

2 Faculdade Metropolitana Unidas, São Paulo, Brazil

3 Instituto ABCD, São Paulo, Brazil

References

[1] Alves DC, Casella EB, Ferraro AA. Spelling performance of students with developmental dyslexia and with developmental dyslexia associated to attention deficit disorder and hyperactivity. CoDAS. 2016;**28**(2):123-131. https://dx.doi.org/10.1590/2317-1782/20162015068

[2] ASHA: American Speech-Language-Hearing Association. Scope of Practice in Speech-Language Pathology [Scope of Practice]. 2007. Available from: www.asha.org/policy

[3] Andrade MJ, Carvalho MC, Alves RJR, Ciasca SM. Desempenho de escolares em testes de atenção e funções executivas: estudo comparativo. Revista Psicopedagogia. 2016;**33**(101):123-132.http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S0103-84862016000200002

[4] APA: American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). Arlington: American Psychiatric Publishing; 2013

[5] Callens M, Tops W, Brysbaert M (2012) Cognitive Profile of Students Who Enter Higher Education with an Indication of Dyslexia. PLoS ONE **7**(6): e38081

[6] Catts HW. The early identification of language-based reading disabilities. Language, Speech, and Hearing Services in Schools. 1997;**28**(1):86-89. DOI: 10.1044/0161-1461.2801.86

[7] Catts HW, Adlof SM, Hogan T, Weismer SE. Are specific language impairment and dyslexia distinct disorders? Journal of Speech, Language, and Hearing Research : JSLHR. 2005;**48**(6):1378-1396. http://doi.org/10.1044/1092-4388(2005/096)

[8] Cunningham AJ, Witton C, Talcott JB, Burgess AP, Shapiro LR. Deconstructing phonological tasks: The contribution of stimulus and response type to the prediction of early decoding skills. Cognition. 2015;**143**:178-186. DOI: https://doi.org/10.1016/j.cognition.2015.06.013

[9] Deacon SH, Kieffer MJ, Laroche A. The relation between morphological awareness and reading comprehension: Evidence from mediation and longitudinal models. Scientific Studies of Reading. 2014;**18**(6):432-451. DOI: http://dx.doi.org/10.1080/10888438.2014.926907

[10] Deacon SH, Tong X. Inesperados maus compreendedores: crianças com dificuldades de leitura muitas vezes não reconhecidas e profundamente impactantes. In: Maluf MR, Cardoso-Martins C. (Org.). Alfabetização no Século XXI: como se aprende a ler e a escrever. 1 ed. Porto Alegre: PENSO; 2013.

[11] Ebert KD, Scott CM. Bringing the simple view of reading to the clinic: Relationships between oral and written language skills in a clinical sample. Journal of Communication Disorders. 2016;**62**:147-160. DOI: https://doi.org/10.1016/j.jcomdis.2016.07.002

[12] Elbro C, Petersen DK. Long-term effects of phoneme awareness and letter sound training: An intervention study with children at risk for dyslexia. Journal Educational Psychology. 2004;**96**(4):660-670. DOI: 10.1037/0022-0663.96.4.660

[13] Everatt J. The abilities and disabilities associated with adult developmental dyslexia. Journal of Research in Reading. 1997;**20**(1):13-21. DOI: 10.1111/1467-9817.00016

[14] Goswami U, Ziegler JC, Richardson U. The effects of spelling consistency on phonological awareness: A comparison of English and German. Journal of Experimental Psychology. 2005;**92**:345-365

[15] IAPL: International Association of Logopedics and Phoniatrics. The Revised International Association of Logopedics and Phoniatrics (IALP) Education Guidelines; 2009. http://ialpasoc.info/sites/default/files/Revised%20IALP%20Guidelines%20for%20Initial%20Education%20of%20SLT.pdf

[16] Instituto ABCD. Guide for School and Universities about Students with Dyslexia and Other Learning Disorders. http://www.institutoabcd.org.br/wp-content/uploads/2016/02/Guia-para-Escolas-e-Universidades-_2016_vf.pdf; 2016

[17] Jesus MSV, Soares AN, Lobo LK, Aurora LC, Horta MIS. Estimulação da consciência fonológica: proposta de atuação em creche. Revista Tecer, Belo Horizonte. 2008;**1**(0):56-65. http://dx.doi.org/10.15601/1983-7631/rt.v1n0p56-65

[18] Jiménez G, Defior S. Developmental dyslexia intervention framework for speech therapists. Investigación en logopedia. 2014;**4**:48-66

[19] Kiuru N, Lerkannen MK, Niemi P, Poskiparta E, Ahonen T, Poikkeus AM, Nurmi JE. The role of reading disability risk and environmental protective factors in students' reading fluency in grade 4. Reading Research Quarterly. 2013;**48**(4):349-368. DOI: 10.1002/rrq.53

[20] Landerl K, Ramus F, Moll K, Lyytinen H, Leppänen PHT, Lohvansuu K, et al. Predictors of developmental dyslexia in European orthographies with varying complexity. Journal of Child Psychology and Psychiatry. 2013;**54**:686-694. DOI: 10.1111/jcpp.12029

[21] Lee IA, Shaftel J. Facilitating transition from high school and special education to adult life: Focus on youth with learning disorders, attention-deficit/hyperactivity disorder, and speech/language impairments. Child and Adolescent Psychiatric Clinics of North America. 2017;**26**(2):311-327

[22] Machado-Nascimento N, Melo e Kümmer A, Lemos SMA. Alterações fonoaudiológicas no transtorno de déficit de atenção e hiperatividade: revisão sistemática de literatura. CoDAS. 2016;**28**(6):833-842. https://dx.doi.org/10.1590/2317-1782/20162015270

[23] NJCLD: National Joint Committee on Learning Disabilities. Using a Multitiered System of Supports to Maximize Success for Students with Learning Disabilities. 2015. Available from: http://www.ldonline.org/pdfs/njcld/specially_designed_instruction.pdf

[24] Nippold MA. Reading comprehension deficits in adolescents: Addressing underlying language abilities. Language, Speech, and Hearing Services in Schools. 2007;**48**(2):125-131. DOI: 10.1044/2016_LSHSS-16-0048

[25] Nunes C, Frota S, Mousinho R. Consciência fonológica e o processo de aprendizagem de leitura e escrita: implicações teóricas para o embasamento da prática fonoaudiológica. Revista CEFAC. 2009;**11**(2):207-212. DOI: http://dx.doi.org/10.1590/S1516-18462009000200005

[26] Olofsson A, Ahl A, Taube K. Learning and study strategies in university students with dyslexia: Implications for teaching. Procedia—Social and Behavioral Sciences. 2012;**47**:1184-1193. DOI: https://doi.org/10.1016/j.sbspro.2012.06.798

[27] Pestun MSV, Omote LCF, Barreto DCM, Matsuo T. Estimulação da consciência fonológica na educação infantil: prevenção de dificuldades na escrita. Psicologia Escolar e Educacional, Campinas. 2010;**14**(1):95-104. DOI: http://dx.doi.org/10.1590/S1413-85572010000100011

[28] Ramus F. Neuroimaging sheds new light on the phonological deficit in dyslexia. Trends in Cognitive Science. 2014;**18**(6):274-275

[29] Regtvoort AGFM, van der Leij A. Early intervention with children of dyslexic parents: Effects of computer-based reading instruction at home on literacy acquisition. Learning and Individual Differences. 2007;**17**(1):35-53. DOI: https://doi.org/10.1016/j.lindif.2007.01.005

[30] Rodrigues SD, Ciasca SM. Dislexia na escola: identificação e possibilidades de intervenção. Revista Psicopedagogia., São Paulo. 2016;**33**(100):86-97. http://pepsic.bvsalud.org/scielo.php?script=sci_arttext&pid=S0103-84862016000100010

[31] Silva AAM, Martins-Reis VO. The influence of morphological awareness on reading and writing: A systematic review. CoDAS. 2017;**29**(1) e20160032. DOI: https://dx.doi.org/10.1590/2317-1782/20172016032

[32] Schwanenglugel PJ, Hamilton AM, Wisenbaker JM, Kuhn MR, Stahl SA. Becoming a fluent reader: Reading skill and prosodic features in the oral reading of young readers. Journal of Educational Psychology. 2004;**96**:119-129. DOI: 10.1037/0022-0663.96.1.119

[33] Varanda CA, Mendes ECCS, Campina NN, Aulicino MGGMC, Nascimento RGVO, et al. Aplicativos para *tablets* sensíveis ao toque para melhorar vocabulário, processamento auditivo central e habilidades de interação social entre pré-escolares. Psicopedagogia (São Paulo). 2015;**32**:136-149

[34] Varanda CA, Mendes ECCS, Campina NN, Aulicino MGGMC, Nascimento RGVO, et al. The relation of externalizing behavior and central auditory processing deficits in 4-year-old children. Psychology. 2015;**06**:1589-1593

[35] Santos MTM, Navas ALGP. Transtornos de Linguagem escrita: teoria e prática. 1a. Edição. Ed. Manole; 2016. ISBN: 8520432298, 302 p.

[36] Befi-Lopes DM, Gândara JP, Felisbino FS. Categorização semântica e aquisição lexical: desempenho de crianças com alteração do desenvolvimento da linguagem. Rev CEFAC. 2006;**8**(2):155-161

Chapter 7

Comorbidity of Motor and Sensory Functions in Childhood Motor Speech Disorders

Helena Björelius and Şermin Tükel

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69710

Abstract

Subtypes of speech sound disorders (SSDs) with a sensorimotor origin are known as motor speech disorders (MSDs). The symptoms can be diverse, and the causes of the disorders in children are in many cases unknown. Examples of MSD are childhood apraxia of speech and dysarthria. MSD is often seen in neurodevelopmental disorders such as cerebral palsy, developmental coordination disorder (DCD) or autism spectrum disorders (ASD), or it is seen with no obvious diagnosis but usually with comorbid problems. Within all existing comorbidity dysfunctions, the motor and sensory systems are of interest for identifying possible underlying mechanisms of MSD. Namely, soft neurological signs such as hypotonia, decreased speed and low accuracy of motor skills and delayed motor development are given consideration by many researchers for better understanding of underlying motor mechanisms of MSD. Results from comorbidity studies highlight the relationship of MSD with complex sensorimotor tasks and sequential motor tasks. In this chapter, our aim is to frame findings from studies about comorbidity of sensory and motor dysfunctions in MSD in order to theorise affected mechanisms and propose an underlying global motor deficit. We will conclude with implications for therapy models.

Keywords: comorbidity, speech, manual, childhood apraxia of speech, dysarthria, motor function, sensory processing, sensorimotor, motor learning

1. Introduction

Childhood motor speech disorders (MSDs) are covered under speech sound disorders (SSDs) as described by Bowen in **Figure 1** [1] and are commonly identified by problems in speech sound production originated from dysfunctions in sensorimotor processing. The causes of the disorders are in many cases unknown, and the symptoms are diverse, though there is an ongoing search for diagnostic criteria that can help differentiate between different speech disorders in children addressed by several authors [2–9]. Based on genetic and environmental risk factors, Shriberg et al. [9] defined three types of MSDs in their classification system. These are (1) Motor Speech Disorder-Apraxia of Speech (MSD-AOS), (2) Motor Speech Disorder-Dysarthria (MSD-DYS) and (3) Motor Speech Disorder-Not Otherwise Specified (MSD-NOS). Dysarthria is defined as a motor speech disorder that results from a central or peripheral damage of the nervous system and is characterised with impaired execution and motor control of the muscles used for speech production, including the lips, tongue, vocal folds and/or diaphragm. There are several types of dysarthria depending on neurological localisation: *flaccid*, *spastic*, *ataxic*, *hypokinetic and hyperkinetic.* There can also be a mixture of types [10–12]. Childhood dysarthria is often defined as developmental and/or acquired; thus, dysarthria can also be 'idiopathic' without the influence of neurological damage [12, 13]. Childhood apraxia of speech (CAS) is defined as a motor speech disorder that is characterised by problems in planning of the movements (e.g. praxis of the lips, jaw, tongue and vocal folds) needed for speech [14]. The motor speech symptoms can intertwine and be mixed with perceptual and phonological dysfunctions, which makes it difficult to define exact diagnosis, and there are probably subgroups and definitions not yet found [1, 9].

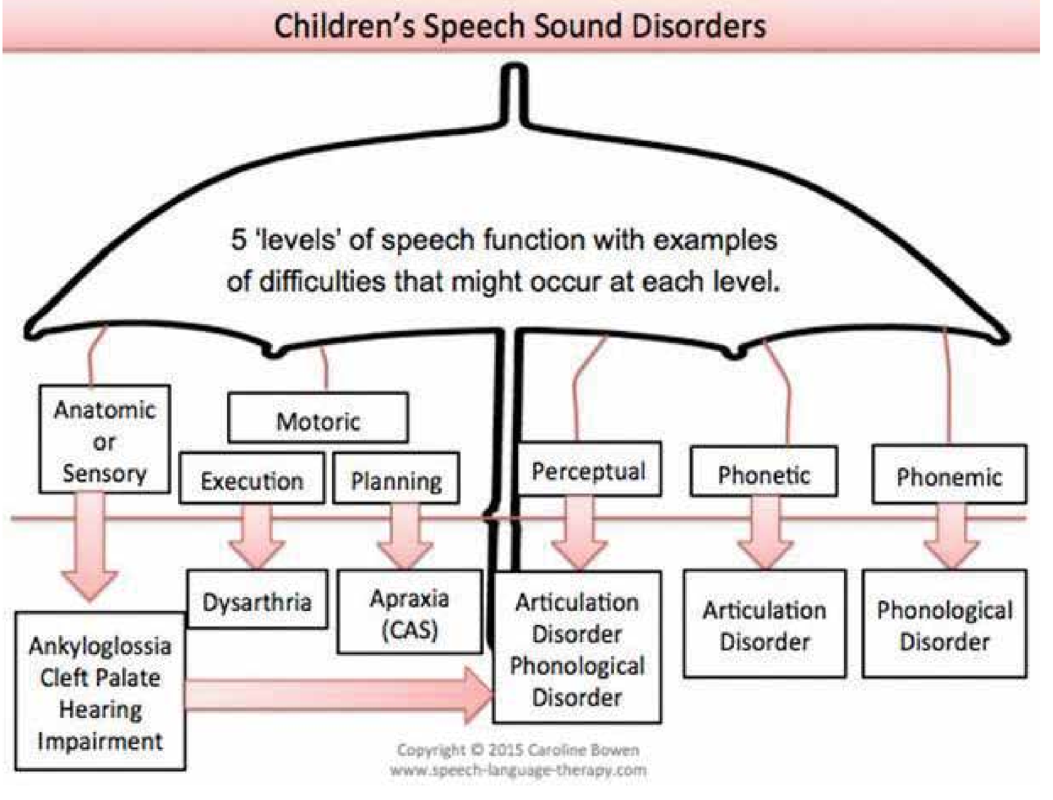


Figure 1. Five levels of speech function with examples of difficulties that might occur at each level [1] (Retrieved from www.speech-language-therapy.com/index.php?option=com_content&view=article&id=45 on 01.03.2017. Used by permission).

http://dx.doi.org/10.5772/intechopen.69710

Comorbidity studies highlight the relationship of MSDs with dysfunctional sensory processing, complex sensorimotor tasks and sequential motor learning tasks as well as fine motor problems [15–17]. Findings also suggest some common neural correlates of speech and fine motor functions [18]. Soft neurological signs such as hypotonia, decreased speed, low accuracy of motor skills and delayed motor development have been considered by some researchers for better understanding of the motor origin of MSD [13, 17, 19]. MSD can also be part of symptomatic picture in specific neurodevelopmental disorders, genetic conditions or metabolic syndromes. Some but not all of these are cerebral palsy (CP), developmental coordination disorder (DCD), autism spectrum disorder (ASD), velocardiofacial syndrome and galactosemia. For example, dysarthria sometimes occurs in the context of CP. Isolated form of MSD seems to happen very rare; more often it occurs with subtle sensory, motor and cognitive problems. Hence, co-occurrence of subtle problems in MSD complicates the understanding of the disorder and planning of the intervention. In this chapter we will present our findings in MSD population with an integrative framework that draws on previous research including behavioural and neuroimaging studies as well as major motor control and learning theories. The main MSD diagnosis we present is CAS because more research findings exist and we have also conducted our previous study in this group [17]. It is important to mention that in clinical work we find that symptoms of 'idiopathic' dysarthria can be misinterpreted being symptoms of CAS or another developmental oral dysfunction due to similarities in speech deviances, for example, vowel distortions, nasality, imprecise consonants, rate control and abnormal prosody. In differential diagnosing of pure CAS from dysarthria, it is important to verify that the child has all three features that were presented and considered to have diagnostic validity in the technical report by ASHA [14]: (1) inconsistent error production on both consonants and vowels across repeated production of syllables and words, (2) lengthened and impaired co-articulatory transitions between sounds and syllables and (3) inappropriate prosody. The group of children with 'idiopathic' dysarthria has not yet been researched enough; therefore, we have chosen to broaden the view with inclusion of some examples from speech and language impairment (SLI) and neurodevelopmental disorders (NDDs). We have tried to dig in to co-occurrence of subtle or severe sensory and motor problems and shed light to this 'grey zone'. With support in our findings, we propose an underlying sensorimotor programming and motor learning vulnerability affecting more than one motor area and the presence of a global motor deficit.

2. General motor development and motor learning

Motor development is a biological process where genes and environmental factors interact. Children are born with a specialised repertoire of preprogrammed non-volitional movements, and during the first months of development, the newborns' interaction with the environment leads to integration of these motor patterns/schemas. The motor schemas become the foundation for development of volitional movements [20–22], and most of the skills that are unique to human beings such as speech or drawing can therefore be learned via practice implicitly throughout lifetime. Stages of motor learning, proposed by Fitts and Posner [23], are the *cognitive phase*, the *associative phase* and the *autonomous phase*. In *cognitive phase*, the child is new to the task and tries out different strategies to attain success. This period is characterised with trials and errors. While strategies leading to targeted action are retained, strategies leading to failure are discarded. This stage is very important for the development of sensory feedback and feedforward processes that eventually lead to the achievement of desired motor control in muscular organs. Here, muscle tone is an important aspect, and the contractibility thereby exertion of necessary force by muscles is essential for motor control. For example, hypotonia influences the ability of individual muscle groups to contract, and infants with low muscle tone put great effort into holding their heads up where oral-motor functions such as sucking can be affected as well as speech development [24]. The *associative phase* is characterised by refinement of the attained motor skill in terms of rate, consistency and energy expenditure. Further practice results in the *autonomous phase* where automatic motor response has small or no error and that defines the last phase of motor learning. Cognitive effort during motor learning decreases throughout the phases making *autonomous phase* the least cognitively demanding [25]. Typically developing children continue to learn motor skills almost in an effortless fashion despite the increasing complexity of the motor tasks as the child grows [26]. For children with sensorimotor dysfunctions as in MSDs, development of complex movements as in speech is somehow disrupted, and motor learning is highly affected by the nature and severity of the impairment [27]. More recent research has emphasised the importance of functioning cells in the 'mirror neuron system' being part of learning and execution of new sensorimotor skills as an interesting topic concerning MSDs [28].

3. Neural correlates of speech, fine and gross motor functions

During the last decade's computer models of brain function and technically advanced neuroimaging, studies have exploded as well as thorough literature on the topic [29]. Research has mainly drawn conclusions of which parts of the brain are involved during speech based on adults. Liegeois and Morgan [30] emphasised the lack of research computed on children and conducted a review searching for which kind of brain abnormalities children and adolescents with severe speech disorders had in developmental, progressive or childhood-acquired conditions. They found evidence that there is predominantly malfunction of neural networks bilaterally involved in severe childhood speech disorders not a leftward cortical dominance, which has often been reported in adults. The main brain regions affected in the children with apraxia of speech and dysarthria were the basal ganglia, thalamus, cerebellum as well as perisylvian and rolandic cortices. They do also suggest that their data show that neuroanatomical basis for speech production also to some extent overlaps in children and adults. One study using functional magnetic resonance imaging comparing children with DCD with typically developing peers demonstrated an under-activation in cerebellar-parietal and cerebellar-prefrontal networks and in brain regions associated with visual-spatial learning suggesting negative affects in learning motor skills [31]. Most of the studies we present below are made on an adult population, and for a child's brain, considerations on developmental and critical periods as well as plasticity should be taken. Before dominance between hemispheres is established, many sensorimotor tasks are processed bilaterally. For example, in childhood MSDs, the effect of bilateral structural anomalies results in functional reorganisation of cortical speech networks that is different from an adult population [32]. We have tried to highlight brain regions such as the cerebellum and cerebral cortex and functional connections in between that have been reported to relate with speech motor and visual-motor functions. We find cerebellum being one of the most interesting parts tickling our curiosity.

The cerebellum is most understood in terms of its contribution to motor control and learning, balance, posture and muscle tone; however, it is also involved in cognitive functions especially related to language. It consists of approximately 10% of the brain's volume; on the other hand, it contains over 50% of the total number of neurons in the brain showing the complexity of neural computations for its role in motor systems [33]. Motor commands are not initiated in the cerebellum; rather, the cerebellum modifies the motor commands of the descending pathways to make movements more adaptive and accurate via its functional subdivisions [34]. Neural activity within the cerebellum and also basal ganglia has found to be highly connected with motor areas for movements in the cerebral cortex and areas of prefrontal cortex related to cognitive functions [35]. Cerebellar subdivisions that are of interest for commonality of speech, fine and gross motor functions are the spinocerebellum and the cerebrocerebellum. While the spinocerebellum is involved in integration of sensory input with motor commands to produce adaptive motor coordination, the cerebrocerebellum, the largest functional subdivision with its extensive connections with cerebral cortex, is involved in the planning and timing of movements and the cognitive functions [33]. In 1998, Schmahmann and Sherman [36] defined the cerebellar cognitive affective syndrome (CCAS) in a group of 20 adult patients with disorders confined to the cerebellum. They found that not all deficits occurred in each patient, but decreased verbal fluency and visual-motor problems were particularly prominent, which was also replicated by others [37]. This is consistent with the outcome of our examination [17] of overall motor functions in 18 children with CAS where similar symptoms were found as in the group with CCAS though the children with CAS did not have any identified cerebellar dysfunction or lesion. Almost all the children had fine motor problems that required visual-motor integration, and an intriguing finding was correlation between visual-motor control, for example, drawing skill, and speech motor control which supports the hypothesis that cerebrocerebellar interconnections are involved in underlying speech motor control and complex eye-hand coordination tasks like drawing. The CCAS is described as a constellation of deficits affecting linguistic, visuospatial and executive functions. Similarly, in CAS, problems in executive functions are usually observed. However, not enough studies have explored the possible role of the cerebellum in apraxic disorders especially in CAS; the pathophysiological mechanisms remain to be elucidated [18].

The *cerebral cortex* has been mapped for functional regions in neuroimaging studies. For speech motor production, some models have been raised discussing functional networks instead of functional regions [38, 39] as it also was proposed for visual-motor functions [40, 41]. The neural correlates of speech motor control include the premotor and primary motor cortex, somatosensory cortex, auditory cortex, cerebellum and the basal ganglia as mentioned before [39]. Grossly similar regions were described as part of the so-called dorsal and ventral stream for visual-motor functions [40]. Brodmann area 6, which is located in premotor cortex, has been shown to be activated bilaterally during speech listening as well as speech production [38]. The same area was proposed to be involved in dorsal visual stream that is responsible for planning of visual-motor tasks [40]. Another cortical region that is of interest for communality between speech motor and hand motor functions is posterior parietal cortex (PPC). PPC receives cortical afferents from visual, auditory and somatosensory areas and projects mainly to frontal premotor areas [42]. Its role in planned movement execution has been mostly shown in visual-motor integration tasks [43–45]. However, it was also shown to be activated during auditory-motor integration tasks [46, 47]. Searching for the commonality of speech and hand motor learning, the supplementary motor area (SMA) and pre-supplementary motor area (pre-SMA), parts of medial premotor area, have been related to the learning of motor sequences. Both of them are shown to be sensitive to the order of movement elements within a sequence [48]. The pre-SMA is found to be important during the initial stage of motor learning [49] and when adapting to a new sequence [49, 50]. The SMA activation, on the other hand, increases with practice [51, 52]. It was proposed that pre-SMA is related to temporal control and the SMA integrates this temporal coding with the required motor output [53]. Recent studies report that, in addition to speech-related activation, Broca's area is also significantly involved during tasks devoid of verbal content. It has been shown that Broca's area is responsible for hand actions as well as integration of speech perception [54, 55].

3.1. Summary

Cortical and subcortical areas including the basal ganglia as well as the cerebellum are involved in complex sensorimotor functions like speech and fine motor tasks. Supporting studies in cognitive neuroscience propose that functional networks of speech motor and visual-motor functions do overlap especially in the parietal cortex, cerebellum and basal ganglia, where the cerebellum plays a central role in the emergence to be discovered. Highly skilled movements including speech and handwriting are unique for human beings, and there are still many question marks on how the brain and body interact concerning both typical development and when we meet dysfunctions. Here, we have tried to show that human motor functions are interacting with each other neurologically, and we hope for an interesting future research to come.

4. Comorbidities in motor functions within MSD and SLI

4.1. Background

Specific fine and gross motor milestones and locomotor skills such as head control, rolling, sitting, crawling, walking and pincer grip, should be reached by a certain age [22, 56–58]. The problem in different motor domains is commonly pronounced areas that accompany speech and language disorders, and the development of speech is associated with the ability to manoeuvre hand actions from the babbling stage and onwards [55]. Handling objects with vision, touch and speed of processing interact with the emergence of certain perceptive and cognitive abilities and also influence motor development [59, 60].

4.2. Motor functions in children with SSD and MSD

A few studies exist more or less recently exploring the possible correlation between oral motor, speech motor and fine and gross motor functions. Dewey et al. [61] found that children with CAS showed difficulties in sequencing both limb and orofacial gestures compared with children that had phonological disorders and discussed possible problems with general praxis. (Praxis involves motor programming and motor integration that is required to be able to execute complex learned and skilled movements.) General praxis dysfunctions were also revealed in a study by Poole et al. [62]. They compared children with developmental dyspraxia and adults having acquired apraxia, and both groups made similar movement error patterns when imitating oral and body gestures. Newmeyer et al. [15] evaluated fine motor skills, object manipulation, grasping and visual-motor integration in 32 preschool children between 2 and 5 years of age with severe speech sound disorders using Peabody Developmental Motor Scales. They also measured the ability to imitate oral-motor movements with Kaufman Speech Praxis Test. All children were lower than average in fine motor skills, and significant results was found between oral-motor imitation and visual-motor integration. (Visual-motor integration tasks can include measurements of precision in skills such as drawing, cutting or folding and drawings of geometric shapes.) The studies presented above show similarities in dysfunctional praxis of oral and limb functioning amongst children with CAS covering three decades. Even though there has been an evolution in assessments and diagnostic criteria for children with CAS and also NDD, an interesting concern is that united assessments and diagnostic markers covering both manual and oral/speech dyspraxia have not yet been invented as far as we know. An approach concerning these aspects could be beneficial in understanding the challenges children with CAS carry and in the development of therapies.

Dodd [19] looked for possible co-occurrence of deficiencies in oral-verbal and fine motor skills and compared speech-disordered children with a typically developed control group on tasks assessing volitional and non-volitional oral movements, fine motor skills and speech motor planning. The children (n = 51) were divided into five groups depending on which type of speech dysfunctions the child had. In comparison to other speech impairments and to the control group, the children with inconsistent speech errors but not diagnosed with CAS (n = 9) were poorer than controls in fine motor movements involving speed and dexterity. (Dexterity tasks can include specific activities such as reaching, grasping and bimanual coordination by using small objects, where accuracy in time is measured.) The children that were diagnosed with CAS (n = 5) had the same results as the previous group on speed and dexterity but also performed poorer on fine motor tasks involving deficiencies in integrating sensory information into a plan of actions such as visual-motor integration. Our own study [17] has similar findings as previous studies and shows a variety of motor problems that are moderately severe. The study involved 18 children with CAS between 4 years 5 months and 10 years 7 months (**Figure 2**). All the children suffered from a limited repertoire of speech sounds, inconsistent articulation of vowels and consonants and vowel distortions also affecting prosody. We measured correlations between three tests of the Verbal Motor Production Assessment for Children: *focal oromotor control*, *sequencing maintenance control* and *connected speech and language control* [63] and five tests from the Bruininks-Oseretsky Test of Motor Proficiency [64]: *overall body motor coordination*, *upper limb coordination*, *manual dexterity*, *fine motor precision* and *fine motor integration.* The number of motor problems was investigated by using −1 SD as a cut-off point on the different subtests. Looking at **Figure 2**, a mosaic profile of motor problems is shown. Co-occurrence of non-speech, speech, manual and gross motor problems is seen in 15 of the 18 children (83%), and each child demonstrated problems in 2 of the 7different tests. Fourteen children had results lower than average in fine motor tasks including visual-motor integration. Correlations were found between *fine motor integration* and *focal oromotor control* which include non-speech and speech oral-motor movements (r = 0.54) and also with *connected speech and language control* (r = 0.51). The findings can be compared to a study by Rodger et al. [65] where the children with DCD performed lower than −1 SD on the *focal oromotor control* and *global motor control* (including oral reflexes) from the Verbal Motor Production Assessment for Children. Our study also gave interesting findings in the oral-motor area with significant results showing that the children had more deviant production of mandibular and lingual non-speech movements compared to non-speech labio-facial movements ($p < 0.005$) which is intriguing in the context of what Nijland et al. [66] found in their study with bite blocks. In that study, the children with CAS could not compensate their articulatory movements when the mandible was fixed in a bite block leading to more increased speech errors. No speech errors were made by typical developed children and adults performing the same exercise. The researcher established that they found evidence for an underlying motor programming deficits in children with CAS. Ho and Wilmut [67] also suggest a possible underlying motor deficit based on findings of atypical patterns of movement and inferior motor control of complex speech gestures in children with DCD.

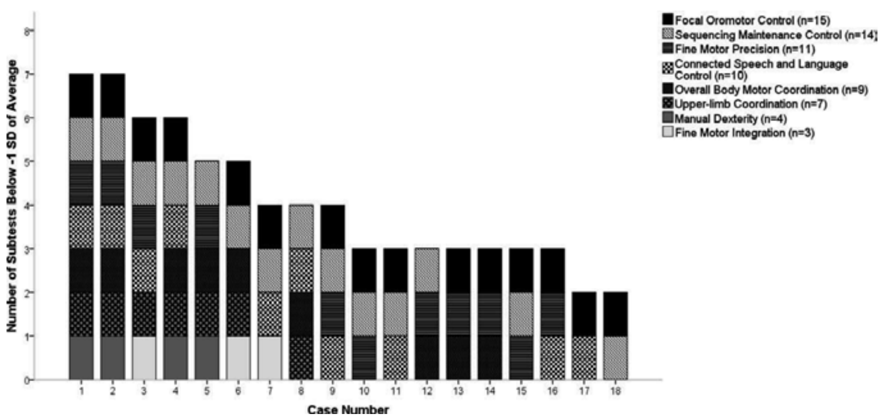


Figure 2. Co-occurrence of non-speech, speech, fine and gross motor problems (below −1 SD of average) in children with CAS. Each block presents one case in the group. Blue boxes are for problems in fine motor or overall body motor functions. Red boxes are for problems in speech motor functions. Only Cases 1 and 2 show pure speech motor problems, whereas other 16 cases show variety and different numbers of motor problems.

4.3. Motor functions in children with SLI

There is a rather large body of research on comorbidity of motor functions in children with SLI. The prevalence of motor disorder in children with SLI was found to be 18 out of 40 children where 12 out of the 18 had the diagnosis of DCD [68]. Similarly, Webster et al. [69] found that 52% of children with SLI had motor impairments. An exhaustive review of the literature on comorbidity between SLI and motor skill was conducted by Hill [70]. The review gives clear and substantial evidence that children with SLI had poorer fine and gross motor functions, poorer coordination as well as praxis functions than typical peers. Many of the children had similar symptoms as those seen in other neurodevelopmental disorders such as DCD. She suggests that SLI is part of a broader range of challenging symptoms where comorbidity of motor functions is one. More recent studies on this concept reveal similar outcomes as described above. Marton [71] found that children with SLI had poorer ability in imitating gross motor body postures, and in a study by Zelaznik and Goffman [72], the children had lower results in gross and fine motor skills both compared to age-matched peers. Very recent studies found that children with SLI have bimanual coordination dysfunctions and poor visual-motor sequencing learning correlated with lexical abilities [73, 74]. Also, children with mild expressive language disorder showed lower performance in manual dexterity, ball skills and static and dynamic balance [75]. This topic has been lifted in research for many decades, and in 1987 Bishop and Edmundson [76] described the poorer motor functions in children with SLI as a lag in maturation.

4.4. Comorbidity of speech and motor functions in children with NDD

NDDs such as CP, ASD, ADHD and DCD which are also to be elucidated with genetic causality usually affect more than one domain of development [77]. Even though the most prominent symptom is different in each, all of them present variety of symptoms in sensory, motor and cognitive domains of development. MSD can be one part of symptomatic picture in these specific neurodevelopmental disorders. Children with CP have delayed skills in communication related to severity in gross motor functions, and the severity of motor functions was also related with language dysfunctions and speech problems primarily in the motor speech domain [78, 79]. Children with ASD show disturbances in body movements and a non-natural shape of the mouth seen as early as at the age of 4–6 months [80], and it is common with a delay in motor development giving impact on never-reaching gross motor milestones [81]. Gernsbacher et al. [82] found a relationship between the development of oral and manual skills amongst toddlers and later dysfluency of speech in the children that was diagnosed with autism. The study was conducted in three steps: a caregiver landmark-based interview targeting motor skills, historical home videos confirming the information from step one and oral-motor assessment from the Kaufman Speech Praxis Test. The children were divided into two groups: one with minimal speech fluency and one with high speech fluency. The children with less fluent speech performed overall poorer in manual skills as well as in oral-motor items and had less capacity for communication with gestures which indicates that there is a deviant oral and manual development in children with autism giving impact on speech-language and communications skills. Authors suggest that the results are not a failure in understanding or lack of compliance based on the notion that the children succeeded performing some items. Diffuse symptoms including dysfunctional speech and motor skills have the last decade being discovered secondary to genetic disorders that often are very rare. One recent study found speech features of CAS amongst children with 16p11.2 deletions. Some of the children also performed low on fine and gross motor functions though there were large variations between the children in the motor function part [83]. We have presented a small range of articles in the NDD domain because the comorbid symptoms are well known amongst clinicians; nevertheless, it is important to highlight the challenges children with NDD can meet.

4.5. Summary

Comorbidity of general motor functions, speech motor and language skills is very common in children having interventions at SLP clinics. For some children the symptoms are severe and can be detected easily as often for children with NDD which can lead to therapy programmes from different professionals, physiotherapists, occupational therapists, psychologists, etc., sometimes working in teams. With children who have atypical patterns of development, the challenge for clinicians and educators is more camouflaged. Delayed or inappropriate speech production during preschool age is often the most visible problem but is frequently accompanied by unusual or clumsy fine and gross motor functions that can be considered less important to handle. However, when children reach school age, these subtle fine motor problems can lead to functional problems in academic skills. These children are somehow located in an undefinable 'grey zone' where not much of interventions for their entire dysfunctions exist. The question is what should be done for this type of children?

5. Comorbidities in sensory processing functions within MSD and SLI

5.1. Background

The sensory system is the foundation that makes it possible for our motor programmes to execute, coordinate and plan functional movements. The sensory system converts the environment into neural signals which the motor system through neural signals turns into muscle force [34]. Our abilities to extract an action relevant to the estimated goal rely on the ability of the nervous system to process the sensory information [84]. The brain decodes multisensory organs of our bodies, smell, taste, auditory, visual, touch, proprioceptive and vestibular, and serves us in every moment of life. If the ability to process sensory information is out of tune, it can turn into dysfunctional behavioural patterns [85, 86]. Children coming to SLPs often show different kinds of behaviours and have needs that have to be handled by the clinician. Some children have difficulties sitting on the chair due to restlessness or fatigue which could be caused by hyper- or hypotonicity of postural muscles; are easily disrupted by sudden sounds or visual objects in the room; are being sensitive to auditory and visual disturbance; are anxious and want to withdraw from the situation or have short intervals of concentration span. Dunn has proposed a conceptual model for how sensory processing functions affect daily life and the abilities to learn and develop new skills. The Sensory Profile Questionnaire [87] is a 125-item questionnaire for caregivers and school staff assessing a child's function in daily life. Different aspects of sensory functions are grouped into three main areas: sensory processing, sensory modulation and behavioural and emotional responses. Sensory processing measures the response and abilities in auditory, visual, vestibular, touch, multisensory and oral sensory systems. Sensory modulation refers to the ability to regulate sensory input in terms of facilitating or inhibiting responses and behavioural and emotional responses refer to the behaviours that the person shows as a result of abilities to process sensory information. Authors in the past have found relationship between sensory processing, speech production and language acquisition are Ayres [88], Ayres and Mailloux [89] and Fallon et al. [90] amongst others.

5.2. Sensory processing functions in children with MSD

This topic has not yet been vastly explored. The one and only existing article performed on children with CAS is by Newmeyer et al. [91] where the Sensory Profile Questionnaire was used for 38 children with severe CAS. The results reveal significant differences in several sensory processing areas compared to typical developed peers. The children with CAS had difficulties processing sensory information through their auditory, visual, tactile and multisensory systems. Differences were also seen in areas of modulation of movement affecting activity levels and sensory input. Factor clusters regarding oral sensitivity, fine motor/perceptual, emotional reactivity, sensory seeking and inattention/distractibility had strong significant differences compared to typical peers. The results from the Sensory Profile Questionnaire were also compared with Kaufman Speech Praxis Test which revealed significant positive correlations between oral-motor apraxia, abnormal imitations of oral movements and abnormal repetition of simple phonemes compared with sensitivity. Nijland et al. [16] found that complex sensorimotor and sequential tasks correlate significantly with the severity of the speech impairment in children with CAS indicating a comorbidity in nonverbal sequential functioning.

5.3. Sensory processing functions in children with SLI

In children with SLI, there has been some research connected to sensory processing. Taal et al. [92] found through the Sensory Profile Questionnaire that 116 children with SLI confirmed atypical behaviours in the sensory processing domains such as auditory processing, touch processing, vestibular processing, oral processing and visual processing compared to peers with neurotypical development. This interferes with normal development, and the effect generates multiple impairments in functions needed for speech and language learning. Sensory processing abnormalities also seem to negatively affect children with SSD not making the same progress in speech therapy compared to children with SSD without sensory processing disorders [93].

5.4. Sensory processing functions in children with NDDs and others affecting speech and language development

One recent article on sensory processing functions in children with CP found differences in 16 out of the 23 categories of sensory processing compared to typical developed peers evaluated by the Sensory Profile Questionnaire. The author accentuates the importance in sensory processing abilities for the development of motor and communication skills and functional behaviours that support in daily life activities [94]. Research on toddlers that suffered from non-organic failure-to-thrive and feeding problems found atypical performance in sensory processing areas of tactile, vestibular and oral compared with a control group. The children that had abnormal sensory processing in one or more area also showed delayed development in cognition, motor skills and language [95]. Atchison [96] has observed speech and language dysfunctions amongst children with sensory modulation disorder due to traumatic histories including adoption, foetal alcohol syndrome and abuse. He stresses that it is essential for SLPs to recognise the behaviours of children with a history of emotional and physical traumatic stress and how this affects their learning of speech and language.

5.5. Research on auditory and somatosensory processing

Through neurophysiological investigations, researchers have analysed sensorimotor commands behind speech and deviant speech. For example, Terband and Maassen ([97], p. 139) proposed that reduced oral sensitivity could be a core deficit in children with CAS. They discuss in a hypothesis that 'the lack of auditory feedback control is predicted to affect speech production more if the motor commands are inherently deviant/unstable (as is the case with degraded somatosensory information) since this can no longer be compensating by (over) reliance on auditory feedback'. Also in a later study computed with simulations in the DIVA model, Terband et al. [98] found that a combination of motor programming functions and the ability in auditory self-monitoring/auditory feedback affects to which extent phonemic representations develop on a phonological level. They hypothesise that deficiencies in these sensorimotor programmes can be part of the symptomatic picture in paediatric motor speech disorders. In another experimental study, the researchers claim evidence that somatosensory feedback which corporates proprioception has a central role in achieving the precision needed for acquisition of speech movements for both consonants and vowels independent of auditory feedback [99]. This gives strength to the previous study mentioned by Terband et al. [97] that oral proprioception, 'to read' somatosensory information, can be lacking in children with CAS. Other neurophysiological researchers have been interested in the relationship between sensory processing of auditory input and the ability to produce speech sounds in children with CAS. In a study by Groenen et al. [100], the children with CAS performed poorer than the control group in auditory discrimination of consonants. They also found a relationship between the frequency of substitutions in articulation and the degree of auditory processing deficit within some children. Studies have also showed that negatively affected perception of vowels in children with CAS indicated phonetic processing dysfunctions [101] and significant results were found between perception and performance [102].

5.6. Summary

Children with speech and language disorders process sensory information in a different way than typical peers which impact on their ability to learn and develop adequately and can also affect their behaviours in daily life. Oral-motor apraxia, abnormal imitation and oral movement correlated with increased sensory sensitivity in children with CAS, and one hypothesis is that deviant proprioception affecting somatosensory feedback could be a core deficit. It is of immense importance that SLPs working with children understand behaviours and demands that occur due to abnormal sensory processing and deeper knowledge in this area can support the choice of treatment. It seems that sensory processing dysfunctions amongst children affect their ability to develop speech, language and communication skills and also their quality of life [91–95].

6. Therapy models for children with MSD

6.1. Background

Children with MSDs often need to continue longer in therapy than for other types of articulatory speech dysfunctions. Patients usually have to exercise almost every day for several years in order to achieve results [103, 104]. This places high demands on both children and their caregivers. There are scarce with evidence that support treatments aimed for CAS and for dysarthria. There are some important reports available on intervention approaches that also discuss the outcomes and evidence of today's existing treatments [104–106].

6.2. Treatment with oral-motor exercises

Traditionally, treatment with oral-motor exercises has frequently been used as part of assessments and intervention programmes for children with MSD. The intention is to increase/decrease movement, relaxing/strengthening muscles, increase proprioception and increase/decrease dysfunctions in the sensory system of the lips, tongue and jaw to reinforce speech development. Oral-motor treatment is an umbrella term for different treatment models used for motor speech, feeding, orofacial myofunctional, oral awareness/discrimination and oral activities/exercises [107]. The application of non-speech oral movements (NSOMs) in treatment for speech has been questioned in several reports due to the absence of scientific research [108, 109]. Kent has in this debate contributed with a sober evaluation of the literature and with a very valuable summary of oral and speech muscle functioning [105]. And, Ruscello [110] gives credibility to clinicians to use their clinical judgement, proven experience and common sense together with empirical evidence [111]; indeed, more research is needed. As mentioned by other authors, not many studies exist where the effect on speech is measured after intervention with oral-motor exercises. The studies are mainly on children with dysarthria secondary to CP. Ray [112] examined speech intelligibility using orofacial myofunctional therapy (OMT) programme on 16 children with spastic CP and myofunctional disorder. OMT is a training programme for the tongue, lips and jaw muscles facilitating adequate posturing and function. After a 4-month therapy with OMT, speech intelligibility improved in words, and significant correlation was found between tongue functioning and speech intelligibility. Another study showed improvement of speech in some of the children with CP using orthodontic stimulatory plates together with oral and facial physiotherapy treatment according to Castillo-Morales orofacial regulation therapy. This therapy is based on the understanding that orofacial muscular functions are closely interlinked with postural control and breathing mechanisms [113]. Two studies on children with mild articulation disorder showed no significant improvements on speech output after the use of oral-motor exercises [114, 115]. No study on children with CAS has been found. Maybe the following proposition by Kent ([105], p. 777) can serve as a guideline in the search if oral-motor exercises ought 'to be or not to be'? 'To be useful, NSOMs may need only to resemble the target behaviours in some fundamental respect that can be used to modify a motor response, whether by strengthening or altering the basic motor pattern'.

6.3. Treatment with strategies based on principles of motor learning

Principles of motor learning (PML) strategies have gained ground in the last decade especially concerning treatment for CAS. PML is partly based on the target movement that is produced with high frequency (up to 100 times) in various conditions to support motor learning. When PML is incorporated in speech treatment, the target sounds are produced through modelling or being modelled by the facilitator (clinician/caregiver); successively, the facilitator reduces the support, all performed after a template. The goal is also to keep a standard of high motivation which can be supported by reinforcements [27, 116]. Murray and colleagues [104] found that two treatment programmes using PML aimed for CAS had suggestive or preponderant evidence, Integral Simulation/Dynamic Temporal and Tactile Cueing (DTTC) and Rapid Syllable Transition Treatment (ReST), with 14 children in each study. In a later study by Murray et al. [117] on a larger population of children with CAS comparing two treatments, effects were shown using ReST and the Nuffield Dyspraxia Programme-Third Edition (NDP3). CAS is a rare diagnosis, and at the clinic, the children often have co-occurring symptoms with other motor-based diagnoses including dysarthria features [13, 103], and a few single case studies on CAS inform that the children also were diagnosed with dysarthria [118–120]. In these studies, they performed an intervention with DTTC which showed less progress in some cases with mixed diagnoses though the studies did not problematise if the neuromuscular dysfunctions of dysarthria made an impact on the outcome. All the PML studies presented above had positive outcome on treated sounds and words which seems to be the biggest achievement this treatment strategy gives to children with CAS [121]. Less effect is noted on non-treated words, intelligibility and speech fluency though most studies did last for a fairly short period of time and acquisition of the new skills can prolong [105]. Pennington et al. [106] made a review on speech treatment for children with developmental dysarthria including the use of PML strategies. Pennington found that a few small observational studies had positive results on intelligibility and clarity of voice which gave impact on the children's participation in social and educational activities and quality of life. Also, Lee Silverman Voice Treatment (LSVT LOUD) works in the context of motor learning and activity-dependent neuroplasticity. Part of the goal is to strengthen muscles orally and for breath support to facilitate speech output. Research has shown positive outcomes indicating development of vocal loudness and intelligibility in children with dysarthria secondary to CP [122, 123].

6.4. Treatment strategies based on multisensory input

Motor learning principles are also involved in methods which try to incorporate input from several sensorimotor processing areas. Some are used for many decades, and others are emerging.

6.4.1. Multisensory cues for muscles used in speech

The Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT) approach indicated that the use of multisensory input through auditory, visual and tactile-kinaesthetic-proprioceptive cues triggering specific facial muscles for each phoneme leads to a greater impact on speech development compared with children lacking sensorimotor input. In recent studies with children that had motor control issues as part of their speech disorder such as jaw sliding, jaw over extension and inadequate lip rounding/retraction, the PROMPT treatment showed to have effect on treated and untreated words, development of speech sounds and speech motor control [124–128]. PROMPT also seems to support positive development of motor speech movement patterns and intelligibility for children with CP [129, 130]. Another fairly new treatment method using biofeedback has been investigated in children with CAS. In biofeedback there is visual feedback with real-time ultrasound images of the tongue. Development of their ability to produce some of the practised target sounds was found, and a transfer into word production was also seen [131].

http://dx.doi.org/10.5772/intechopen.69710

6.4.2. Sensorimotor integration approach

One model by Ayres [132] using exercises for development of sensory integration is based on the notion that the ability to process sensory information affects behaviour and learning. A few studies exist where speech development is measured. Ayres conducted a study with children suffering from apraxia and SLI, using sensory integration intervention, and found that the four children in the study increased their expressive language abilities [89]. And, another study involving children with ASD showed an increased complexity of utterance after sensory-based interventions [133]. One neurophysiological study on 17 children with CP using brainstem auditory evoked potential (BAEP) examination with significant improvement of transmissions in the auditory pathway section of the brainstem was measured after rehabilitation with Masgutova Neurosensorimotor Reflex Integration (MNRI) [134], a new form of a manual neuromodulation technique [135]. Hypothetically this improvement could lead to increased function in auditory processing. Several intervention studies with MNRI have recently been published mainly on children with NDD [136] however nonfocusing on speech outcome.

7. Conclusion and implications for therapy models used in MSD

There is still very little empirical evidence; however, a respectful volume of clinical experience for treatment addressed children with MSD. Recently, more studies have been published especially concerning treatments with motor learning strategies, and the future looks prosperous. As we have been discussing in this chapter, it is noted that children with MSD can suffer from comorbidity in several areas such as fine and gross motor including posture control dysfunctions and sensory processing disorders even when there is no NDD found. We have also presented neural correlates giving evidence for the co-occurrence and interaction of different motor skills in several brain regions which give strength to the hypothesis that motor, speech and language dysfunctions seldom come alone and can be symptoms of an underlying global deficit. This enhances the question if therapeutic models ought to work with a holistic perspective reinforcing sensorimotor processing functions (e.g. oral and manual proprioception, postural, visual, auditory and tactile) on several levels of the brain as part of a treatment approach premised on the notion that the functions of the extrapyramidal nervous system must be addressed in the case of abnormal sensorimotor integration [134]. Maybe if there is an underlying core deficit, it could be reached through corrections of the dysfunctional basic sensorimotor patterns enhancing development of adequate motor responses leading to functional behaviour [134] as also proposed by Kent [105] concerning oral-motor exercises as we earlier quoted under Section 5.2. Even though sensorimotor approaches like MNRI and others based on PML such as PROMPT, DTTC or ReST show some promising results in research and clinical experience, more studies are needed confirming evidence-based treatment models in MSD. Future case-control study designs and especially randomised-controlled trials would be very valuable. Our experience with MSD population is that it is a complex group with a variety type of subtle problems. Trying to achieve a study group as homogeneous as possible seems to be important for the statistical power of studies. However, such studies could affect the generalisation of the results. We suggest using clinical experience as an integral guide for inclusion criteria and the design of the studies. We welcome more research on existing as well as new treatment models increasing quality of life for children with MSD.

Author details

Helena Björelius[1]* and Şermin Tükel[2]

*Address all correspondence to: helena.bjorelius@sll.se

1 Department of Speech and Language Pathology, Oral Motor Centre, Danderyds Hospital, Stockholm, Sweden

2 Faculty of Health Sciences Department of Physical Therapy and Rehabilitation İzmir University of Economics, İzmir, Turkey

References

[1] Bowen C. Classification of Children's Speech Sound Disorders; 2011. Available from: www.speech-language-therapy.com/index.php?option=com_content&view=article&id=45

[2] Dodd B. Differentiating speech delay from disorder: Does it matter? Topics in Language Disorders. 2011;**31**(2):96

[3] Kent RD. Research on speech motor control and its disorders: A review and prospective. Journal of Communication Disorders. 2000;**33**(5):391-428

[4] Morgan AT, Liegeois F. Re-thinking diagnostic classification of the dysarthrias: A developmental perspective. Folia Phoniatrica et Logopedica. 2010;**62**(3):120-126

[5] McCauley RJ, Strand EA. Treatment of childhood apraxia of speech: Clinical decision making in the use of nonspeech oral motor exercises. Seminars in Speech and Language. 2008;**29**(4):284-293

[6] Shriberg LD, Aram DM, Kwiatkowski J. Developmental apraxia of speech: III. A subtype marked by inappropriate stress. Journal of Speech, Language, and Hearing Research. 1997;**40**(2):313-337

[7] Shriberg LD, Aram DM, Kwiatkowski J. Developmental apraxia of speech: II. Toward a diagnostic marker. Journal of Speech, Language, and Hearing Research. 1997;**40**(2):286-312

[8] Shriberg LD, Aram DM, Kwiatkowski J. Developmental apraxia of speech: I. Descriptive and theoretical perspectives. Journal of Speech, Language, and Hearing Research. 1997;**40**(2):273-285

[9] Shriberg LD, Fourakis M, Hall SD, Karlsson HB, Lohmeier HL, McSweeny JL, et al. Extensions to the speech disorders classification system (SDCS). Clinical Linguistics & Phonetics. 2010;**24**(10):795-824

[10] Darley FL, Aronson AE, Brown JR. Differential diagnostic patterns of dysarthria. Journal of Speech, Language, and Hearing Research 1969;**12**(2):246-269

[11] Simmons KC, Mayo R. The use of the Mayo Clinic system for differential diagnosis of dysarthria. Journal of Communication Disorders. 1997;**30**(2):117-131; quiz 31-2

[12] Hodge MM, Wellman L. Management of children dysarthria. In: Caruso AJ, Strand EA, editors. Clinical Management of Motor Speech Disorders in Children. New York, NY, USA: George Thieme Verlag; 1999. pp. 209-280

[13] Hayden D. Differential diagnosis of motor speech dysfunction in children. Clinics in Communication Disorders. 1994;**4**(2):119-141

[14] American Speech-Language-Hearing Association. Childhood Apraxia of Speech [Technical Report]. 2007. Available from: http:/www.asha.org/policy

[15] Newmeyer AJ, Grether S, Grasha C, White J, Akers R, Aylward C, et al. Fine motor function and oral-motor imitation skills in preschool-age children with speech-sound disorders. Clinical Pediatrics (Phila). 2007;**46**(7):604-611

[16] Nijland L, Terband H, Maassen B. Cognitive functions in childhood apraxia of speech. Journal of Speech, Language, and Hearing Research. 2015;**58**(3):550-565

[17] Tükel S, Björelius H, Henningsson G, McAllister A, Eliasson AC. Motor functions and adaptive behaviour in children with childhood apraxia of speech. International Journal of Speech-Language Pathology. 2015;**17**(5):470-480

[18] Mariën P, van Dun K, Verhoeven J. Cerebellum and apraxia. Cerebellum (London, England). 2015;**14**(1):39-42

[19] Dodd B. Do all speech-disordered children have motor deficits? Clinical Linguistics & Phonetics. 1996;**10**(2):77-101

[20] Anokhin PK. Biology and Neurophysiology of the Conditioned Reflex and Its Role in Adaptive Behavior: International Series of Monographs in Cerebrovisceral and Behavioral Physiology and Conditioned Reflexes. Oxford, England: Pergamon Press. Elsevier; 2013

[21] Einspieler C, Marschik PB, Prechtl HF. Human motor behavior: Prenatal origin and early postnatal development. Zeitschrift für Psychologie/Journal of Psychology. 2008;**216**(3): 147-153

[22] Gallagher S. How the Body Shapes the Mind. New York, NY, USA: Oxford University Press; 2005

[23] Fitts PM, Posner MI. Human Performance. Oxford, UK: Calif Brooks/Cole Publishing Company. 1967

[24] Bagnall AK, Al-Muhaizea MA, Manzur AY. Feeding and speech difficulties in typical congenital nemaline myopathy. Advances in Speech Language Pathology. 2006;**8**(1):7-16

[25] Sullivan KJ, Kantak SS, Burtner PA. Motor learning in children: Feedback effects on skill acquisition. Physical Therapy. 2008;**88**(6):720

[26] Schmidt RA, Lee TD. Motor Control and Learning: A Behavioral Emphasis. 4th ed. Champaign, IL, USA: Human Kinetics; 2005

[27] Maas E, Robin DA, Austermann Hula SN, Freedman SE, Wulf G, Ballard KJ, et al. Principles of motor learning in treatment of motor speech disorders. American Journal of Speech-Language Pathology. 2008;**17**(3):277-298

[28] Catmur C, Walsh V, Heyes C. Sensorimotor learning configures the human mirror system. Current Biology. 2007;**17**(17):1527-1531

[29] Guenther FH. Neural Control of Speech. Cambridge, MA, USA: MIT Press; 2016

[30] Liegeois FJ, Morgan AT. Neural bases of childhood speech disorders: lateralization and plasticity for speech functions during development. Neuroscience & Biobehavioral Reviews. 2012;**36**(1):439-458

[31] Zwicker JG, Missiuna C, Harris SR, Boyd LA. Brain activation associated with motor skill practice in children with developmental coordination disorder: An fMRI study. International Journal of Developmental Neuroscience. 2011;**29**:145-152

[32] Morgan AT, Masterton R, Pigdon L, Connelly A, Liégeois FJ. Functional magnetic resonance imaging of chronic dysarthric speech after childhood brain injury: Reliance on a left-hemisphere compensatory network. Brain. 2013;**136**(2):646-657

[33] Broussard DM. The Cerebellum: Learning Movement, Language, and Social Skills. John Wiley & Sons; 2013

[34] Ghez C, Krakauer J. The organization of movement. Principles of Neural Science. 2000; **656**:668

[35] Middleton FA, Strick PL. Basal ganglia and cerebellar loops: Motor and cognitive circuits. Brain Research Reviews. 2000;**31**(2-3):236-250

[36] Schmahmann JD, Sherman JC. The cerebellar cognitive affective syndrome. Brain. 1998; **121**(4):561-579

[37] Wolf U, Rapoport MJ, Schweizer TA. Evaluating the affective component of the cerebellar cognitive affective syndrome. The Journal of Neuropsychiatry and Clinical Neurosciences. 2009;**21**(3):245-253

[38] Pulvermüller F. Brain mechanisms linking language and action. Nature Reviews. Neuroscience. 2005;**6**(7):576-582

[39] Golfinopoulos E, Tourville J, Guenther F. The integration of large-scale neural network modeling and functional brain imaging in speech motor control. NeuroImage. 2010;**52**(3):862-874

[40] Atkinson J. The Developing Visual Brain UK: Oxford University Press; 2002

[41] Braddick O, Atkinson J. Visual control of manual actions: Brain mechanisms in typical development and developmental disorders. Developmental Medicine & Child Neurology. 2013;**55**(s4):13-18

[42] Kolb B, Whishaw IQ. Fundamentals of Human Neuropsychology. 5th ed. New York, NY, USA: Worth Publishers; 2003

[43] Andersen R, Essick G, Siegel R. Neurons of area 7 activated by both visual stimuli and oculomotor behavior. Experimental Brain Research. 1987;**67**(2):316-322

[44] Buneo CA, Andersen RA. The posterior parietal cortex: Sensorimotor interface for the planning and online control of visually guided movements. Neuropsychologia. 2006; **44**(13):2594-2606

[45] Iacoboni M. Visuo-motor integration and control in the human posterior parietal cortex: Evidence from TMS and fMRI. Neuropsychologia. 2006;**44**(13):2691-2699

[46] Lewis PA, Wing A, Pope P, Praamstra P, Miall R. Brain activity correlates differentially with increasing temporal complexity of rhythms during initialisation, synchronisation, and continuation phases of paced finger tapping. Neuropsychologia. 2004;**42**(10):1301-1312

[47] Karabanov A, Blom Ö, Forsman L, Ullén F. The dorsal auditory pathway is involved in performance of both visual and auditory rhythms. NeuroImage. 2009;**44**(2):480-488

[48] Shima K, Tanji J. Neuronal activity in the supplementary and pre-supplementary motor areas for temporal organization of multiple movements. Journal of Neurophysiology. 2000;**84**(4):2148-2160

[49] Nakamura K, Sakai K, Hikosaka O. Neuronal activity in medial frontal cortex during learning of sequential procedures. Journal of Neurophysiology. 1998;**80**(5):2671-2687

[50] Kennerley SW, Sakai K, Rushworth M. Organization of action sequences and the role of the pre-SMA. Journal of Neurophysiology. 2004;**91**(2):978-993

[51] Grafton ST, Hazeltine E, Ivry R. Functional mapping of sequence learning in normal humans. Journal of Cognitive Neuroscience. 1995;**7**(4):497-510

[52] Hazeltine E, Grafton ST, Ivry R. Attention and stimulus characteristics determine the locus of motor-sequence encoding. A PET study. Brain. 1997;**120**(1):123-140

[53] Ashe J, Lungu OV, Basford AT, Lu X. Cortical control of motor sequences. Current Opinion in Neurobiology. 2006;**16**(2):213-221

[54] Fadiga L, Craighero L. Hand actions and speech representation in Broca's area. Cortex. 2006;**42**(4):486-490

[55] Gentilucci M, Volta RD. Spoken language and arm gestures are controlled by the same motor control system. The Quarterly Journal of Experimental Psychology. 2008; **61**(6):944-957

[56] Holle B, Albeck A, Bergérus K-L, Jensen S, Kylén G, Söderberg-Reeves I. Normala och utvecklingshämmade barns motoriska utveckling: praktisk vägledning med utvecklingsschema och övningsexempel. 2nd ed. Stockholm, Sweden: Natur och kultur;1987. pp. 15-20

[57] Grillner S. Fundamentals of Motor System. In: Squire L, Berg D, Bloom FE, Du Lac S, Ghosh A, Spitzer NC, editors. Fundamental Neuroscience. 4th ed. Oxford, UK: Academic Press; 2012. pp. 599-611

[58] Wijnhoven TM, de Onis M, Onyango AW, Wang T, Bjoerneboe G, Bhandari N, et al. Assessment of gross motor development in the WHO Multicentre Growth Reference Study. Food Nutr Bull 25:S37-45; 2004

[59] Bushnell EW, Boudreau JP. Motor development and the mind: The potential role of motor abilities as a determinant of aspects of perceptual development. Child Development. 1993;**64**(4):1005-1021

[60] Piek JP, Dawson L, Smith LM, Gasson N. The role of early fine and gross motor development on later motor and cognitive ability. Human Movement Science. 2008;**27**(5):668-681

[61] Dewey D, Roy EA, Square-Storer PA, Hayden DC. Limb and oral praxic abilities of children with verbal sequencing deficits. Developmental Medicine & Child Neurology. 1988;**30**(6):743-751

[62] Poole JL, Gallagher J, Janosky J, Qualls C. The mechanisms for adult-onset apraxia and developmental dyspraxia: an examination and comparison of error patterns. American Journal of Occupational Therapy. 1997;**51**(5):339

[63] Hayden D, Square P. VMPAC Manual. San Antonio, TX: The Psychological Corporation; 1999

[64] Bruininks RH. Bruininks-Oseretsky Test of Motor Proficiency, (BOT-2). Minneapolis, MN: Pearson Assessment; 2005

[65] Rodger S, Watter P, Marinac J, Woodyatt G, Ziviani J, Ozanne A. Assessment of children with Developmental Coordination Disorder (DCD): Motor, functional, self-efficacy and communication abilities. New Zealand Journal of Physiotherapy. 2007;**35**(3):99

[66] Nijland L, Maassen B, Meulen Svd. Evidence of motor programming deficits in children diagnosed with DAS. Journal of Speech, Language and Hearing Research. 2003;**46**(2):437

[67] Ho AK, Wilmut K. Speech and oro-motor function in children with developmental coordination disorder: A pilot study. Human Movement Science. 2010;**29**(4):605-614

[68] Gaines R, Missiuna C. Early identification: Are speech/language-impaired toddlers at increased risk for Developmental Coordination Disorder? Child: Care, Health and Development. 2007;**33**(3):325-32

[69] Webster RI, Majnemer A, Platt RW, Shevell MI. Motor function at school age in children with a preschool diagnosis of developmental language impairment. The Journal of Pediatrics. 2005;**146**(1):80-85

[70] Hill EL. Non-specific nature of specific language impairment: A review of the literature with regard to concomitant motor impairments. International Journal of Language & Communication Disorders. 2001;**36**(2):149-171

[71] Marton K. Imitation of body postures and hand movements in children with specific language impairment. Journal of Experimental Child Psychology. 2009;**102**(1):1-13

[72] Zelaznik HN, Goffman L. Generalized motor abilities and timing behavior in children with specific language impairment. Journal of Speech, Language, and Hearing Research. 2010;**53**(2):383-393

[73] Desmottes L, Meulemans T, Maillart C. Implicit spoken words and motor sequences learning are impaired in children with specific language impairment. Journal of the International Neuropsychological Society. 2016;**22**(5):520-529

[74] Vuolo J, Goffman L, Zelaznik HN. Deficits in coordinative bimanual timing precision in children with specific language impairment. Journal of Speech, Language, and Hearing Research. 2017;**60**(2):393-405

[75] Müürsepp I, Aibast H, Gapeyeva H, Pääsuke M. Sensorimotor function in preschool-aged children with expressive language disorder. Research in Developmental Disabilities. 2014;**35**(6):1237-1243

[76] Bishop DV, Edmundson A. Specific language impairment as a maturational lag: Evidence from longitudinal data on language and motor development. Developmental Medicine & Child Neurology. 1987;**29**(4):442-459

[77] Gillberg C. The ESSENCE in child psychiatry: Early symptomatic syndromes eliciting neurodevelopmental clinical examinations. Research in Developmental Disabilities. 2010;**31**(6):1543-1551

[78] Coleman A, Weir KA, Ware RS, Boyd RN. Relationship between communication skills and gross motor function in preschool-aged children with cerebral palsy. Archives of Physical Medicine and Rehabilitation. 2013;**94**(11):2210-2217

[79] Pirila S, van der Meere J, Pentikainen T, Ruusu-Niemi P, Korpela R, Kilpinen J, et al. Language and motor speech skills in children with cerebral palsy. Journal of Communication Disorders. 2007;**40**(2):116-128

[80] Teitelbaum P, Teitelbaum O, Nye J, Fryman J, Maurer RG. Movement analysis in infancy may be useful for early diagnosis of autism. Proceedings of the National Academy of Sciences. 1998;**95**(23):13982-13987

[81] Fournier KA, Hass CJ, Naik SK, Lodha N, Cauraugh JH. Motor coordination in autism spectrum disorders: A synthesis and meta-analysis. Journal of Autism and Developmental Disorders. 2010;**40**(10):1227-1240

[82] Gernsbacher MA, Sauer EA, Geye HM, Schweigert EK, Goldsmith HH. Infant and toddler oral- and manual-motor skills predict later speech fluency in autism. Journal of Child Psychology and Psychiatry. 2008;**49**(1):43-50

[83] Fedorenko E, Morgan A, Murray E, Cardinaux A, Mei C, Tager-Flusberg H, et al. A highly penetrant form of childhood apraxia of speech due to deletion of 16p11.2. European Journal of Human Genetics. 2016;**24**(2):302-306

[84] Abbs JH, Gracco VL, Cole KJ. Control of multi-movement coordination: Sensorimotor mechanisms in Speech motor programming. Journal of Motor Behavior. 1984;**16**(2):195-232

[85] Dunn W. The impact of sensory processing abilities on the daily lives of young children and their families: A conceptual model. Infants & Young Children: An Interdisciplinary Journal of Early Childhood Intervention. 1997;**9**(4):23-35 13p

[86] Miller LJ, Nielsen DM, Schoen SA, Brett-Green BA. Perspectives on sensory processing disorder: A call for translational research. Frontiers in Integrative Neuroscience. 2009;**3**:22

[87] Dunn W. Sensory Profile. San Antonio, TX: Psychological Corporation; 1999

[88] Ayres AJ. Improving academic scoresthrough sensory integration. Journal of Learning Disabilities. 1972;**5**(6):338-343

[89] Ayres AJ, Mailloux Z. Influence of sensory integration procedures on language development. American Journal of Occupational Therapy. 1981;**35**(6):383-390

[90] Fallon MA, et al. The effectiveness of sensory integration activities on language processing in preschoolers who are sensory and language impaired. Infant-Toddler Intervention: the Transdisciplinary Journal. 1994;**4**(3):235-243

[91] Newmeyer AJ, Aylward C, Akers R, Ishikawa K, Grether S, deGrauw T, et al. Results of the sensory profile in children with suspected childhood apraxia of speech. Physical & Occupational Therapy in Pediatrics. 2009;**29**(2):203-218

[92] Taal MN, Rietman AB, Meulen SV, Schipper M, Dejonckere PH. Children with specific language impairment show difficulties in sensory modulation. Logopedics, Phoniatrics, Vocology. 2013;**38**(2):70-78

[93] Tung L-C, Lin C-K, Hsieh C-L, Chen C-C, Huang C-T, Wang C-H. Sensory integration dysfunction affects efficacy of speech therapy on children with functional articulation disorders. Neuropsychiatric Disease and Treatment. 2013;**9**:87

[94] Pavão SL, Rocha NACF. Full length article: Sensory processing disorders in children with cerebral palsy. Infant Behavior and Development. 2017;**46**:1-6

[95] Sook-Hee Y, Yoo-Sook J, Yon Ho C, Eun-Hye K, Jeong-Yi K. Sensory processing difficulties in toddlers with nonorganic failure-to-thrive and feeding problems. Journal of Pediatric Gastroenterology & Nutrition. 2015;**60**(6):819

[96] Atchison BJ. Sensory modulation disorders among children with a history of trauma: A frame of reference for speech-language pathologists. Language, Speech, and Hearing Services in Schools. 2007;**38**(2):109-116

[97] Terband H, Maassen B. Speech motor development in childhood apraxia of speech: Generating testable hypotheses by neurocomputational modeling. Folia Phoniatrica et Logopedica. 2010;**62**(3):134-142

[98] Terband H, Maassen B, Guenther F, Brumberg J. Auditory–motor interactions in pediatric motor speech disorders: Neurocomputational modeling of disordered development. Journal of Communication Disorders. 2014;**47**:17-33

[99] Nasir SM, Ostry DJ. Somatosensory precision in speech production. Current Biology. 2006;**16**(19):1918-1923

[100] Groenen P, et al. The specific relation between perception and production errors for place of articulation in developmental apraxia of speech. Journal of Speech and Hearing Research. 1996;**39**(3):468-482

[101] Maassen B, Groenen P, Crul T. Auditory and phonetic perception of vowels in children with apraxic speech disorders. Clinical Linguistics & Phonetics. 2003;**17**(6):447-467

[102] Nijland L. Speech perception in children with speech output disorders. Clinical Linguistics & Phonetics. 2009;**23**(3):222-239

[103] Caruso AJ, Strand EA. Clinical Management of Motor Speech Disorders in Children. New York, NY, USA: George Thieme Verlag; 1999

[104] Murray E, McCabe P, Ballard KJ. A randomized controlled trial for children with childhood apraxia of speech comparing rapid syllable transition treatment and the Nuffield dyspraxia programme. Journal of Speech, Language, and Hearing Research. 2015;**58**(3):669-686

[105] Kent RD. Nonspeech oral movements and oral motor disorders: A narrative review. American Journal of Speech-Language Pathology. 2015;**24**(4):763-789

[106] Pennington L, Parker NK, Kelly H, Miller N. Speech therapy for children with dysarthria acquired before three years of age. The Cochrane Database of Systematic Reviews. 2016;**7**:CD006937

[107] Bahr D, editor. The oral motor debate: Where do we go from here. Poster session, ASHA convention; 2008

[108] Lof GL, Watson MM. A nationwide survey of nonspeech oral motor exercise use: Implications for evidence-based practice. Language, Speech, and Hearing Services in Schools. 2008;**39**(3):392-407

[109] McCauley RJ, Strand E, Lof GL, Schooling T, Frymark T. Evidence-based systematic review: effects of nonspeech oral motor exercises on speech. American Journal of Speech-Language Pathology. 2009;**18**(4):343-60

[110] Ruscello DM. Collective findings neither support nor refute the use of oral motor exercises as a treatment for speech sound disorders. Evidence-based Communication Assessment and Intervention. 2010;**4**(2):65-72

[111] Rycroft-Malone J, Seers K, Titchen A, Harvey G, Kitson A, McCormack B. What counts as evidence in evidence-based practice? Journal of Advanced Nursing. 2004;**47**(1):81-90

[112] Ray J. Functional outcomes of orofacial myofunctional therapy in children with cerebral palsy. The International Journal of Orofacial Myology: Official Publication of the International Association of Orofacial Myology. 2001;**27**:5-17

[113] Fischer-Brandies H, Avalle C, Limbrock G. Therapy of orofacial dysfunctions in cerebral palsy according to Castillo-Morales: First results of a new treatment concept. The European Journal of Orthodontics. 1987;**9**(1):139-143

[114] Forrest K, Luzzini J. A comparison of oral motor and production training for children with speech sound disorders. Seminars in Speech and Language. 2008;**29**(4):304-311

[115] Braislin MAG, Cascella PW. A preliminary investigation of the efficacy of oral motor exercises for children with mild articulation disorders. International Journal of Rehabilitation Research. 2005;**28**(3):263-266

[116] Edeal DM, Gildersleeve-Neumann CE. The importance of production frequency in therapy for childhood apraxia of speech. American Journal of Speech-Language Pathology. 2011;**20**(2):95-110

[117] Murray E, McCabe P, Ballard KJ. A randomized controlled trial for children with childhood apraxia of speech comparing rapid syllable transition treatment and the nuffield dyspraxia programme. Journal of Speech, Language, and Hearing Research. 2015

[118] Strand EA, Stoeckel R, Baas B. Treatment of severe childhood apraxia of speech: A treatment efficacy study. Journal of Medical Speech-Language Pathology. 2006;**14**(4):297-308

[119] Maas E, Butalla CE, Farinella KA. Feedback frequency in treatment for childhood apraxia of speech. American Journal of Speech-Language Pathology. 2012;**21**(3):239-257

[120] Maas E, Farinella KA. Random versus blocked practice in treatment for childhood apraxia of speech. Journal of Speech, Language, and Hearing Research 2012;**55**(2):561-578

[121] Maas E, Gildersleeve-Neumann CE, Jakielski KJ, Stoeckel R. Motor-based intervention protocols in treatment of childhood apraxia of speech (CAS). Current Developmental Disorders Reports. 2014;**1**(3):197-206

[122] Fox CM, Boliek CA. Intensive voice treatment (LSVT LOUD) for children with spastic cerebral palsy and dysarthria. Journal of Speech, Language, and Hearing Research. 2012;**55**(3):930-945

[123] Boliek CA, Fox CM. Individual and environmental contributions to treatment outcomes following a neuroplasticity-principled speech treatment (LSVT LOUD) in children with dysarthria secondary to cerebral palsy: A case study review. International Journal of Speech-Language Pathology. 2014;**16**(4):372-385

[124] Dale PS, Hayden DA. Treating speech subsystems in childhood apraxia of speech with tactual input: The PROMPT approach. American Journal of Speech-Language Pathology. 2013;**22**(4):644-661

[125] Grigos MI, Hayden D, Eigen J. Perceptual and articulatory changes in speech production following PROMPT treatment. Journal of Medical Speech-Language Pathology. 2010;**18**(4):46-53

[126] Namasivayam A, Pukonen M, Hard J, Jahnke R, Kearney E, Kroll R, et al. Motor speech treatment protocol for developmental motor speech disorders. Developmental Neurorehabilitation. 2015;**18**(5):296-303

[127] Square PA, Namasivayam AK, Bose A, Goshulak D, Hayden D. Multi-sensory treatment for children with developmental motor speech disorders. International Journal of Language & Communication Disorders. 2014;**49**(5):527-542

[128] Yu VY, Kadis DS, Oh A, Goshulak D, Namasivayam A, Pukonen M, et al. Changes in voice onset time and motor speech skills in children following motor speech therapy: Evidence from/pa/productions. Clinical Linguistics & Phonetics. 2014;**28**(6):396-412

[129] Ward R, Leitão S, Strauss G. An evaluation of the effectiveness of PROMPT therapy in improving speech production accuracy in six children with cerebral palsy. International Journal of Speech-Language Pathology. 2014;**16**(4):355-371

[130] Ward R, Strauss G, Leitão S. Kinematic changes in jaw and lip control of children with cerebral palsy following participation in a motor-speech (PROMPT) intervention. International Journal of Speech-Language Pathology. 2013;**15**(2):136-155

[131] Preston JL, Brick N, Landi N. Ultrasound biofeedback treatment for persisting childhood apraxia of speech. American Journal of Speech-Language Pathology. 2013;**22**(4):627-643

[132] Sensory integration and learning disorders. Los Angeles, CA, USA: Western Psychological Services; 1972

[133] Preis J, McKenna M. The effects of sensory integration therapy on verbal expression and engagement in children with autism. International Journal of Therapy and Rehabilitation. 2014;**21**(10):476

[134] Koberda J, Akhmatova N. Masgutova neurosensorimotor reflex integration (MNRI) as a new form of manual neuromodulation technique. Journal of Neurology and Neurobiology. 2016;**2**(5)

[135] Pilecki W. The impact of rehabilitation carried out using the masgutova neurosensorimotor reflex integration method in children with cerebral palsy on the results of brain stem auditory potential examinations. Age. 2012;**18**:21

[136] Svetlana Masgutova Educational Institute. Masgutova Neurosensorimotor Reflex Integration MNRI® Method. Available from: https://masgutovamethod.com/learn-more/articles#dv.i58

Section 2

New Research Results About Speech and Language

Chapter 8

Information and Impression Regarding ASD Questionnaire Answered by Foreigners Living in Brazil

Cibelle Albuquerque de la Higuera Amato,
Daniela Regina Molini-Avejonas and
Cristina de Andrade Varanda

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.70397

Abstract

Autism Spectrum Disorders (ASDs) constitute a group of disorders characterized by changes present at early ages and manifesting in the areas of development of communication, behavior, and interpersonal relationship. Because ASD significantly affects communication and the social skills, all multicultural context needs to be better investigated. There is an urgent need to understand the impact of migratory process, bilingual environment exposure on the language development of children with ASD. The present study aims to present the results of 657 foreign residents in Brazil that answered an online questionnaire to know the consolidated information about ASD. Participants from 23 countries responded to the survey. Bolivia and Argentina were the countries with the highest number of participants. The present study found that 100% of the participants have heard of autism. About 80.6% of the sample had a family member with autism. The sociodemographic diversity identified in this study reflects the sociocultural diversity present in Brazil, besides reinforcing the importance of considering this population when thinking about strategies and behaviors directed at individuals with ASD.

Keywords: Autism Spectrum Disorder, knowledge, lay beliefs, survey

1. Introduction

Autism Spectrum Disorders (ASDs) constitute a group of disorders characterized by changes present at early ages and manifesting in the areas of development of communication, behavior, and interpersonal relationship. Early diagnosis and intervention are essential for the prognosis [1]. The Centers for Disease Control and Prevention (CDC) estimate the prevalence of ASD to be 1 in 68 children [2]. The Diagnostic and Statistical Manual, Fifth Edition (DSM-5) [3], provides criteria to diagnose ASD. The two sets of criteria involved are related to social communication deficits and restricted, repetitive patterns of behavior, interests, or activities. The social and language difficulties characteristic of ASD make the speech therapist participation indispensable in any action for ASD.

Studies on language in ASD highlight that the greatest difficulty of these individuals is related to the functional use of language. Language skills are certainly the greatest perceived difficulties in individuals with ASD [4].

The pragmatic aspects of language involve specific communication skills, deficits in nonverbal communication, and difficulties adjusting behavior according to various social contexts, which includes language adjustment for different listeners. The characterization of language in the pragmatic perspective considers the relationship established between interlocutors, the communicative context, and the sociocultural elements involved [5].

For the communication to be effective, the interlocutor must be able to use the language in each situation appropriately, to understand social cues used in each context. This pragmatic competence includes verbal and nonverbal communication skills, besides considering the social understanding and the communicative context in which the communicative exchanges are carried out [5, 6].

Because ASD significantly affects communication and the social skills, all multicultural context needs to be better investigated. There is an urgent need to understand the impact of migratory process, bilingual environment exposure on the language development of children with ASDs.

In recent years, the world has experienced a great migratory movement. In 2015, the Department of Economic and Social Affairs (UN DESA) [7] registered the mark of 244 million international immigrants, an increase of 41% over the year 2000. The number of immigrants totaled 3.3% of the global population in 2015, while in 2000, they totaled 2.8%.

Some studies have pointed out the importance of investigating autism in an international setting considering all the cultural, social, and language implications involved in a migratory process [8–11].

Within this scenario, Brazil is characterized as a country of continental dimensions, with a territory of more than 8 million km^2 and with an estimated population of more than 206 million inhabitants. Many are the indexes that point to the existing inequality within the country as well as to the difficulties imposed by its size and diversity. Faced with this reality, there are very few population data, especially in terms of communication aspects, as well as access to specialized assessment and intervention programs. However, it is possible to know that just as in the world Brazil has also received many international immigrants. In 2015, there were 1,847,274 regular immigrants according to the statistics of the Brazilian Federal Police [12].

Cultural, social, and linguistic diversity needs to be considered when focusing on ASD diagnosis and intervention. Therefore, systematized research regarding the degree of knowledge and information that the population has about autism can contribute to the construction of a body of evidence that bases the decision making regarding proposals of intervention directed to those with ASD [13, 14].

http://dx.doi.org/10.5772/intechopen.70397

This premise originated a study [15] that had for its purpose the elaboration and application of an online questionnaire to know what the consolidated information that the Brazilian population has on the subject of autism. A total of 5000 people answered the survey of whom 657 were foreign residents in Brazil.

The participation of foreigners was not predicted by the study. None of the instruments used (invitation, questionnaire, and instructions) were elaborated in another language or with any additional resources that facilitated the participation of nonfluent citizens in Portuguese. As the participation of foreigners was not objective of the study, the information collected from the participants did not contemplate sufficient data to characterize the foreign participants. However, the spontaneous participation of 657 foreigners (13% of all study participants) reveals the urgent need to understand the particularities of this population and establish proposals for specific attention and care for them.

The present study aims to present the results of this group of foreigners, considering the particularities and importance in the deepening of the reflection at world level.

Immigration is an important phenomenon all over the world today. The results described in this chapter involve the participation of professionals and family members of children with ASD from 23 different countries. This certainly helps to increase the knowledge of how much this population has of information and impression regarding ASD. This better characterization and understanding becomes paramount for the different realities of countries that receive any kind of immigration phenomena.

2. Methods

An authorization was obtained from the Ethics Committee for Research of the host institution (protocol number: 954.385), which authorized the study and agreed with the request to waive the use of the free and informed consent term.

A total of 657 people participated in this study, who were willing to respond to a digital questionnaire composed of closed questions written in Portuguese. These people were contacted to participate in the survey by invitation received by e-mail or by publication in social network. The two invitations were also written in Portuguese. Each participant could forward the invitation to whom it considered pertinent. There was no way to identify the respondent or the device used to complete the questionnaire. As there was an exemption from the consent form, only completed questionnaires were considered, with the understanding that if the person answered all the questions and sent the answers she agreed to participate in the study. Completion of the questionnaire was done only in digital media because it was part of the study to consider the efficiency of this medium as a research tool.

A total of 4600 e-mails were sent per month at regular intervals throughout the 18-month period in which the questionnaire was available on the web. During this period, there was also 1 weekly publication in social networks, inviting to participate in the study.

The questionnaire was self-explanatory allowing to be answered in an autonomous way. The instrument contained five parts, the first involved information about the participant. The second block of questions sought to know if the participant already had some contact with the topic autism and how was given this contact. The third part of the instrument addressed the participant's knowledge about the etiology, signs, and symptoms of autism. The fourth part of the instrument sought to investigate the participant's knowledge about the variability of the symptoms of individuals with ASD. The last part of the questionnaire had as an objective to know from the perception of the participant which professionals are essential for the monitoring of the autistic individual.

Of the 5000 completed questionnaires, only 657 were considered for this study because they were answered by non-Brazilian citizens.

3. Results

3.1. Sociodemographic profile

The predominant age group of the participants was between 30 and 39 years of age, of the feminine gender, and of the race declared as white. The informant family income was between R$1000.00 and R$3000.00—equivalent to US$ 300.00 and 900.00 per month (**Table 1**).

Demographic information	**Classification**	***N***	**%**
Age group	18–29 years old	208	31.7
	30–39 years old	256	**39.0**
	40–49 years old	146	22.1
	50–59 years old	34	5.2
	Over 60 years old	13	2.0
Genre	Male	105	16.0
	Female	552	**84.0**
Race	White	410	**62.4**
	Yellow	105	16.0
	Brown	96	14.6
	Black	36	5.5
	Indigenous	10	1.5
Monthly household income	Less than US$300	89	13.5
	Between US$300 and US$900	226	**34.4**
	Between US$900 and US$1800	177	26.9
	More than US$1800	57	8.7
	Did not know	0	0.0
	Was not able to inform	108	16.5

Note: The data marked in bold represent the most frequent occurrences

Table 1. Description of the 657 participants in the study.

All study participants attended school. The majority completed higher education (25.9%) and the smallest part had postgraduation (4.3%) (**Table 2**).

Participants from 23 countries responded to the survey. Bolivia and Argentina were the countries with the highest number of participants (17.2 and 14.8%, respectively) (**Table 3**).

Level of education	Classification	*N*	%
	Elementary school	85	13.0
	Complete primary education	120	18.3
	High school	122	18.5
	Incomplete higher education	132	20.0
	Complete higher education	170	**25.9**
	Postgraduate studies	28	4.3

Note: The data marked in bold represent the most frequent occurrences

Table 2. Level of education of the 657 participants.

Country of origin	*N*	%
Bolivia	113	**17.2**
Argentina	97	**14.8**
Japan	79	12.0
China	54	8.2
Colombia	43	6.5
USA	37	5.6
Paraguay	33	5.0
Uruguay	29	4.4
Netherlands	28	4.3
Jordan	24	3.7
Lebanon	20	3.0
Spain	19	2.9
Haiti	16	2.4
Portugal	14	2.2
Greece	11	1.7
Italy	11	1.7
Peru	9	1.4
Indonesia	8	1.2
Germany	7	1.1
Belgium	2	0.3
Israel	1	0.2
Cuba	1	0.2
Chile	1	0.2

Note: The data marked in bold represent the most frequent occurrences

Table 3. The country of origin of the 657 participants.

3.2. Information about how the participant had access to the topic autism

All participants knew the term "autism" (100%). Most of them have an autistic individual in the family (87.8%) (**Tables 4** and **5**).

3.3. Information about what the participant knew about autism

The answers given to questions about the participant's knowledge about autism were categorized (**Table 6**). The percentage of occurrence was less than 10% only in the question about the contagion, and in seven questions, the answers were between 40 and 50% (**Table 7**).

3.4. Information about what the participant identifies as specific characteristics of an autistic person

The highest concordances as to the characteristics of autistic individuals are the difficulties of communication (77.2%) and do not answer to the name when called (74.1%) (**Table 7**).

3.5. Information on what professionals are indispensable for the care of an autistic individual

The professionals who presented the highest concordance as essential for the treatment of an autistic individual were: Neurologist (98.9%), Neuropediatrician (96.5%), Specialized Teacher (89.3%), Psychiatrist (89.3%), and Speech therapist (85.8%) (**Table 8**).

Means of access	*N*	%
TV	87	13.2
Desktop	116	17.7
Family	577	**87.8**
Website	398	60.6

Note: The data marked in bold represent the most frequent occurrences

Table 4. Means of access to the autism theme of the 657 participants.

Means of contact	*N*	%
Mother	343	**52.2**
Father	72	11.0
Family	114	17.4
Professional	128	19.5

Note: The data marked in bold represent the most frequent occurrences

Table 5. How the contact with the autistic individual occurred by the 657 participants.

Knowledge about autism	**Yes**		**No**	
	N	%	*N*	%
Is autism a disability?	427	65	230	35
Is autism a psychological state?	105	16	552	84
Is autism a social condition?	265	40.3	392	59.7
Is autism a disease?	321	48.9	336	51.1
Is autism an illness that you are born with?	287	43.7	370	56.3
Does autism have genetic origin?	81	12.3	576	87.7
Is autism hereditary? Do you move from a mother/father to a child?	67	10.1	590	89.9
Does autism have a cure?	390	59.4	267	40.6
Is autism contagious?	21	**3.2**	636	96.8
Is autism a rare disease?	104	15.8	553	84.2
Is autism an acquired illness?	227	34.5	430	65.5
Are there different types of autism?	301	45.8	356	54.2
Environmental factors cause autism?	157	23.9	500	76.1
Are there medications for autism?	201	30.6	456	69.4
Is there an exam that detects autism?	97	14.8	560	85.2
Is the cause of autism known?	147	22.4	510	77.6
Is the cause of autism determined?	169	25.7	488	74.3
Is autism a consequence of emotional trauma?	187	28.5	470	71.5
Is autism a developmental disorder?	301	45.8	356	54.2
Vaccine causes autism?	294	44.7	363	55.3

Note: The data marked in bold represent the most frequent occurrences

Table 6. What the participant knows about autism.

Specific characteristics	**All**		**Many**		**Some**		**None**	
	N	%	*N*	%	*N*	%	*N*	%
Isolation	361	55	158	24.1	43	6.5	5	0.9
Aggressive behaviors	66	10.4	183	27.85	251	38.2	157	23.89
Difficulty in social life	93	14.15	426	64.84	138	21	0	0
Do not make eye contact	154	23.43	207	31.5	152	23.13	144	21.91
Do not talk	257	39.11	354	53.88	36	5.47	10	1.52
Eye contact changed	216	32.87	194	29.52	158	24.04	22	3.34
Difficulty in communicating	507	77.16	134	20.39	16	2.43	0	0
Specific physical characteristics	150	22.83	4	0.6	3	0.45	410	62.4
Intellectual deficit	121	18,41	267	40.63	154	23.43	25	3.8

Specific characteristics	All		Many		Some		None	
	N	%	*N*	%	*N*	%	*N*	%
Special skills	132	20.09	232	35.31	187	28.46	106	16.13
Sleep disorders	60	9.13	163	24.8	69	10.5	365	55.55
Hearing compromised	29	4.41	110	16.74	320	48.7	198	30.13
Food difficulties	14	2.13	321	48.85	292	44.44	30	4.56
Visual impairments	170	25.87	0	0	0	0	487	74.12
Respiratory distress	28	4.26	160	24.35	0	0	469	71.38
Difficulty playing	187	28.46	274	41.7	196	29.83	0	0
No response when called by name	487	74.12	0	0	20	3.04	150	22.83
Absence of affection, affection for anyone	39	5.93	204	31.05	287	43.68	127	19.33
Repetition of phrases, decontextualized words (echolalia)	150	22.83	150	22.83	205	31.2	152	23.13
Can be independent, take over the conduct of one’s life	63	9.58	143	21.76	152	23.13	299	45.5
Behavior of waving, swinging, turning, or staring	354	53.88	8	1.21	11	1.67	284	43.22

Table 7. What the participant knows about the autistic person.

Essential professional	*N*	%
Neurologist	650	**98.9**
Neuropediatrician	634	**96.5**
Specialized teacher	587	**89.3**
Psychiatrist	587	**89.3**
Speech therapist	564	**85.8**
Pediatrician	509	77.5
Psychologist	460	70.0
Psychopedagogue	398	60.6
Nutritionist	354	53.9
Occupational therapist	325	49.5
Psychomotrist	201	30.6
Physical educator	125	19.0
Geneticist	109	16.6
Physiotherapist	107	16.3
Dentist	0	0.0

Note: The data marked in bold represent the most frequent occurrences

Table 8. Professionals essential to care for an autistic person.

4. Discussion

The study involved participants from 23 countries. Among the 23 countries, 10 countries are Spanish-speaking or Portuguese speaking, and 13 countries with more different languages, such as Greece, Lebanon, and Jordan. Unfortunately, the study did not provide information on participants' level of proficiency in Portuguese. Therefore, it is only possible to suppose that participants from Spanish-speaking countries had less difficulty answering the questionnaire than participants from countries with languages more distant from Portuguese. Another hypothesis to be considered is the possibility of participants using a digital tool as a resource to translate the questionnaire into their native language.

The present study found that 100% of the participants have heard of autism, and the level of autism awareness can be considered as high. The high level of awareness reported in the present study reflected the fact that 80.6% of the sample had a family member with autism. Women (84%) and mothers (52.2%) of autistic children mainly answered the questionnaire. These data suggest that the care of children with ASD is still responsibility of women, mothers, and professionals working with children with ASD.

Another aspect to be considered is the high level of education of the participants. This fact should have contributed to the study access and the possibility of responding to the questionnaire.

The low family income declared by the participants points to possible difficulties faced by foreigners, difficulties in adapting to different realities and culture.

Generally, the immigration process involves difficulties for social, school, and work adaptation. These difficulties can be hard hit by the presence of an autistic child who requires more care and closer and systematic follow-up in social and communication situations.

Many studies have investigated the information that the general population or specific groups have about autism. The autism knowledge in a health care setting [16], experiences of autism diagnosis [17], lay beliefs, and the role of cultural values [18]. A general population survey assessed autism awareness, knowledge about autism, and perceptions about autism interventions in Northern Ireland using a digital instrument and had similar results to those found in this study [19].

Other studies investigating language aspects of autistic children in bilingual [20–23], multicultural environments [24, 25], specifically with minority groups [26], of immigrants [27] reported aspects like those observed in this study. One study [10] was found that involved research into autism awareness and knowledge about autism specifically in foreigners.

The great migratory movement observed worldwide reflects in the growing ethnic and cultural diversity of the Brazilian population. This reality brings new challenges for professionals working in the field of health and education. Based on what is already happening in other countries [25], it is necessary to establish public proposals that guarantee the access of this population to basic services through culturally appropriate strategies. Specifically, the speech therapist must improve instruments and procedures that are efficient to distinguish what is characteristic of social adaptation, which is part of the heritage of culture, the native language, and what is really a communication disorder.

About ASD, it is necessary to ensure that all children have equal access to quality and early diagnosis. Speech-language assessment should be sensitive enough to distinguish cultural differences from communication disorders characteristic of ASD.

The speech pathologist has a responsibility to enhance knowledge about the social media profile characteristic of ASD, to strengthen information about the initial characteristics of ASD, and to improve early detection. The speech therapist should engage in the dissemination and awareness of the ASD by strengthening access to information and care for all by reducing social disparities.

5. Conclusion

The sociodemographic diversity identified in this study reflects the sociocultural diversity present in Brazil, besides reinforcing the importance of considering this population when thinking about strategies and behaviors directed at individuals with ASD. It is important to emphasize that all participants in the research were linked to people with autism or family ties or working with this population.

Since it was not the focus of the original study, it is not possible to know the exact situation of foreigners in Brazil, whether they are temporary workers, residents, or refugees. The fact is that regardless of the condition in which these people meet, the unique condition of the ASD mobilizes them to seek information and help. In this sense, the Internet becomes a very important tool because it allows reducing the sociocultural and linguistic distances that can so much impact the acquaintanceship of these people.

Social isolation and stigmatization may be intensified by economic, social, and linguistic difficulties in addition to limited awareness of autism.

Regardless of the condition of life, parents play a crucial role in the early identification and treatment of ASD. Their cultural beliefs about development and disability can influence the proximal processes and decisions about caring for their children.

Care must be taken to ensure that situations experienced by foreigners, such as social isolation, language difficulties, cultural diversity do not interfere with the diagnosis of ASD.

Acknowledgements

This project was supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

Author details

Cibelle Albuquerque de la Higuera Amato[1]*, Daniela Regina Molini-Avejonas[2] and Cristina de Andrade Varanda[3]

*Address all correspondence to: cibelleamato@gmail.com

1 Universidade Presbiteriana Mackenzie, São Paulo, Brazil

2 Universidade de São Paulo, São Paulo, Brazil

3 Universidade Paulista, Santos, Brazil

References

[1] Fernandes FDM, Amato CAH, Defense-Netvral DA, Balestro JI, Molini-Avejonas DR. Addressing Communication Difficulties of Parents of Children of the Autism Spectrum, Recent Advances in Autism Spectrum Disorders—Volume I, Fitzgerald M, editor. Croatia, InTech; 2013. DOI: 10.5772/53964. Available from: https://www.intechopen.com/books/recent-advances-in-autism-spectrum-disorders-volume-i/addressing-communication-difficulties-of-parents-of-children-of-the-autism-spectrum

[2] Centers for Disease Control and Prevention (CDC). Prevalence of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 sites, United States, 2010 (MMWR No. 63-SS02); 2014. Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/ss6302a1.htm

[3] American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, 5th ed. (DSM-V). Arlington, VA: American Psychiatric Association; 2013

[4] Fernandes FDM, et al. Orientação a mães de crianças do espectro autístico a respeito da comunicação e linguagem. Jornal da Sociedade Brasileira de Fonoaudiologia. 2011; **23**(1):1-7

[5] Westby C. Social-emotional bases of pragmatic and communication development In: Singleton NC, Shulman BB. Language Development—Foundations, Processes and Clinical Applications. EUA, Jones & Bartlett Learning; 2010. pp. 119-146

[6] Riquelme LF, Rosas J. Multicultural perspectives: The road to cultural competence. In: Singleton NC, Shulman BB. Language Development—Foundations, Processes and Clinical Applications. EUA, Jones & Bartlett Learning; 2010. pp. 231-249

[7] United Nations, Department of Economic and Social Affairs, Population Division. International Migration Report 2015: Highlights (ST/ESA/SER.A/375); 2016. Retrieved from http://www.un.org/en/development/desa/population/migration/publications/migrationreport/docs/MigrationReport2015_Highlights.pdf

[8] Siller M, Morgan L, Swanson M, Hotez E. Promoting Early Identification of Autism in the Primary Care Setting: Bridging the Gap Between What We Know and What We Do, Recent Advances in Autism Spectrum Disorders—Volume I, Fitzgerald M, editor. Croatia, InTech; 2013. DOI: 10.5772/53715. Available from: https://www.intechopen.com/books/recent-advances-in-autism-spectrum-disorders-volume-i/promoting-early-identification-of-autism-in-the-primary-care-setting-bridging-the-gap-between-what-w

[9] Crafa D. Migration and Autism Diagnosis, Autism—Paradigms, Recent Research and Clinical Applications. Fitzgerald M, editor. InTech; 2017. DOI: 10.5772/65981. Retrieved from: https://www.intechopen.com/books/autism-paradigms-recent-research-and-clinical-applications/migration-and-autism-diagnosis

[10] Ijalba E. Hispanic immigrant mothers of young children with Autism Spectrum Disorders: How do they understand and cope with autism? American Journal of Speech-Language Pathology. 2016 May;**25**:200-213. Retrieved from: http://ajslp.pubs.asha.org

[11] Stronach ST, Wetherby AM. Observed and Parent-Report measures of social communication in Toddlers with and without Autism Spectrum Disorder across Race/Ethnicity. American Journal of Speech-Language Pathology. 2017 May;**26**:355-368. Retrieved from: http://ajslp.pubs.asha.org/pdfaccess.ashx?url=/data/journals/ajslp/936252/

[12] Brasil. Departamento de Migrações da Secretaria Nacional de Justiça e Cidadania Ministério da Justiça. Brasília: Ministério da Justiça; 2016

[13] Keen D, Rodger S, Doussin K, Braithwaite M. A pilot study of the effects of a social-pragmatic intervention on the communication and symbolic play of children with autism. Autism. 2007;**11**(1):63-71

[14] Sutera A, Pandey J, Esser EL, Rosenthal MA, Wilson LB, Barton M, et al. Predictors of optimal outcome in toddlers diagnosed with autism spectrum disorders. Journal of Autism and Developmental Disorders. 2007;**37**(1):98-107

[15] Amato CAH, Varanda CA, Molini-Avejonas DR. Questionário digital sobre o conhecimento da população geral sobre autismo—analise preliminar. CoDAS. 2017; Epub ahead of print

[16] Heidgerken AD, Geffken G, Modi A, Frakey L. A survey of autism knowledge in a health care setting. Journal of Autism and Developmental Disorders. 2015;**35**(3):323-330

[17] Crane L, Chester JW, Goddard L, Henry LA, Hill E. Experience of autism diagnosis: A survey of over 1000 parents in the United Kingdom. Autism. 2016;**20**(2):153-162

[18] Qi X, Zaroff CM, Bernardo AB. Autism spectrum disorder etiology: Lays beliefs and the role of cultural values and social axioms. Autism. 2016;**20**(6):673-686

[19] Dillenburger K, Jordan JA, McKerr L, Devine P, Keenan M. Awareness and knowledge of autism and autism interventions: A general population survey. Research in Autism Spectrum Disorders. 2013;**7**(12):1558-1567

[20] Lund EM, Kohlmeier TL, Durán LK. Comparative language development in bilingual and monolingual children with Autism Spectrum Diosrder: A Systematic Review. Journal of Early Intervention. 2017;**39**(2):106-124

[21] Petersen J, Marinova-Todd SH, Mirenda P. An exploratory study of lexical skills in bilingual children with Autism Spectrum Disorder. Journal of Autism and Developmental Disorders. 2012;**42**(7):1499-1503

[22] Hambly C, Fombonne E. The impact of bilingual environments on language development in children with autism spectrum disorders. Journal of Autism and Developmental Disorders. 2012;**42**(7):1342-1352

[23] Kohnert K, Yim D, Nett K, Kan PF, Duran L. Intervention with linguistically diverse preschool children: A focus on developing home languages(s). Language, Speech and Hearing Services in Schools. 2005;**36**:251-263

[24] Winsler A, Burchinal MR, Tien H-C. Early development among dual language learners: The roles of language use at home, maternal immigration, country of origin, and socio-demographic variables. Early Child Research Quaterly. 2014;**29**(4):750-764

[25] Stronacha ST, Wetherby AM. Observed and parent-report measures of social communication in toddlers with and without Autism Spectrum Disorder across race/ethnicity. American Journal of Speech-Language Pathology. 2017;**26**:355-368

[26] Yua B. Issues in bilingualism and heritage language maintenance: Perspectives of minority-language mothers of children with Autism Spectrum Disorders. American Journal of Speech-Language Pathology. 2013;**22**:10-24

[27] Reetzke R, Zou X, Sheng L, Katsosb N. Communicative development in bilingually exposed Chinese Children with Autism Spectrum Disorders. Journal of Speech, Language, and Hearing Research. 2015;**58**:813-825

Chapter 9

Comparison of the Results of Token Test and Sentence Comprehension Test in Pre-school Czech Children with Typical Language Development and with Speech-Language Disorders

Renata Mlčáková

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69709

Abstract

27 pre-school (26 native Czech-speaking and 1 native Russian-speaking) children (age 4; 6–7; 9 and gender 18 m; 9 f); 17 children with speech and language disorders from speech and language kindergarten (SLK) and 10 children with typical language development (TLD) from a kindergarten of common type, received two tests of language comprehension, the Token Test (TT) and the subtest from the Heidelberg Language Development Test (H-S-E-T) called The Sentence Comprehension Test (SCT). The results of the TT (success rate of children with TLD was 77%; children from SLK scored 70%) surpassed the results of the SCT (children with TLD 59%; children from SLK 44%) in both groups. The most severe deficiencies have been observed in children with SLI and a boy with severe bilateral sensorineural hearing loss. The observed differences between the means in both groups (TLD, $N = 10$; SLD, $N = 17$) were not statistically significant, using Student's t-test (TT, $p = 0.28$; SCT, $p = 0.11$). There were not statistically significant differences between the means in children from three compared groups (TLD, $N = 10$; SLI, $N = 8$; articulation disorders, $N = 6$), using the ANOVA (TT, $p = 0.60$; SCT, $p = 0.23$).

Keywords: specific language impairment, comprehension, language disorders

1. Introduction

This paper focuses on understanding sentences communicated via oral speech in pre-school children. As reported by Smolík and Seidlová-Málková [1], only grammatical knowledge can help a child in recognizing different meanings of phrases, such as *"A cat chases a dog"* and

"A cat is chased by a dog." We decided to observe the issue of understanding oral speech in pre-school children because it far exceeds school education and offers new areas for research exploration. School work is imbued with permanently working with a given language in the area of reception (understanding) and expression (production)—in the speaking, reading and written forms. In some cases, pre-school children who face difficulties in understanding words, sentences and context will not correctly understand verbal information and may experience aggravated conditions of education in the school, although their problems may not be visible "at a glance."

2. Basic terminology

The concept of **comprehension** [2, 3] can be seen as a comprehension of relationship, respect, sense, and the substance of the problem; as a method of cognition, understanding is similar to intuition, and it is achieved directly. In speech therapy, the issue of understanding is closely related to the areas of language disorders. Language disorders pose difficulties in language encoding or decoding; they include difficulties in verbal communication, understanding, reading, writing, and problem-solving; in terms of processing language symbols, language disorders are divided into receptive and expressive. In case of a receptive language disorders (RLD), the understanding of words or sentences is disrupted. RLD affectees have difficulty in understanding the meaning of words and phrases when exposed to them, for example, they are asked to point at a named object or image, handling according to instructions is complicated, and demandingness increases with the length of sentences, variety of tasks, the use of a negation, etc. An important prerequisite for understanding the language is physiological and distinct speech (e.g., pronunciation, fluency, prosody) of the examiner. Expressive language disorder (ELD) causes difficulty with verbal expression, i.e., difficulty in formulating thoughts, difficulty in finding words, naming objects, in the lack of appropriate vocabulary, difficulty with semantics (linguistic branch of science, the science of meaning of words, phrases, and communications), difficulty with phonology (refers to speech sound, sound patterns, and rules of sound organization), difficulty with morphology (rules describing the form taken by individual words), and deficiencies in syntax (rules for building words in sentences) [2]. According to Prucha [4], the qualitative aspect of the process of learning the meanings of words, i.e., learning words as semantic categories, is illustrated much less than the quantitative aspect of learning vocabulary by children. According to Lerner and Johns [5], children with difficulties in understanding the language can understand separate simple words, such as "*to sit,*" "*chair,*" "*to eat,*" and "*biscuit,*" but they will have difficulty in understanding the sentence in which these words are used, such as: "*Sit in the chair only after eating the biscuit.*"

Developmental language disorders include **specific language impairment** (SLI). SLI is manifested by impaired ability or inability to learn to communicate verbally even if the conditions for the development of language (speech) are adequate [2]. According to Mikulajová [6], it is a neurobiological developmental disorder of speech; the children have impaired ability to understand speech and/or express themselves in speech compared to their peers. According to Shipley and McAfee [7], a seemingly pure language impairment with no obvious cause or

http://dx.doi.org/10.5772/intechopen.69709

co-occurring condition. With SLI, the main symptoms of language nature include difficulty in producing speech and understanding words, sentences or context. According to Lorusso et al. [8], linguistic impairments in children with SLI disrupt abstract language processing more than visual-motor impairments in nonverbal learning disabilities.

Speech sound disorders include problems with articulation—**articulation disorder** (making sounds) and **phonological disorders** (sound patterns).The ability of humans to produce sounds is used to convey a message, and the act of producing such sounds is identified as **articulation**, and this activity is a major component of speech as distinguished from the term language [9, p. 6]. **Phonological disorders** form a group of language disorders that affect the ability of the child (usually around 3 to 4 years of age) to mimic the speech patterns of words in adults; they affect the ability to learn and organize sounds into words. It is reported that the children show auditory discrimination problems and acoustic feedback weakening; these problems occur at the linguistic level, and they are not related to the creation of sounds by vocal organs [2].

3. Research objectives

The author of the contribution collected the research data during June 2016. In children of the selected research sample, the research goals were set as follows:

- Investigate understanding of oral speech by two methods.
- Evaluate the results of understanding oral speech.
- Compare the success of children in understanding oral speech in terms of the type of kindergarten.

4. Research methods

Regarding the research methods of data collection, the oral speech understanding component was examined using the Token Test (TT) [10] and the Sentence Comprehension Subtest from the Heidelberg Language Development Test [11]. In all participating participants, with the consent of children's legal representatives, the examinations using the Token Test and Sentence Comprehension Subtest were recorded on a video camera. The video was taken with the intent to evaluate the children's reactions as precisely as possible. In all 27 children from the research sample, their oral speech understanding was examined by the author of this article. At the conclusion of the entire examination, the examiner briefly assessed the children's work: "You see, well you made it."

4.1. Token Test

Token Test (TT) assesses understanding of orally communicated sentences. It is a widely used diagnostic method utilized in the field of children's language, in neuropsychology and cognitive investigations in general [1]. According to Ref. [10], all versions of the Token Test are based on the original work by Ennio De Renzi and Luigi Amadeus Vignola (1962 in Bolceková et al. [10]). For children, there is a Token Test for Children-Second Edition TTFC-2 (McGhee et al., 2007 in Paul and Norbury [12]). In our research, we used a shortened version of TT with 36 items divided into six parts. For examinations, we needed 20 tokens, varying in size (large and small), shape (round and square), and color (blue, green, yellow, white, and red). The proband's task was to handle the tokens according to instructions of the examiner. Demands on verbal working memory gradually increase in the first five parts, e.g., "*Touch the circle. Touch the blue shape. Touch the white square. Touch the large yellow circle. Touch the white square and the green circle. Touch the big white square and the small green circle.*" In the sixth part, the instructions are more complex and their proper fulfillment requires proper understanding of grammatical structures, e.g., "*Touch the blue circle with the red square. When it is a black circle, touch the red square. After touching the yellow circle, touch the blue circle.*" The demandingness of the instructions increases with the number of tokens involved in one handling and the number of characteristics (color, shape, and size), which must be considered for proper execution of the instruction. Correct and incorrect responses/reactions were evaluated by one or zero points, respectively. Each child could receive a maximum of 36 points. When assessing the level of understanding of oral speech, we used the following criteria: 29–36 points = no disorder, 25–28 points = minor disorder, 17–24 points = moderate disorder, 9–16 points = severe disorder, and 0–8 points = very severe disorder [10].

4.2. Sentence Comprehension Test

Twenty-seven children received a subtest from the Heidelberg Language Development Test H-S-E-T (Heidelberg speech evolution test, henceforth H-S-E-T) [11] called the Sentence Comprehension Test (SCT). The Heidelberg Language Development Test was originally created to the German language and was adapted from German to Slovak language by Mikulajová [11], translated to the Czech language by Smékalová [11]. The test is not standardized for the Czech language, and the orientation standards taken from Slovakia are applied. We do not have many options in the Czech Republic to diagnose language development in childhood, and the area of understanding the syntactic structures can be diagnosed by the Sentence Comprehension Subtest by a speech-language pathologist. H-S-E-T is intended for children from 4 to 9 years of age; it has 13 subtests and assesses the level of language skills. Individual subtests of the H-S-E-T, for example, focus on sentence comprehension, the ability to form plurals and singulars, on repeating phrases, the ability to form derived words, ability to form sentences, and other language areas. Subtest Sentence Comprehension Test (SCT) contains 10 instructions of varying grammar complexity; the task of a child is to handle objects according to instructions spoken by the examiner. Examples of instructions (for 5-year-old and older children) are the following sentences: "*The duck swam before the sheep lay down. The rabbit let the cat stroke the dog. A grass-hopper will jump before the dog runs.*" Grimmová et al. [11] indicate that the child will resolve these tasks incorrectly when insisting only on surface strategies without penetrating into the semantic depth of sentences. Children's reactions are evaluated as either correct or incorrect. Correct and incorrect responses are evaluated by one or zero points, respectively. In the subtest, children could receive a maximum of 10 points.

http://dx.doi.org/10.5772/intechopen.69709

5. Research sample

The research sample consisted of 27 children ranging in age from 4 years and 6 months to 7 years and 9 months. These children were from the pre-school section of two kindergartens in the Czech Republic. Ten children (37% of the monitored sample) attended a kindergarten of common type—this group included children (labeled P1-P10) with typical language development. Seventeen children (P11-P27), which means 63% of the monitored sample, attended a speech and language kindergarten due to communication difficulties. As shown in **Figure 1**, we worked with 14 boys and 3 girls in the speech and language kindergarten and with four boys and six girls in the kindergarten of common type.

We selected our specific participants in order to point out at difficulties in oral speech comprehension in children with speech-language disorders, especially with developmental language disorders. Their difficulties in sentence comprehension are not visible "at a glance."

Regarding the 17 children from the speech and language kindergarten, school attendance in eight of them (47%) was postponed by 1 year. The situation was different in children from the kindergarten of common type; none of the 10 examined children had deferred school attendance. The youngest child was participant P6 from the kindergarten of common type, aged 4 years and 6 months. The oldest child from the kindergarten of common type (P3) was aged 6 years and 9 months. At the time of examination, the oldest participant (P14)—a boy from the speech and language kindergarten—was aged 7 years and 9 months. The youngest participant (P25) from the speech and language kindergarten was aged 5 years and 9 months.

We were interested in the sample composition **for reason of inclusion in the speech and language kindergarten** (**Figure 2**). Children-participants were labeled P11 up to P27. One of them (P14) was diagnosed with delayed speech development and minor articulation disorder. Four children (P15, P16, P17 and P22) had severe articulation disorder, which

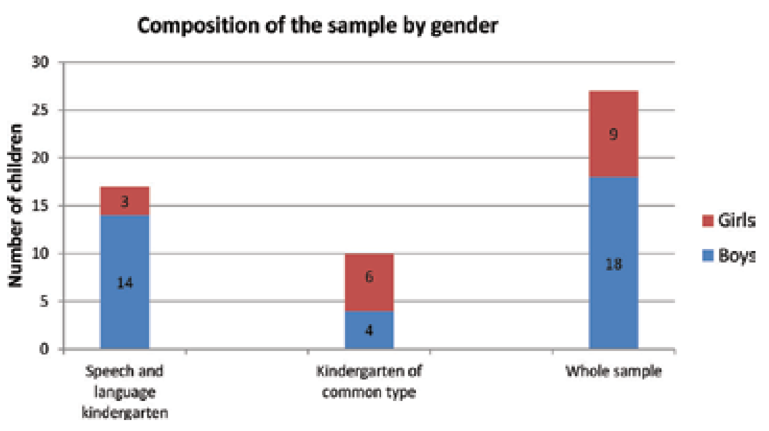


Figure 1. Composition of the sample by gender.

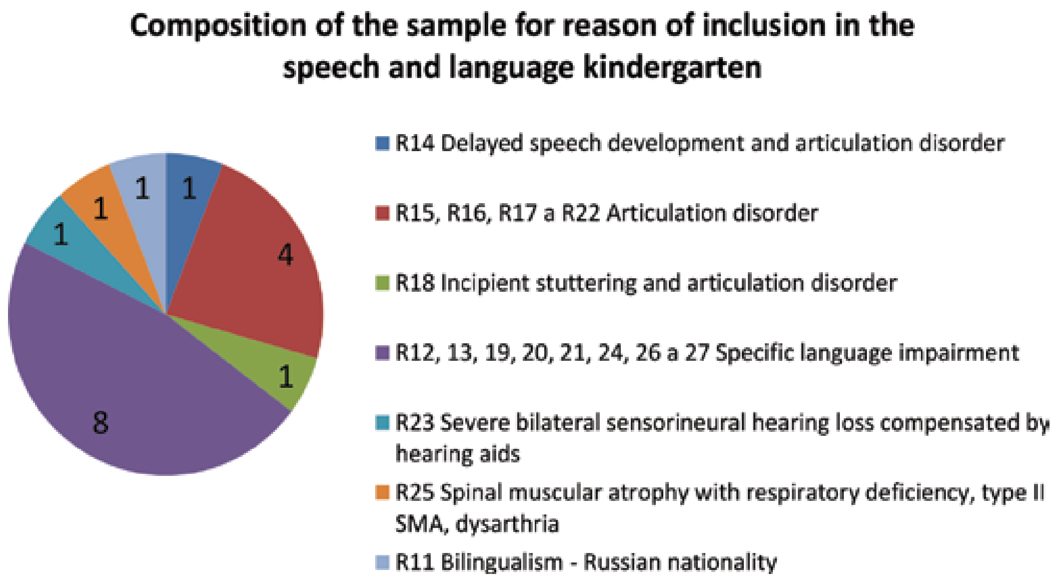


Figure 2. Composition of the sample for reason of inclusion in the speech and language kindergarten.

was accompanied by difficulties in graphomotorics, visual motor skills, oral motor skills, and auditory and visual perception in various combinations. Participant P18 struggled with incipient stuttering, impaired articulation, difficulty in graphomotorics, and visual perception. Eight children (P12, 13, 19, 20, 21, 24, 26, and 27) attended the speech and language kindergarten due to SLI, dysgrammatismus, difficulties in speech comprehension and production, difficulties in graphomotorics, oral motor skills, visual motor skills, and visual and auditory perception. One boy (P23) was diagnosed with severe bilateral sensorineural hearing loss compensated by hearing aids, difficulties in graphomotorics, and visual perception. Another boy (P25) struggled with symptomatic speech disorder in terms of dysarthria based on primary impaired mobility, spinal muscular atrophy with respiratory deficiency, and type II SMA. Examination of understanding of oral speech in this boy (P25) took place in the presence of an assistant teacher who cares for the boy in his kindergarten. Participant P11 came from a Russian-speaking environment and had slight difficulty in producing speech; his speech contained specific grammar errors and incorrect articulation.

6. Results

The success results of the children in the Token Test are shown in **Figure 3**. These results are expressed by the number of points—the absolute rate of successful responses. The risk of moderately severe comprehension disorder (17–24 achieved points of a total of 36 points) was observed in seven participants (P13, P14, P15, P17, P19, P20 and P27) from the speech and language kindergarten (**Tables 1** and **2**). In participants P13, P19, P20 and P27, the deficits

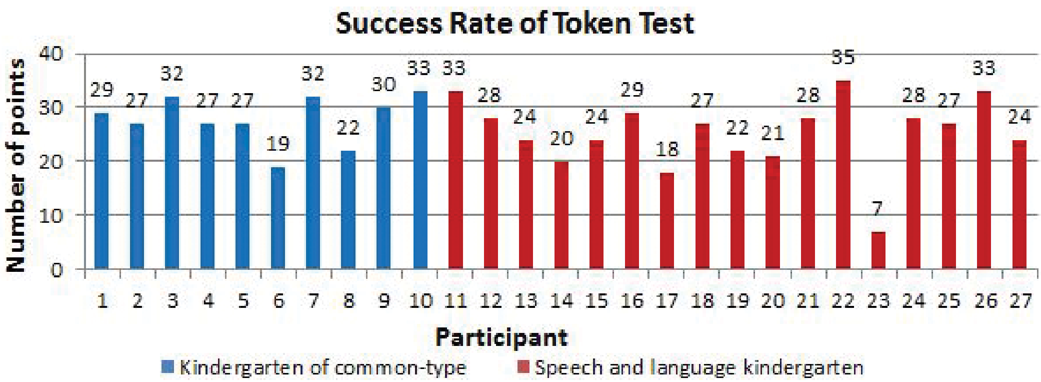


Figure 3. Success rate of Token Test.

Number of points	Degree of understanding of oral speech
29–36	No disorder
25–28	Minor disorder
17–24	Moderate disorder
9–16	Severe disorder
0–8	Very severe disorder

Table 1. Degree of understanding of oral speech (according to DeRenzi and Faglioni, 1978 in Bolceková et al. [10]).

Participant	Number of correct responses (n)	Relative number (in %)
P13	24	67
P14	20	56
P15	24	67
P17	18	50
P19	22	61
P20	21	58
P23	7	19
P27	24	67

Table 2. Results in Token Test at children with comprehension disorders.

were associated with SLI diagnosis. Participants P14, P15 and P17 attended the speech and language kindergarten due to impaired articulation and phonological disorder. The risk of very severe comprehension disorder (0–8 achieved points of a total of 36 points) was found in one boy (P23) with severe bilateral sensorineural hearing impairment compensated by hearing aids. The two youngest participants (P6, 4 years and 6 months, and P8, 5 years and 4 months) achieved 19 and 22 points; these results, however, were predicted because of their age. A positive development of language functions was indicated in both of these boys, and it could be assumed that their oral speech comprehension would continue to develop positively.

The most difficult instruction of the Token Test was the 29th where the least number of children was able to follow it (*N* = 6, 22%): *"If there is a black circle, touch the red square."* Only seven children (26%) successfully reacted to the 25th instruction: *"Touch the blue circle with a red square."* Ten out of 27 (37%) successfully performed the 30th, 34th, and the 36th instruction: *"Put the green square next to a red circle. Touch the red circle, not the white square. After touching the yellow circle, touch the blue circle."*The instructions no. 5, 6, and 7: *"Touch a blue shape. Touch a green shape. Touch a white shape."* were all successfully completed by every child.

Figure 4 and **Table 3** show that the most pronounced difficulties with sentence comprehension (H-S-E-T) occurred in participants P13, P14, P17, P20, P23, and P25. Participants P19, P21, and P27 gave only four correct responses out of 10. Instruction processing was very difficult in participants with SLI (P13, P19, P20, P21 and P27) and also in participants P14 and P17 who struggled with impaired articulation and phonological disorder. We observed serious problems in the area of comprehension in P23, the boy with severe bilateral sensorineural hearing impairment compensated by hearing aids, and P25, the boy with dysarthria pursuant to spinal muscular atrophy with respiratory deficiency, type II SMA. Considerable difficulties were associated with the implementation of instructions containing time sequences expressed by prepositions *"before"* and *"after."* Children were the most successful in following the third instruction, which, as the only one, was expressed in a simple sentence of four words. Twenty-four children (89%) correctly followed the third instruction. The other nine sentences contained six or seven words, which demanded, apart from adequate language processing of the sentence, a high level of working verbal-acoustic memory.

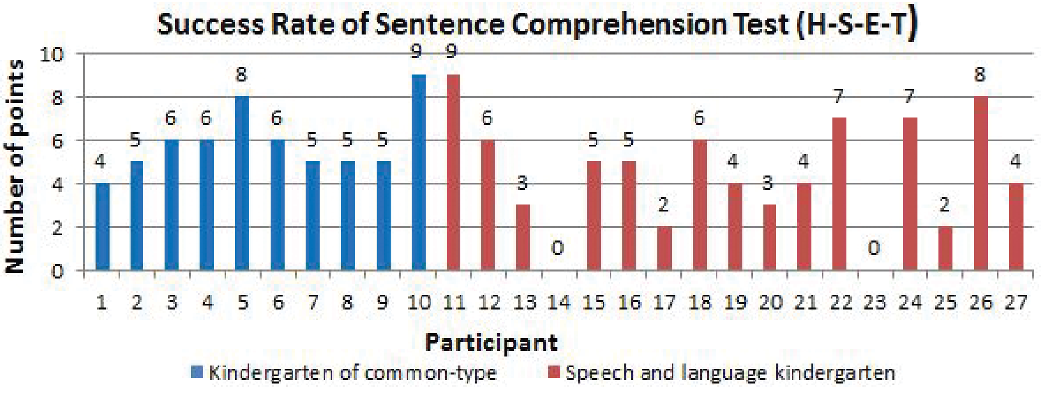


Figure 4. Success rate of Sentence Comprehension Test (H-S-E-T).

Participant	Number of correct responses (n)	Relative number (in %)
P1	4	40
P13	3	30
P14	0	0
P17	2	20
P19	4	40
P20	3	30
P21	4	40
P23	0	0
P25	2	20
P27	4	40

Table 3. Results in Sentence Comprehension Test at children with comprehension disorders.

7. Conclusions

In the monitored groups, we noted differences in the results of the Token Test and Sentence Comprehension Test, in favor of children from the kindergarten of common type. **Figure 5** shows that children with typical speech development from the kindergarten of common type achieved an average success of 77% in the Token Test and 59% in the Sentence.

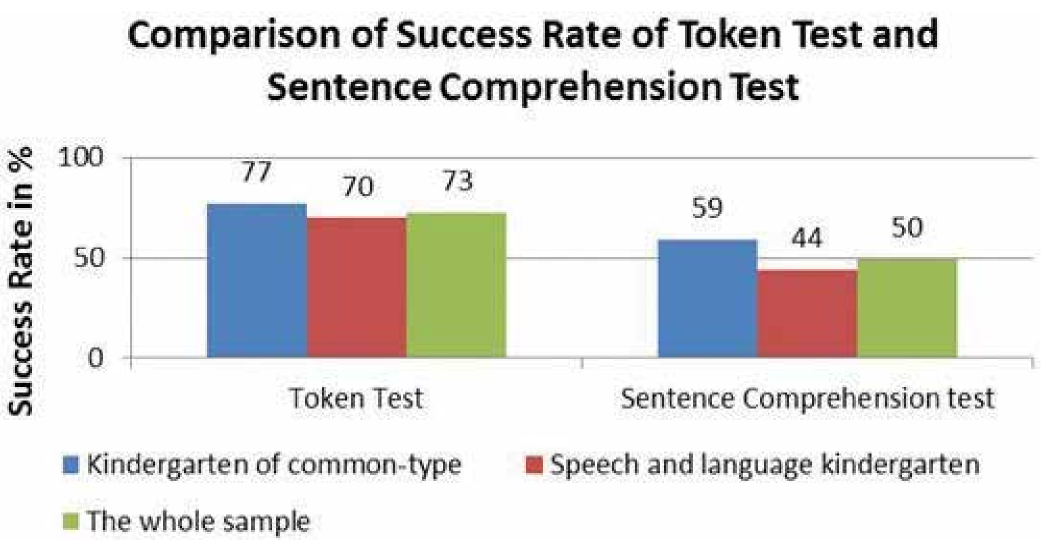


Figure 5. Comparison of success rates of Token Test and Sentence Comprehension Test.

Comprehension Test: children from the speech and language kindergarten achieved an average success of 70% in the Token Test and 44% in the Sentence Comprehension Test. **Figure 5** shows that children with TLD were more successful in the Token Test by 7% and by 15% in the Sentence Comprehension Test than children from SLK.

The results obtained with children with typical language development are within what should be expected due to their age, due to their intact language development in pragmatics, semantics, syntax, phonology as so as intact development in cognitive area.

The difference in achievements on the part of the children was wider in the Sentence Comprehension Subtest. This subtest was more difficult for both groups. In the Token Test, the resulting differences may appear to be small. However, it is necessary to consider differences in the age composition of the groups. The average age of children from the speech and language kindergarten was 6 years and 5 months, while the children from the kindergarten of common type were younger by 11 months–their age was 5 years and 6 months on average. It is, therefore, important to note that even a small difference between the results in favor of children from the kindergarten of common type had its predicative value. The weaker results of children from the speech and language kindergarten (**Table 4**) can be justified by shortcomings in the development of reception, language processing and expression. Higher error rate was observed in children with developmental language disorders (SLI) and associated deficits in cognitive abilities (P13, P19, P20 and P27). In one boy (P23), the difficulties in understanding were the consequence of severe hearing impairment. We believe that participants P14 and P17—enrolled in the speech and language kindergarten due to impaired articulation—should be differentially diagnosed in order to examine the level of sentence comprehension and other areas of communication skills since their difficulties in understanding could be primarily based on SLI. The boy with dysarthria based on spinal muscular atrophy (P25) had severe issues with the Sentence Comprehension Test.

The most severe deficiencies in oral speech comprehension have been observed in children with SLI and in a boy with severe bilateral sensorineural hearing loss. Deficits appeared in the understanding of six to nine-word instructions in the Token Test and in the Sentence Comprehension Test.

7.1. Statistical analysis of the results

The average score in the Token Test and in the Sentence Comprehension Test in children from kindergarten of common-type and children from speech and language kindergarten was compared using Student's *t*-test.

As can be seen in **Table 5**, there are not statistically significant differences between the mean results in the Token Test of children with TLD from kindergarten of common type and in children with speech-language disorders in speech and language kindergarten (calculated value of significance $p = 0.28$).

There are not statistically significant differences between the mean results of the Sentence Comprehension Test of children with TLD from kindergarten of common type and in children

Participant	Gender	Age (years; months)	Diagnosis	Token Test		Sentence Comprehension Test	
				n/36	%	n/10	%
P1	m	6;1	TLD	29	81	4	40
P2	f	5;9	TLD	27	75	5	50
P3	m	6;9	TLD	32	89	6	60
P4	f	5;9	TLD	27	75	6	60
P5	f	4;8	TLD	27	75	8	80
P6	m	4;6	TLD	19	53	6	60
P7	m	6;0	TLD	32	89	5	50
P8	f	5;4	TLD	22	61	5	50
P9	f	4;11	TLD	30	83	5	50
P10	f	6;8	TLD	33	92	9	90
P11	m	7;1	BLV	33	92	9	90
P12	m	5;10	SLI	28	78	6	60
P13	**f**	**5;10**	**SLI**	**24**	**67**	**3**	**30**
P14	*m*	*7;9*	*DSD, MAD*	*20*	*56*	*0*	*0*
P15	m	5;10	SAD	24	67	5	50
P16	m	6;3	SAD	29	81	5	50
P17	*m*	*6;0*	*SAD*	*18*	*50*	*2*	*20*
P18	m	6;3	Stutter, AD	27	75	6	60
P19	**m**	**7;6**	**SLI**	**22**	**61**	**4**	**40**
P20	**f**	**7;6**	**SLI**	**21**	**58**	**3**	**30**
P21	m	6;10	SLI	28	78	4	40
P22	m	6;10	SAD	35	97	7	70
P23	**m**	**6;8**	**HL**	**7**	**19**	**0**	**0**
P24	f	6;10	SLI	28	78	7	70
P25	m	5;9	Dysarthria	27	75	2	20
P26	m	7;2	SLI	33	92	8	80
P27	**m**	**6;7**	**SLI**	**24**	**67**	**4**	**40**

Notes: n/36, number of correct responses in Token Test; n/10, number of correct responses in Sentence Repetition Test; %, relative number, number of correct responses in %; TLD, typical language development; BLV, a boy from Russian-speaking family, specific errors in grammar and incorrect articulation; SLI, specific language impairment; DSD, delayed speech development; MAD, minor articulation disorder; SAD, severe articulation disorder; Stutter, incipient stuttering; AD, articulation disorder; HL, severe bilateral sensorineural hearing loss compensated by hearing aids; Dysarthria, dysarthria pursuant to spinal muscular atrophy with respiratory deficiency, type II SMA.

Table 4. Data about gender, age, diagnosis, and results in Token Test and Sentence Comprehension Test.

Variable	*t*-Tests; grouping: kindergarten (DATA) Group 1: kindergarten of common-type (KCT) Group 2: speech and language kindergarten (SLK)								
	Mean KCT	Mean SLK	*t*-value	df	*p*	Valid N KCT	Valid N SLK	Std. Dev. KCT	Std. Dev. SLK
Token/36	27.80	25.18	1.11	25	0.28	10	17	4.49	6.64
SCT/10	5.90	4.41	1.64	25	0.11	10	17	1.52	2.60

Table 5. Means and standard deviations of results in TT and SCT.

with speech-language disorders in speech and language kindergarten (calculated value of significance $p = 0.11$) (**Table 5**).

The average mean in the Token Test and in the Sentence Comprehension Test in three compared groups (TLD, $N = 10$; SLI, $N = 8$; and articulation disorders AD, $N = 6$) was compared using the analysis of variance (ANOVA).

There are not statistically significant differences between the mean results in the Token Test in children from three compared groups (TLD, SLI, and AD) (calculated value of significance $p = 0.60$) (**Table 6**).

Cell No.	Group; LS means (DATA) Current effect: $F(2, 21) = 0.53084$, $p = 0.60$ Effective hypothesis decomposition					
	Group	Token/36 Mean	Token/36 Std. Err.	Token/36 −95.00%	Token/36 +95.00%	*N*
1	TLD	27.80	1.52	24.64	30.96	10
2	SLI	26.00	1.70	22.47	29.53	8
3	AD	25.50	1.96	21.42	29.58	6

Table 6. Analysis of variance (ANOVA) of Token Test.

Cell No.	Group; LS means (DATA) Current effect: $F(2, 21) = 1.5653$, $p = 0.23$ Effective hypothesis decomposition					
	Group	SCT/10 Mean	SCT/10 Std. Err.	SCT/10 −95.00%	v	*N*
1	TLD	5.90	0.62	4.61	7.19	10
2	SLI	4.88	0.69	3.43	6.32	8
3	AD	4.17	0.80	2.50	5.83	6

Table 7. Analysis of variance (ANOVA) of Sentence Comprehension Test.

http://dx.doi.org/10.5772/intechopen.69709

As can be seen in **Table 7**, there are not statistically significant differences between the mean results in the Sentence Comprehension Test in children from three compared groups (TLD, SLI, and AD) (calculated value of significance $p = 0.23$).

Although differences in the Sentence Comprehension Test are not statistically significant, we believe that when the sample is enlarged, the differences could already be significant.

7.2. Possibilities of further research

School work implies good understanding of the spoken language, as well as reading and writing. Speech comprehension is considered a significant predictor of successful reading, writing, and school work as such. In relation to understanding sentences, Paul and Norbury [12] state that it is necessary to realize that the syntax used in school texts is more complex than the syntax used in oral speech. Souto et al. [13] found out: although novel verb studies show a clear connection between how children with SLI hear new verbs and how they use them, we do not yet have evidence that this connection is tied to a poor understanding of the input sentences that house the verbs. In this study, we found poor understanding on the children's part, but no signs that this limited understanding was the actual source of auxiliary inconsistency.

We, therefore, conclude that the gaps in speech comprehension in children with developmental language disorders make their education even more challenging and that it is necessary to reveal these problems as soon as possible and work diligently on the development of speech comprehension. We suggest observing changes in the behavioral area; we have seen, for example, a change in pragmatics, specifics in eye contact, increased psychomotor restlessness, or questions posed by children after they were told the instructions ("*What? What did you say?*"). We do not know whether children have room for these questions in the ordinary school lessons. In our opinion, we currently do not have much information in the Czech specialized literature about the level of language understanding in early-school children with SLI and we consider it necessary to research this area more.

Acknowledgements

The paper is dedicated to the following project: "*Research of selected parameters of the production and perception of voice, speech and language in relation to specific aetiological determinants in the speech and language therapy Insight* (IGA_PdF_2016_019)."

Author details

Renata Mlčáková

Address all correspondence to: renata.mlcakova@upol.cz

Faculty of Education, Institute of Special Education Studies, Palacký University, Olomouc, Czech Republic

References

[1] Smolík F. Seidlová-Málková G. Vývoj jazykových schopností v předškolním věku. 1st ed. Praha: Grada Publishing; 2014. 248 p

[2] Dvořák J. Logopedický slovník. 3rd ed. Ždár nad Sázavou: Logopedické centrum; 2007. 248 p

[3] Hartl P, Hartlová H. Velký psychologický slovník. 4th ed. Praha: Portál; 2010. 800 p

[4] Prucha J. Dětská řeč a komunikace. 1st ed. Praha: Grada; 2011. 199 p

[5] Lerner J, Johns B. Learning Disabilities and Related Mild Disabilities. 12th ed. Wadsworth: Cengage Learning; 2012. 484 p

[6] Mikulajová M, editor. Čítanie, písanie a dyslexia. 1st ed. Bratislava: Mabag; 2012. 296 p

[7] Shipley KG, McAfee JG. Assessment in Speech-Language Pathology. 4th ed. Clifton Park: Delmar; 2009. 647 p

[8] Lorusso ML, Burigo M, Borsa V, Molteni M. Processing Sentences with Literal versus Figurative Use of Verbs: An ERP Study of Children with Language Impairments, Nonverbal Impairments, and Typical Development [Internet]. 2015. Available from: http://dx.doi.org/10.1155/2015/475271

[9] Kent R. Normal aspects of articulation. In: Bernthal JE, Bankson NW, Flipsen P, editors. Articulation and Phonological Disorders Speech Sound Disorders in Children. 7th ed. New York: Pearson; 2013. pp. 6-57

[10] Bolceková E, Preiss M, Krejčová L. Token test pro děti a dospělé. 1st ed. Otrokovice: Propsyco, s.r.o.; 2015. 19 p

[11] Grimmová H, Schöler H, Mikulajová M. Heidelbergský test vývoje řeči H-S-E-T. 1st ed. Brno: Psychodiagnostika; 1997

[12] Paul R, Norbury CF. Language Disorders from Infancy through Adolescence, Listening, Speaking, Reading, Writing and Communicating. 4th ed. St. Louis: Elsevier; 2012. 756 p

[13] Souto SM, Leonard LB, Deevy P, Fey ME, Bredin-Oja SL. Subordinate clause comprehension and tense/agreement inconsistency in children with specific language impairment. Journal of Communication. 2016;**62**(July–August):45-53. DOI: https://doi.org/10.1016/j.jcomdis.2016.05.002

Chapter 10

Speech Impairment, Phonation, Writing, Salivation, and Swallowing in Patients with Parkinson's Disease

Goran Savić

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69711

Abstract

Introduction Parkinson's disease (PD) can influence the function of respiration, phonation and articulation, quality of speech, swallowing, salivation, and graphomotor skills.

Aim and methodology: This chapter is based on research of the degree of impairments of speech, phonation, salivation, swallowing, and handwriting in 64 patients with PD. The results of maximal phonation time (MPT) were compared with two control groups of healthy young ($N = 35$) and healthy elderly ($N = 35$) subjects. The degree of impairment of these functions was measured by the Unified Parkinson Disease Rating Scale (UPDRS) subtests.

Results and discussion: In the group with PD, speech impairments of various degrees were present in 82.81% of patients. The problem of salivation control of different degrees was present in 68.75% of the sample. Swallowing difficulty of different degrees was present in 53.15% of the sample. Difficulty writing of various degrees had 84.38% of the sample. The average MPT in group with PD was 11.61 s, 21.39 s in the group of healthy young, and 20.52 in the group of healthy elderly subjects.

Conclusion: Patients with PD on subtests UPDRS had various degrees of damages to the functions. Patients with PD had significantly shorter MPT than the control group.

Keywords: Parkinson's disease, speech impairments, dysarthria, phonation, maximum phonation time, salivation, dysphagia, swallowing, handwriting

1. Introduction

Parkinson's disease (PD) follows Alzheimer's disease on the list of most common neurodegenerative diseases and affects approximately 6.3 million people worldwide [1].

Approximately 89% of people worldwide with idiopathic PD have disordered communication [2], and approximately 90% of individuals with idiopathic PD develop hypokinetic dysarthria [3, 4]. The disease is caused by pathoanatomical and physiological changes in the brain cells. The changes are manifested by a significant reduction in the concentration of dopamine in the basal ganglia as a result of degeneration of nigrostriatal dopaminergic neurons.

James Parkinson was the first to define the manifestation of "shaking palsy" two centuries ago [5]. In 1912, Fritz Heinrich Lewy identified the abnormal inclusions in nerve cell bodies in 25 Parkinson's patients [6]. Carlsson et all discovered that dopamine was a putative neurotransmitter [7]. The Nobel Prize in Medicine was awarded to Arvid Carlsson, Paul Greengard, and Eric R. Kandel in 2000 for their discoveries concerning the role of dopamine in signal transduction in the nervous system [8].

When the disease is diagnosed, approximately 70% striatum dopamine has already been depleted and it advances in time [9]. In the advanced stage of PD, most of the dopaminergic neurons are lost, concomitant with significant cell death during the process [10]. PD is still diagnosed based on clinical observations. The acronym TRAP is used for the four major signs of PD and it stands for tremor at rest, rigidity, akinesia (bradykinesia), and postural instability [11]. These signs of the disease are associated with primary motor symptoms, including dynamic gait, micrographia, and others. Besides the motor symptoms, there are equally important non-motor symptoms such as cognitive impairment, apathy, sleep disorders, and so on. The most widely used tool nowadays is the Unified Parkinson's Disease Rating Scale (UPDRS) for clinical observation, which was introduced in 1987 and is currently awaiting revision [12, 13].

Parkinson's disease can influence the function of respiration, phonation, articulation, swallowing, salivation, and graphomotor skills. Damage to these functions has resulted in the occurrence of variations in the quality of voice and speech.

Phonation, prosody, and articulation are the three main speech components altered in PD. These changes are grouped under the term "hypokinetic dysarthria." Vowel production, an important aspect of speech for intelligibility, is commonly altered in PD [14].

The simplest examination functions of the glottides in phonation is to determine the maximum duration of vowel phonation after the previous deepest possible inspirium. If the phonation is shorter than 15 s, this happens for two reasons: either vocal cords in phonation are damaged, that is, dysfunctional, or the vital capacity is reduced [15, 16]. Shortening the maximum length of phonation in patients with PD is a consequence of failure of respiratory muscles and reduced vital capacity. There are also glottal insufficiency functions to further reduce the length of phonation.

Maximal phonation time (MPT) is in practice in the area of Serbian-speaking language is rarely used for verification and diagnostic quantitative skills phonation patients with PD. It is impossible to know that the MPT is used as a routine method in the diagnosis of patients with PD with other spoken languages. We could not find information about it from the available literature. The introduction of MPT as one of the routine quantitative methods can be supplemented by information about the levels of damage or progression of PD.

Speech disorders in Parkinson disease result from the disorder

- Disorders of the respiratory function due to the weakening of respiratory muscles. Insufficient amount of air inhaled; small expiratory volume in expiratory stage. The patient is forced to interrupted speech due to the difficulty in breathing. The rhythm of breathing is disturbed due to uncoordinated movements of muscles involved in breathing.
- The respiratory insufficiency results in reduced pulmonary ventilation and increased accumulation of secretions in the airways. Accumulated secretions in the airways are insufficiently pushed out of the body. It represents a good basis for the development of microorganisms and infection as a result of weaker ventilation of lungs. Frequent respiratory infections are the cause of cardiorespiratory complications, deterioration of general condition of the body, and difficulty in speech communications.
- Some patients had poor controlling functions of the vocal cords which resulted in uncontrolled outflow of air currents. In the advanced stage of disease, hypophonia or aphonia occurred due to vocal cord dysfunction, which further reduced the intelligibility of communication.
- The articulation of a large number of sounds is unclear because of the imprecision of articulation movements, especially the votes requiring a wide mandible angle (a, o, l, r, k, and g). The quality of pronunciation is poorer with voices that require a coordinated movement of several groups of articulator muscles.
- Phonation is very short due to a very short, insufficient expiration. The patient cannot pronounce words with more syllables, as well as short and long sentences without interruption.
- The strength of the voice is not sufficient for good understanding of the voice message. At the beginning of the sentence, the patient is loud and clear. The patient accelerates the speech tempo if the voice message is long. The intensity of the voice decreases. The sounds are superficial and unclear, while the speech becomes less intelligible. In some patients, the speech is monotonous, without modulation or intonation.
- In some patients, the result is a nasal tone, because the soft palate motion is damaged.

Savić et al. investigated the degree of impairments of speech, salivation, swallowing, and writing in 64 patients with PD. In particular, they examined the ability and length of the maximal phonation time of the vowel /a/ in those patients. These results were compared with two control groups of 35 healthy young and 35 healthy elderly subjects [17].

The degree of impairment of the speech, salivation, swallowing, and writing function in patients with PD is estimated with self-evaluation in the part of the Unified Parkinson's Disease Rating Scale—Activities of Daily Living. UPDRS (Unified Parkinson's Disease Rating Scale) is a scale consisting of three different groups of issues related to the mental state—mood, behavior, ability to perform activities of daily living, and motor activity. The maximum score that can be achieved in UPDRS is 199, which also represents the most severe form of disability due to disease.

The authors registered the data of speech, salivation, swallowing, and handwriting during self-evaluation at the beginning of the rehabilitation for the patients examined. It was possible to get 0–16 points for the four variables. It was possible to score 0–4 points for each separate variable. At the same time, 0 points means normal function, 1, mildly affected, 2, moderately affected, 3, severely affected, and 4, no observed features. Score of 16 points means total disability for all four examined variables.

The authors measured the value of the maximum length of phonation of the vowel /a/ for each separate category of the respondents. They calculated the average TMP for each group of the subjects based on the average TMP of each patient. The average scores of MPT for each group of respondents were compared with each other.

In patients with PD, the ability to control and coordinate fine movements of the hand is reduced or completely lost due to the presence of a neurological damage. There is often a different degree of the impairment of previously acquired skills of writing as a result of a neurological damage. The graphomotor movements are insecure and of a limited amplitude, resulting in a small and shaky handwriting (extrapyramidal micrograph). The letters become tortuous and blade-like teeth ("sawtooth" writing), which is caused by the tremor and rigor of finger arm muscles.

In the context of non-motor manifestations of PD, drooling is defined as an excessive amount of saliva in the mouth, which is especially intensified in the later stages [18]. At present, the pathophysiology of drooling in PD is not completely clear; however, impaired intraoral salivary clearance is likely to be the major factor. There are neither standard diagnostic criteria nor standard severity assessment tools for evaluating drooling in PD. In accordance with the possible pathophysiology, dopaminergic agents have been used to improve salivary clearance; however, these agents are not completely effective in drooling control [19].

Sialorrhea may be higher in PD. Sialorrhea defined as an overflow of saliva from the mouth (drooling) and negatively affects both patient's quality of life and social interactions [20, 21]. Its etiology includes acute and chronic neurological disorders (such as PD), hypersecretion (inflammatory processes in oral cavity), adverse effects of some drugs, or anatomic abnormalities affecting oral cavity [22].

In PD patients, saliva is associated with swallowing problems in 46.5% of patients who complained about the drooling, the saliva, or spills, 18.8% of whom thought their saliva was socially disabling [23]. When a PD patient spills out saliva, it is associated with swallowing problems and posture, characteristic of these patients [24]. More than 80% of patients with Parkinson's disease develop dysphagia during the course of their disease. Swallowing impairment reduces quality of life, complicates medication intake, and leads to malnutrition and aspiration pneumonia, which is a major cause of death in PD [25].

Dysphagia affects approximately 33% of all patients diagnosed with Parkinson's disease, although other prevalent studies highlight dysphagic effects noticeable in a broad range of PD patients from 45 to 90% [26].

2. Speech impairment, phonation, writing, salivation, and swallowing

2.1. Age, gender, and educational level of the sample and duration of the disease

The way PD influences the occurrence of voice disorders, impairments of phonation, handwriting, salivation, and swallowing can be seen from the results of research by Savićet al. on a sample of 64 patients with PD [17].

In this research, the average age of patients with PD was 70.65 years. The age of patients ranged from 45 to 85 years. The average age of the group of healthy elderly respondents was approximately similar. The average age of patients in this group was 70.20.

The average age of the group of healthy young subjects was 24.14. The students were the largest part of the group of healthy young subjects. Respondents of both control groups had the value of certain parameters of speech and language status within the normal limits in relation to the quality of voice, speech, and language in the Serbian language. We took as a control group of healthy young people, because we thought that we would have a greater difference between the variable MPT healthy young and healthy elderly subjects. You will see in the text that follows that the difference MPT of these two groups is small. The answer to the question: Is it a consequence of less physical activity of young people, prolonged sitting in front of computer and physical inactivity young we'll search in some future study.

Most patients (29) with PD had elementary education. Twenty-eight respondents had high school, four respondents had the undergraduate level of education, and three respondents had higher education (university degree). The education level of patients with PD, and the frequent use of speech in the profession and the frequent use of writing could affect at some of the observed variables of the study (on the phonation and writing). It is not the same speech ability of a professional speaker and a poorly educated man. This could be one of our future researches because we have limited space for this chapter. The age and gender structure of patients with PD are shown in **Figure 1**.

The assessment of status of the patients with UPDRS subtests was performed after the average of 57.90 (±5.60) months from the occurrence of the first signs of disease (**Figure 2**).

2.2. Speech impairment

This was present in 53 patients (82.81%) in the group with PD (**Figure 3**). It is approximately similar to the findings of Fox et al., Muller et al., and Duffy [2–4]. There was no significant impairment of the quality of voice, speech, and language in 11 patients (17.18%). In the group of patients with speech impairments, speech was mildly damaged in 41 (64.06%), moderately damaged in 8 (12.50%), and severely damaged in 4 (5.25%) patients. There were no patients with totally incomprehensible speech (**Figure 3**).

The results showed that all patients with PD had different degrees of damage to some of the examined functions. The maximum phonation time in patients with PD was significantly

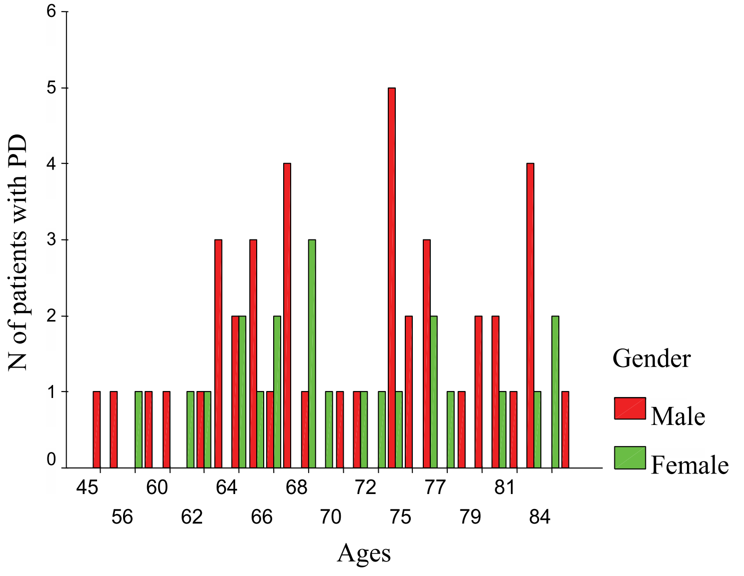


Figure 1. Age and gender of patients with PD in the examined sample.

shorter than in the control groups. They had impairments of the quality of the voice and speech characteristics. The results showed that the speech of different degrees of impairments was present in 82.81% of patients in the group with PD (**Figure 3**).

The average MPT in PD patients without speech impairments was 15.73 s. In PD patients with speech impairments, it was 10.75 s. The group of young healthy subjects had the average MPT of 21.39 s, and MPT of the group of healthy elderly subjects was 20.52 s. MPT of patients with PD was measured only at the beginning of rehabilitation.

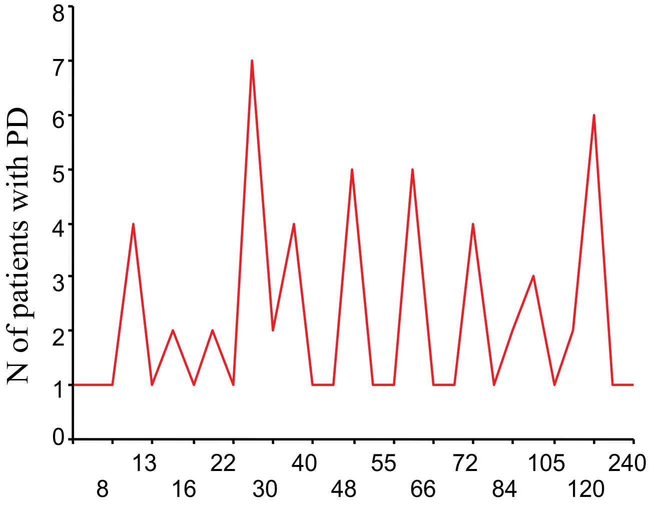


Figure 2. The onset of the first PD signs by the *N* of months.

http://dx.doi.org/10.5772/intechopen.69711

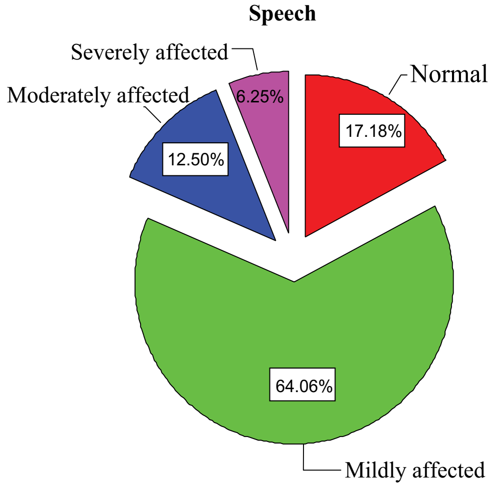


Figure 3. The degree of speech impairments in patients with PD. Speech: 0, normal; 1, mildly affected, but no difficulty being understood; 2, moderately affected, sometimes asked to repeat statements; 3, severely affected, frequently asked to repeat statements; and 4, unintelligible most of the time (patients with this level impairments were not in the sample).

The average maximum length of the vowel /a/ phonation in all patients with PD was 11.61 s (±6.33) ranging from 1.33 to 29.66 s (**Figure 4**). In patients with PD, the presence was indicated of a large range of MPT values. This shows that in patients with PD functions of respiration

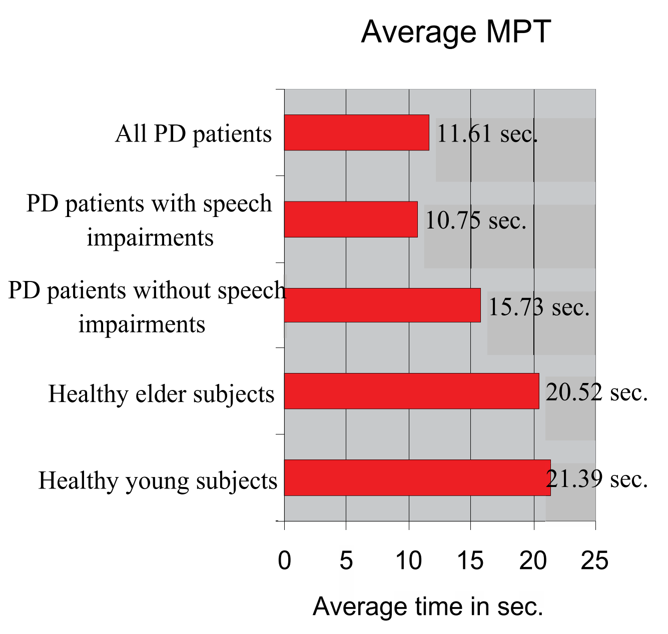


Figure 4. Maximum phonation time in some groups of tested samples.

and phonation were not equally damaged, which directly affected the TMP result. For example, a patient who had MPT of 29.66 s had both of these functions well preserved. The patient was a logger by profession. His profession demanded a great physical effort. He had well-developed functions of respiration and phonation. These people generally have higher intensity of vocalization because they work in noisy environment. They have to speak louder to be able to communicate because of the noise of chainsaws. Based on his results achieved in the testing MPT, we can conclude that both these functions remain preserved or slightly impaired.

It was found that the correlation of the time of first PD symptoms occurrence and the average length of phonation was $r = 0.264$; $p = 0.035$. This means that the duration of the disease onset did not have such a great impact on the MPT in all patients' sample. Some patients had the compromised function of limbs, walk, posture, balance, swallowing, writing, and so on. In a part of this group, the damage reflected on phonation and speech.

Whether the disruption of phonation length is severe or minor will depend on the neurological damage to the respiratory function or damage to the vocal cords or both functions.

In the group of PD patients whose MPT was up to 10 s, there were 32 patients or 50% of the sample. The average MPT of this group was 6.98 s; 28 patients in this group had speech problems, whereas only 4 of them were without speech difficulties.

In the group of patients with PD whose MPT was from 11 to 20 s, there were 24 patients, or 37.50% of the sample. The average MPT of this group was 13.37 s. Only two patients in this group did not have any speech problems.

In the group of patients with PD whose MPT was over 20 s, there were eight patients or 12.50% of the sample. The average MPT of this group was 24.87 s. Only three patients in this group had a speech difficulty, and the remaining five did not have speech problems.

The correlation between the total results of the UPRDS variables measured and the average length of phonation results of the sound /a/ was $r = 0.506$; $p = 0.000$.

Bauer et al. [27] found that in the group of 21 patients with PD and analogous group of healthy people, there was significant difference in the maximum phonation time which was shorter in PD group (15.8 and 23 s, $p = 0.014$).

The average MPT in the group of healthy young subjects was 21.39 s. The average MPT in the healthy elderly subjects was 20.52 s. The results did not agree with the research data by Hedever et al. [28]. The results were in accordance with the findings by Maslan et al. and http://www.foni.mef.hr/Prirucnik/Fonijatrija.htm [15, 16].

Patients with PD without speech impairments had MPT length of 15.73 s. Patients with mildly affected speech had MPT of 12.37 s, those with moderately affected speech had 5.49 sec, and those with severely affected speech had 4.70 s. There were no patients with unintelligible speech.

In patients with speech impairments from the group with PD, we can see that the length of phonation was proportionate to the degree of speech defects. The patients with lower MPT had speech impairment, and patients with greater MPT had less severe speech impairment. The length and quality of voice affected the quality of the speech and influenced the degree of speech damage. The statistical significance of differences in MPT between groups with PD and young healthy subjects was $p = 0.000$, in patients with PD and healthy elderly subjects it was $p = 0.000$. The statistical significance of differences in MPT between groups with different degrees of speech impairments in groups with PD (with and without speech impairments) was $p = 0.088$.

Short MPT is a sign that the respiratory function is insufficient. This leads to the conclusion that it is necessary to work on improving this function to improve the MPT. This prevents the occurrence of secondary complications of poor pulmonary ventilation (respiratory and cardiovascular complications).

MPT values during treatment of and rehabilitation from PD can be used as a predictive indicator of the disease progression rate.

Buzadžija and Savić found that patients with PD who had poor MPT results after the inclusion in rehabilitation also had poor recovery of ability of daily living activities. Daily living activities were measured with Barthel index at the beginning and the end of rehabilitation in 79 patients with PD. Patients were included in the rehabilitation for 3 weeks [29]. The rehabilitation was multidisciplinary. The rehabilitation process involved a doctor specialist physical and rehabilitation medicine, physical therapist, occupational therapist, speech therapist in patients with present speech impairments, a psychologist in patients with present mental disorders, and social worker.

A sample was classified into four groups. The first group patients with PD had Barthel index values below 25 at the beginning of rehabilitation. Assessment of the Barthel index has been found that the patients with PD had an average score of 11.40 (±8.98) points at the beginning and 16.20 (±12.25) points at the end of the rehabilitation. This group of patients had an average of MPT 4.73 (±3.39) s.

The second group of patients with PD had Barthel index of 26–50. This group of patients had an average score at Barthel index of 41.75 (±5.50) points at the beginning, and 48.25 (±6.70) points at the end of rehabilitation. This group of patients had an average of MPT 11.74 s. Barthel index of 50 points and less to the beginning of the rehabilitation had nine patients. Of these, seven had an average value of MPT from 0 to 10 s (**Table 1**).

A third group of patients with PD had Barthel index of 51–75 points (**Table 1**). A third group of patients had an average score at Barthel index of 65.33 (±7.25) points at the beginning and 74.88 (±8.06) points at the end of rehabilitation. This group of patients had an average score of MPT 11.98 (±5.71) s. About two-third of the sample was in this group of patients. In this group, 44.44% of patients had values of MPT 0–10 s (**Table 1**).

The fourth group of patients with PD had Barthel index of 76–100 points. This group of patients had an average score of 80.18 (±3.91) points at Barthel index at the beginning and 85.37 (±6.58) points at the end of rehabilitation. This group of patients had an average score of MPT 15.83 (±8.14) s. Majority of patients with lower achievement in the MPT had lower achievement on tests of activities of daily living [29].

According to analysis of the findings, 22 patients, or 27.84% of the sample, had 60 points or less in Barthel index at the beginning of the rehabilitation. These patients were totally or partially dependent on other persons' help and assistance. Fifty patients (63.29%) had Barthel index value ranging 61–80 of the sample. These patients were classified in the category of

Value of MPT before rehabilitation	Value of Barthel index of patients with PD at before and after rehabilitation								Total *N* of the patients
	N with result 0–25 points before reh.	*N* with result 0–25 points after reh.	*N* with result 26–50 points before reh.	*N* with result 26–50 points after reh.	*N* with result 51–75 points before reh.	*N* with result 51–75 points after reh.	*N* with result 76–100 points before reh.	*N* with result 76–100 points after reh..	
0–10 s	5	4	2	2	24	11	5	19	36
11–20 s	0	-	1	1	24	11	6	19	31
≤21 s	0	-	1	-	6	3	5	9	12
Total	5	4	4	3	54	25	16	47	79

Table 1. The relation between results for MPT and results of Barthel Index at before and after rehabilitation (reh.).

moderate dependent on other persons' aid and assistance. At the end of rehabilitation, totally or partially dependent on other persons' aid and assistance, with the Barthel index of 60 points or less were 12 patients, or 15.18% tested sample. In values ranging 61–80 points of the Barthel index, in the category of moderate depending on other persons' aid and assistance were 45 patients, or 56.96% of the tested sample. Only nine out of 79 patients with PD had 80 or more points at the beginning of the rehabilitation. At the end of rehabilitation, 28 patients had Barthel index value of 80 or more points. Out of those, 11 patients had MPT score ranging from 6.33 to 10.00 s, 12 patients had scores ranging 11–20 s, and five had MPT of over 20 s.

2.3. Problems affecting the motor skills and muscles of fingers and hands (tremor and rigidity), which affect graphomotor and handwriting ability

Motor blocks of fingers, muscles, and hands affect PD patients' ability to write. Motor blocks are related to transient periods in which the intended supple motor activities become a short pause [30–32]. Motor blocks extend the classic signs of PD, such as akinesia, bradykinesia, rigidity, tremor, and disorders of the postural mechanisms [30]. It manifests in 32 [32] to 60% [33] of persons with PD.

In patients with PD, there is a temporary, involuntary inability to move a hand. "Freezing" refers to transient periods in which the voluntary motor activity attempted by an individual is paused. It is a sudden, unplanned state of immobility that appears to arise from deficits to initiate or simultaneously and sequentially execute movements, as well as to correct or plan them [34].

Savić et al. found that the damage to the handwriting of various degrees was present in 84.38% of patients with PD (**Figure 5**). They found 10 patients (15.62%) without difficulty handwriting in the tested group of 64 patients. Slightly slow writing was present in 14 (21.87%) patients. Moderately slow writing with legible handwriting was present in 19 (29.68%) patients, while severely impaired writing with the emergence of poorly legible words was present in eight (12.50%) patients. In 13 (20.31%) patients, the most commonly written word was not legible. The average UPRDS value for all measured items (speech, salivation, swallowing, and handwriting) for patients with PD was 5.09 (±2.60) of the maximum of 16 points. The correlation between the length of time from the PD onset and the overall UPRDS results was $r = 0.292$; $p = 0.019$ [17].

2.4. Sialorrhea (drooling or excessive salivation)

It is a common problem in neurologically impaired adults who suffer from Parkinson's disease or have had a stroke. Sialorrhea is usually caused by neuromuscular dysfunction, hypersecretion, sensory dysfunction, or anatomic (motor) dysfunction. It is most commonly caused by poor oral and facial muscle control. Contributing factors may include hypersecretion of saliva, dental malocclusion, postural problems, and inability to recognize salivary spill. Sialorrhea causes a range of physical and psychosocial complications, including perioral chapping, dehydration, odor, and social stigmatization, all of which can be devastating for patients and their families. The treatment of sialorrhea is best managed by a clinical team that includes primary health-care providers, speech pathologists, occupational therapists, dentists, orthodontists, neurologists, and otolaryngologists. Treatment options range from

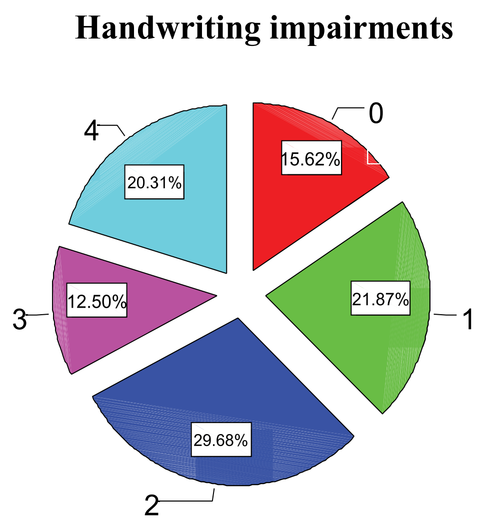


Figure 5. The degree of writing impairments in patients with PD. Handwriting: 0, normal; 1, slightly slow or small; 2, moderately slow or small—all words are legible; 3, severely affected, not all words are legible; and 4, the majority of words are not legible.

conservative (i.e., observation, postural changes, and biofeedback) to more aggressive measures such as medication, radiation, and surgical therapy [35].

Savić, et al. found that the problem of excessive salivation of different degrees was present in 68.75% of PD patients (**Figure 6**).

2.5. Dysphagia

This occurs in a part of patients with PD. Dysphagia can lead to significant deterioration of health and quality of life. Of particular concern is the associated risk of aspiration or ingestion of foreign particles into the airway, a potential cause of aspiration pneumonia resulting in high morbidity and mortality [36, 37].

Studies suggest that 40% of adults aged 60 and older have dysphagia [38, 39]. Stina [40] investigated the connection between swallowing functions and quality of life in patients with PD. The results showed that high levels of swallowing affected the quality of life. There were significant correlations between disease duration and some SWAL-QOL parameters (correlate Swallowing Quality of Life) as well as some of the results of the fiber endoscopic evaluation.

Aspiration pneumonia is often the leading cause of death in persons with neurodegenerative diseases, including Parkinson's disease [41–45]. Patients affected by PD should be aware of and closely monitor all increased coughing episodes or a negative alteration of voice quality, as these may be early symptoms of dysphagia [46].

Savić, et al. found the present swallowing difficulty of different degrees in 53.15% of PD patients [17]. Without swallowing impairments were 30 (46.85%) patients. With more 18 (28.12%) patients had rare swallowing problems; the occasional swallowing difficulty

http://dx.doi.org/10.5772/intechopen.69711

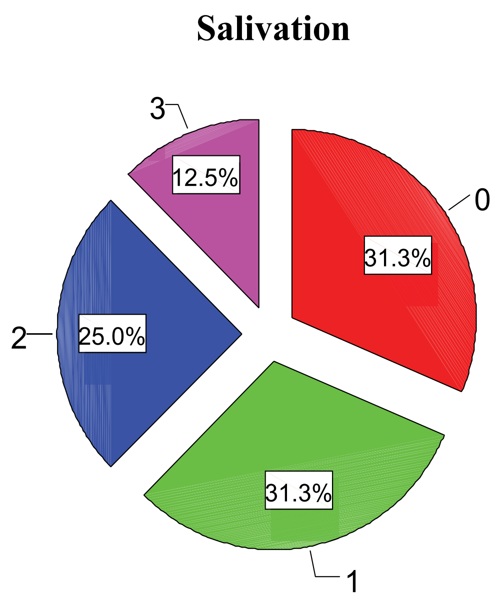


Figure 6. The degrees of present excessive salivation of patients with PD. Salivation: 0, normal; 1, slight but definite excess of saliva in mouth, may have nighttime drooling; 2, moderately excessive saliva, may have minimal drooling; 3, marked excess of saliva with some drooling; and 4, marked drooling, requires constant tissue or handkerchief (patients with this level impairments were not in the sample).

had 14 (21.87%) patients, and swallowing difficulties which required the use of pureed food had two (3.12%) patients. There were no patients with the applied nasogastric tube or gastrostomy feeding (**Figure 7**). Analyzing the relation of the average MPT with the degree of swallowing impairments, the authors have found that the group of patients

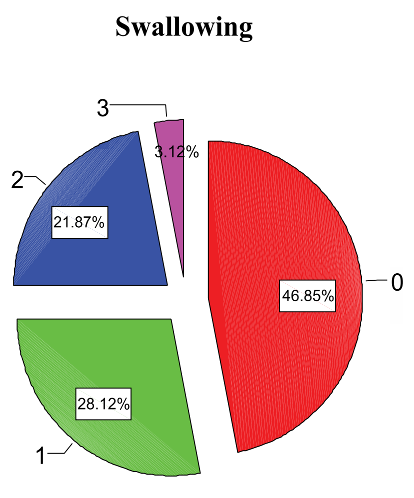


Figure 7. The degree of swallowing impairments in patients with PD. Swallowing: 0, normal; 1, rare choking; 2, occasional choking; 3, requires soft food; and 4, requires nasogastric tube or gastrostomy feeding (patients with this level impairments were not in the sample).

from the group 0 (Normal swallowing) had an average of MPT 13.00 s (±6.88). Group 1 (rare choking) had an average MPT of 12.71 s (±5.88). Group 2 (occasional choking) had an average MPT of 8.51 s (±3.72). Group 3 (requires soft food) had an average MPT of 2.41 s (±1.64). Weaker MPT results were associated with a higher degree of damages to swallowing function.

The higher the degree of swallowing function deterioration, the lower the MPT value. All patients with PD, measured in different UPDRS subsets, had some of the functions damaged.

3. Conclusion

The largest part of the sample with PD had speech impairments. The MPT in patients with PD was significantly shorter compared with the healthy people. This had an impact on the quality of the voice and speech characteristics of patients with PD.

MPT value can be used as an indicator of the degree of respiratory function impairment. Improving these functions during rehabilitation can improve voice and speech quality, but also prevent the development of complications as a result of poor pulmonary ventilation. The values of MPT in certain phases of treatment and rehabilitation of PD can be used as a prognostic indicator of the disease progression rate. The damage to the handwriting of various degrees was present in 84.38% of patients with PD. Over two-thirds of patients with PD had the problem of excessive salivation of different degrees. More than a half of patients with PD had different degrees of swallowing difficulties.

All patients with PD in the measured UPDRS variables had different degrees of damages to some of the functions. Functional testing of phonation, speaking, handwriting, salivation, and swallowing can be used as diagnostic and prognostic sign of severity of the disease in patients with PD.

Acknowledgements

I am grateful for their help to my colleagues Dijana Đurić, Vojo Buzadžija, and my daughter Nina Savić, for the support and assistance for creating this chapter.

Author details

Goran Savić

Address all correspondence to: sakogo@blic.net

Institute for Physical and Rehabilitation Medicine, "Dr Miroslav Zotović" Banja Luka, Republic of Srpska, Bosnia and Herzegovina

References

[1] De Lau LM, Breteler MM. Epidemiology of Parkinson's disease. Lancet Neurology. 2006;**5**(6):525-535. DOI: http://dx.doi.org/10.1016/S1474-4422(06)70471-9

[2] Fox CM, Ramig LO, Ciucci MR, Sapir S, McFarland DH, Farley BG. The science and practice of LSVT/LOUD: Neural plasticity-principled approach to treating individuals with Parkinson disease and other neurological disorders. Seminar Speech and Language. 2006;**27**(4):283-299. Available from: http://dx.doi.org/10.3109/17549507.2014.917438 Published online: 11 Jul 2014

[3] Muller J, Wenning GK, Verny M, McKee A, Chaudhuri KR, Jellinger K, Poewe W, Litvan I. Progression of dysarthria and dysphagia in postmortem-confirmed Parkinsonian disorders. Archive of Neurology. 2001;**58**(2):259-264. DOI:10.1001/archneur.58.2.259

[4] Duffy JR. Motor Speech Disorders: Substrates, Differential Diagnosis, and Management. Philadelphia, PA: Mosby, Elsevier; 2005. ISBN: 9780323087605

[5] Parkinson J. An essay on the shaking palsy. 1817. Journal of Neuropsychiatry & Clinical Neurosciences. 2002;**14**(2):223-236; discussion 222. DOI: 10.1176/jnp.14.2.223

[6] Goedert M, Spillantini MG, Del Tredici K, Braak H. 100 years of Lewy pathology. Nature Review Neurology. 2013;**9**(1):13-24. DOI:10.1038/nrneurol.2012.242

[7] Björklund A, Dunnett SB. Dopamine neuron systems in the brain: An update. Trends in Neuroscience. 2007;**30**(5):194-202. DOI: http://dx.doi.org/10.1016/j.tins.2007.03.006

[8] Mučibabić M, Canters GW, Aartsma TJ. Parkinsonova bolest–tegoba poznih godina. Vojnosanitetskipregled. 2016;**73**(4):303-305. DOI: 10.2298/VSP1604303M

[9] Brooks DJ. The early diagnosis of Parkinson's disease. Annals in Neurology. 1998;**44**(3Suppl 1):S10-S18. DOI: 10.1002/ana.410440704

[10] Cookson MR. Alpha-synuclein and neuronal cell death. Molecular Neurodegeneration. 2009;**4**:9. DOI: 10.1186/1750-1326-4-9

[11] Jankovic J. Parkinson's disease: Clinical features and diagnosis. Journal of Neurology, Neurosurgery, and Psychiatry. 2008;**79**(4):368-376. DOI:10.1136/jnnp.2007.131045

[12] Ebersbach G, Baas H, Csoti I, Müngersdorf M, Deuschl G. Scales in Parkinson's disease. Journal of Neurology. 2006;**253**(Suppl 4):IV32-IV35. DOI: 10.1007/s00415-006-4008-0

[13] Fahn S, Marsden CD, Calne DB, Goldstein M, editors. Recent Developments in Parkinson's Disease, Vol. 2. Florham Park, NJ: Macmillan Health Care Information; 1987. pp 153-163, 293-304. Available from: http://www.parkinsons.va.gov/PARKINSONS/resources/UPDRS.asp [Accessed: January 7, 2017]

[14] Martel SV. Impact de la prise en charge thérapeutique sur les propriété sacoustiques des voyelles dans la maladie de Parkinson. Doctorat en médecine expérimentale Philosophiæ doctor [Ph. D.]. Laval University, Québec, Canada; 2014. Available

from: https://www.researchgate.net/profile/Vincent_Martel_Sauvageau/publications [Accessed: November 15, 2016]

[15] Maslan J, Leng X, Rees C, Blalock D, Butler GS. Maximum phonation time in healthy older adults. Journal of Voice. 2011, Nov;**25**(6):709-713. Published online 2011 Mar 25. DOI:10.1016/j.jvoice.2010.10.002

[16] http://www.foni.mef.hr/Prirucnik/Fonijatrija.htm [Internet] [Accessed: November 17, 2016]

[17] Savić G, Đurić D, Buzadžija V, Savić N. Stepen govornog oštećenja kod pacijenata sa Parkinsonovom bolešću, Zbornik radova 6. Kongresa fizijatara Bosne I Hercegovine sa medunarodnim učešćem, Banja Luka, 6-9. October 2016. pp. 121-122

[18] González-Fernández J, Prieto-Tedejo R, Velasco-Palacios L, Jorge-Roldán S, Cubo-Delgado E. Trastornosdigestivos en la enfermedad de Parkinson: disfagia y sialorrea. Revista de Neurología. 2010;**50**(2):51-54. Available from: http://www.neurologia.com/pdf/Web/50S02/bdS020S51.pdf [Accessed: November 15, 2016]

[19] Srivanitchapoom P, Pandey S, Hallett M. Drooling in Parkinson's disease: A review. Parkinsonism & Related Disorders. 2014;**20**(11):1109-1118. DOI: http://dx.doi.org/10.1016/j.parkreldis.2014.08.013

[20] Bateson MC, Gibberd FB, Wilson RS. Salivary symptoms in Parkinson s disease. Archives of Neurology. 1973;**29**(4):274-275. DOI: 10.1001/archneur.1973.00490280086013

[21] Verma A, Steele J. Botulinum toxin improves sialorrhea and quality of living in bulbar amyotrophic lateral sclerosis. Muscle Nerve. 2006;**34**(2):235-237. DOI: 10.1002/mus.20545

[22] Lim M, Mace A, Nouraei SA, Sandhu G. Botulinum toxin in the management of sialorrhoea: A systematic review. Clinical Otolaryngology. 2006;**31**(4):267-272. DOI: 10.1111/j.1749-4486.2006.01263.x

[23] Hyson C, Johnson A, Jog M. Sublingual atropine for sialorrhea secondary to Parkinsonism: A pilot study. Movement Disorders. 2002;**17**(6):1318-1320. DOI: 10.1002/mds.10276

[24] Kusbeci O, Koken T, Demirbas H, Koca B. Sialorrhea and salivary composition in patients with Parkinson's disease. Poster Presentation/Parkinsonism and Related Disorders. 2009;**1552**:529-5199. [Internet]. Available from: https://www.deepdyve.com/lp/elsevier/p1-014-sialorrhea-and-salivary-composition-in-patients-with-parkinson-S5joPtVZSQ [Accessed: 8 January 2017]

[25] Suttrup I, Warnecke T. Dysphagia in Parkinson's disease. Dysphagia. 2016 Feb;**31**(1):24-32. DOI: 10.1007/s00455-015-9671-9. Epub 2015 Nov 21

[26] Yorkston KM, Spencer KA, Duffy JR. Behavioral management of respiratory/phonatory dysfunction from dysarthria: A systematic review of the evidence. Journal of Medical Speech-Language Pathology. 2003 Jun;**11**(2):13-38.

[27] Bauer V, Alerić, Z, Jančić E, Miholović V. Voice quality in Parkinson's disease in the Croatian language speakers. Collegium Antropologicum. 2011;**35**(Suppl 2):209-212. Available from: http://www.medscape.com/medline/abstract/22220437 [Accessed: 15 November 2016]

[28] Hedever M, Farago E, Huskić S. Voice problems in professional voice users. Acta Medica Saliniana. 2007;**36**(1):1-9. [Internet]. Available from: http://www.taracentar.hr/wp-content/uploads/2015/06/PROBLEMI-GLAS-U-VOKALNIH-PROFESIONALACA.pdf [Accessed: 9 January 2017]

[29] Buzadžija V, Savić G. The success of the rehabilitation of patients with Parkinson's disease in relation the maximum phonation time. 17th Congress of Physiatrists Serbia with International Participation; May 18-21, 2017; Kopaonik. Balneoclimatologia, Vol. 41 br. 2, p 234-35

[30] Narabayashi H, Nakamura R. Clinical neurophysiology of freezing in Parkinsonism. In: Delwaide PJ, Agnoli A, editors. Clinical Neurophysiology in Parkinsonism. Amsterdam, Netherlands: Elsevier; 1985. pp. 49-57

[31] Ringendahl H, Sierla T. Freezing phenomenon in Parkinson's disease. Fortschritte Der Neurologie-Psychiatrie. 1997;**65**:435-445. DOI: 10.1055/s-2007-996349

[32] Giladi N, McMahon D, Przedborski S, Flaster E, Guillory S, Kostic V et al. Motor blocks in Parkinson's disease. Neurology. 1992;**42**:333-339. DOI: 10.1212/WNL.42.2.333

[33] Lamberti P, Armenise S, Castaldo V, de Mari M, Iliceto G, Tronci P et al. Freezing gait in Parkinson's disease. European Neurology. 1997;**38**:297-301. DOI: 10.1159/000113398

[34] Popovitsh MB, Kostitsh V, Dhzoljitsh E, Ercegovac M. A rapid method of detecting motor blocks in patients with Parkinson's disease during volitional hand movements. Srpski arhiv za celokupno lekarstvo, BIBLID 0370-8179. 2002;**130:**11-12, 376-381. DOI: 10.2298/SARH0212376P

[35] Hockstein NG, Samadi DS, Gendron K, Steven D, Handler SD. Sialorrhea: A management challenge. American Family Physician. 2004 Jun 1;**69**(11):2628-2635. [Internet]. Available from: http://www.aafp.org/afp/2004/0601/p2628.html [Accessed: November 22, 2016]

[36] Langmore SE, Skarupski KA, Park PS, Fries BE. Predictors of aspiration pneumonia in nursing home residents. Dysphagia. 2002;**17**(4):298-307. DOI: 10.1007/s00455-002-0072-5

[37] Langmore SE, Terpenning MS, Schork A, Chen Y, Murray JT, Lopatin D et al. Predictors of aspiration pneumonia: How important is dysphagia? Dysphagia. 1998;**13**(2):69-81. DOI: 10.1007/PL00009559

[38] Doggett DL, Turkelson CM, Coates V. Recent developments in diagnosis and intervention for aspiration and dysphagia in stroke and other neuromuscular disorders. Current Atherosclerosis Reports. 2002;**4**(4):311-318. DOI: 10.1007/s11883-002-0010-x

[39] Feinberg MJ, Knebl J, Tully J, Segall L. Aspiration and the elderly. Dysphagia. 1990;**5**(2): 61-71. DOI: 10.1007/BF02412646

[40] Stina S. Preoperative SWAL-QOL ochsväljningsfunktion hos Parkinson patienter selekterade till deep brain stimulation. Umeå University; 2013. Available from: http://www.clinsci.umu.se/digitalAssets/130/130330_arb81.pdf [Accessed: January 9, 2017]

[41] Fernandez HH, Lapane KL. Predictors of mortality among nursing home residents with a diagnosis of Parkinson's disease. Medical Science Monitor. 2002;**8**(4):CR241-CR246. [Internet]. Available from: https://www.researchgate.net/publication/11416037_Predictors_of_mortality_among_nursing_home_residents_with_a_diagnosis_of_Parkinson_disease [Accessed: November 28, 2016]

[42] Gorell JM, Peterson EL, Rybicki BA, Johnson CC. Multiple risk factors for Parkinson's disease. Journal of Neurological Science. 2004;**217**(2):169-174. DOI: http://dx.doi.org/10.1016/j.jns.2003.09.014

[43] Hoehn MM, Yahr MD. Parkinsonism: Onset, progression, and mortality. Neurology. 1967;**17**(5):427-442. Available from: http://www.neurology.org/content/17/5/427.full.pdf [Accessed: 9 January 2017]

[44] Shill H, Stacy M. Respiratory function in Parkinson's disease. Clinical Neuroscience. 1998;**5**(2):131-135. [Internet]. Available from: https://www.ncbi.nlm.nih.gov/labs/articles/10785839/[Accessed: 10 December 2016]

[45] Singer RB. Mortality in patients with Parkinson's disease treated with dopa. Journal of Insurance Medicine. 1992;**24**(2):126-127. [Internet]. Available from: http://aaimedicine.org/journal-of-insurance-medicine/jim/1992/024-02-0126.pdf [Accessed: 10 December 2016]

[46] Turner GS, Tjaden K, Weismer G. The influence of speaking rate on vowel space and speech intelligibility for individuals with amyotrophic lateral sclerosis. Journal of Speech and Hearing Research. 1995;**38**:1001-1013. DOI:10.1044/jshr.3805.1001

Chapter 11

Response Behaviors in Conversational Speech among Japanese- and English-Speaking Parents and Their Toddlers

Yuko Yamashita

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69743

Abstract

The present study aimed at exploring the responses of listeners in conversational speech between parents and toddlers. Children's responses toward parents and parents' responses toward children were the focus of this study. Participants included five dyads each of typically developing two-year-old toddlers and their parents from Japanese- and English-speaking families. Responses of a mother/father toward a child or a child toward a mother/father were classified into three categories: non-lexical backchannels (e.g., hoo, nn, hai), phrasal backchannels (e.g., hontoo "really," soo desu ka "is that right?"), and repetition. The results showed that the average ratio of overall backchannels and repetitions produced by parents was quite similar in both languages and was much greater than that produced by children in both languages. Among Japanese-speaking parents, non-lexical backchannels and repetitions were preferred to phrasal backchannels, while among English-speaking parents non-lexical backchannels were most frequently used. With Japanese-speaking parents, almost half of the repetitions were exact repetitions. They frequently repeated what a child had said and added the sentence-final particle "ne" or content words. These findings are expected to be useful in understanding response behaviors in spoken communication between parents and their children.

Keywords: conversational speech, response behaviors, child-directed speech, backchannels, repetition

1. Introduction

Interactions between parents and children largely influence the early stages of language development. Parents use a specific conversational style when they interact with their children.

There are similar characteristics and cross-linguistic differences in interactions between parents and children across cultures. For example, Ferguson [1] found that phonological and syntactic modifications, exaggerated prosody, and a simplified lexicon were common characteristics of child-directed speech across 27 language backgrounds. Fernald et al. [2] also reported that parents used higher mean-f0, f0-minimum, and f0-maximum; greater f0-variability; shorter utterances; and longer pauses across languages (French, Italian, German, Japanese, British English, and American English) when they interacted with their infants. Other studies showed both similarity and cross-linguistic differences in interactions between parents and children. For example, Fernald and Morikawa [3] reported that Japanese and English mothers displayed some common characteristics such as linguistic simplification and frequent repetition, while the frequency of labeling target objects and the usage of onomatopoetic words were the differences seen between the communicative styles of the two languages. Choi [4] found that English-speaking mothers used more nouns than verbs and focused more on objects than on actions, as compared to Korean-speaking mothers, when they interacted with their children in book-reading and toy-play contexts. These studies showed that there are common characteristics and cultural differences in interactions between parents and their children. However, only a few studies have explored how parents respond as listeners in their interactions with their children during the early stages of language development. The present study explores conversational styles, including the responses of a listener, between English- and Japanese-speaking mothers and their children. An overview will be given of: the literature of the previous research on response behaviors, the method, and the results. Lastly, a discussion will be presented.

2. Literature review

Listeners' responses to a speaker are commonly known as "backchannels" [5] or "reactive tokens" [6]. Backchannel responses include both verbal (e.g., uh-huh, hmm) and non-verbal (e.g., head nods, smile, gazing) forms. The present study focuses on verbal forms. Backchannels produced by the listener play an important role in helping conversations go smoothly. Many researchers have discussed the types and functions of backchannels [6–8]. Clancy et al. [6] suggested that there are several types of reactive tokens in verbal forms: backchannels, reactive expressions, collaborative finishes, repetitions, and resumptive openers. Maynard [8] identified six functions of backchannels: continuer, understanding, support and empathy, agreement, emotive, and minor additions.

Backchannel behaviors are universal across cultures, but there are cultural differences in terms of their frequency, type, and placement [8–11]. Listeners are expected to produce culturally appropriate types of responses toward speakers; otherwise, they are viewed as being inattentive, interrupting the conversation, or not showing empathy [12]. Heinz [9] explored backchannel responses among German and American English speakers and found that German speakers used fewer backchannel responses and placed them less frequently in overlapping positions compared to American English speakers. Clancy et al. [6] explored reactive tokens with English-, Japanese-, and Mandarin-speakers. The results showed that Japanese and English speakers used overall reactive tokens more frequently than Mandarin speakers, and the ratio of backchannel responses to total reactive tokens by Japanese speakers was much higher than that of English- and Mandarin-speakers.

The Japanese term aizuchi is commonly translated as "backchannels." According to Iwasaki [13], aizuchi includes non-lexical backchannels (e.g., hoo, nn), phrasal backchannels (e.g., hontoo "really," soo desu ka "is that right?"), and substantive backchannels (e.g., repetition of words or a clarifying question). Many studies have reported that Japanese listeners frequently use backchannels compared to speakers of other languages [8, 11, 14]. For example, Maynard [8] found that Japanese participants produced backchannels far more frequently than American participants and did not provide greater variability in the types of backchannels than American participants. White [14] also reported that the Japanese provided backchannels for every 14 words, while Americans did so for every 37 words. The reason why Japanese listeners frequently produce aizuchi is that they prefer to construct and maintain interpersonal harmony in their culture [13, 15, 16].

Only a few studies explored response behaviors as a conversational skill in spoken communication between parents and their children. Through their interaction, parents provide and children learn culture-specific responses [17]. For example, Miyata and Nisisawa [18] observed the acquisition of backchannel behaviors (utterance-final *aizuchi* and utterance-internal *aizuchi*) in a boy aged between 1.5 and 3.1 years and found that utterance-internal *aizuchi*, which signifies only continuation and understanding, appeared about 6 months later than the utterance-final *aizuchi*. Hess and Johnston [19] observed backchannel responses in normal children aged between 7.5 and 11.9 years and found that backchannel responses increased significantly with age. Kajikawa et al. [20] explored the conversational style of mother-child interactions. They focused on the frequency of speech overlap such as the particle "ne" produced by the speakers and backchannels produced by the listeners and found that conversational style with frequent overlaps emerged in two-word utterances.

Although response behaviors are important in spoken communication, there are relatively few studies that have explored them in conversations between parents and their children and analyzed how language/cultural backgrounds influence how to respond in conversations. Therefore, this study aims to compare response behaviors in interactions between Japanese parents and their children and English parents and their children. In this study, backchannels and repetitions were counted as response behaviors. The function of repetition is to help learners develop their language by realizing their mistakes and evaluating what they utter [21]. The research questions are as follows:

- How Japanese- and English-speaking parents and children provide responses as listeners in conversational speech.
- Whether there are cross-linguistic differences of response behaviors in conversational speech between parents and children.

3. Method

Participants were ten dyads each comprising typically developing two-year-old toddlers and their parents from Japanese- or English-speaking families. There were four girls and one boy from Japanese-speaking families and two girls and three boys from English-speaking families. Conversational speech between parents and children was recorded and transcribed from each audio file in the Kyushu University children's database constructed by the author [22]. Monologue speech from either the parent or child and singing were not included in this study.

Participants	Speaker change	Conversation topics
EF01	361	TV characters, foods, animals
EF02	343	Cooking, foods
EM01	332	Picture book
EM05	323	Breakfast, picture book
EM06	345	Animals, friends
JF01	285	Foods, animals, lunch
JF03	260	Foods, cooking, books
JM07	300	Foods, TV characters
JF09	212	Toys, park, foods, color
JF10	251	TV characters, foods

Table 1. Basic information of speech data.

Basic information on speech data is shown in **Table 1**. EF/EM and JF/JM refer to English- and Japanese-speaking families, respectively, where F and M denote the gender (female or male) of the child. Speaker changes were counted according to Clancy et al. [6, p. 359] and occurred at any point at which another speaker took a turn; laughter turns were not included in this study. With regard to the types of backchannels, this study followed the categories proposed by Iwasaki [13, p. 666]: "non-lexical backchannels," which comprise vocalic sounds that have little or no meaning (e.g., hoo, nn, hai), and "phrasal backchannels," which are phrases or words with meaning (e.g., hontoo "really," soo desu ka "is that right?"). In Iwasaki's study, there was another category labeled "substantive backchannels," which included repetition, a summary statement, or a clarifying question. This study, however, did not include substantive backchannels; instead, the category of "repetition" was added. Since this study focused on parents and two-year-old children, who were in the process of learning a language, repetitions occurred frequently. If she/he repeated a word or a portion of a speech that another speaker produced, it was counted as a repetition. Responses of a mother/father toward a child or a child toward a mother/father were classified into these three categories: non-lexical backchannels, phrasal backchannels, and repetition. Answering questions and responses to invitations and orders were not included in this study. The frequency of each category was counted, and the variability of these responses was observed.

4. Results

In this study, it was observed that a parent developed a topic or shared information and the child responded toward that parent. It was also observed that parents and children developed topics collaboratively and parents actively provided children with feedback. As noted in Iwasaki [13], if a person develops and controls a topic of conversation, other participants attend the conversation and provide backchannels; however, if participants develop a topic collaboratively, backchannels can occur from all participants. Backchannels of both a parent toward a child and a child toward a parent were counted in this study. **Figure 1** shows the average frequency of overall responses (non-lexical backchannels, phrasal backchannels, and repetitions) among English- and Japanese-speaking parents and children. The ratio of overall responses to all speaker changes was counted. The average frequency of overall backchannels and repetitions was 24.36 and 1.75%, respectively, in English-speaking parents and children,

http://dx.doi.org/10.5772/intechopen.69743

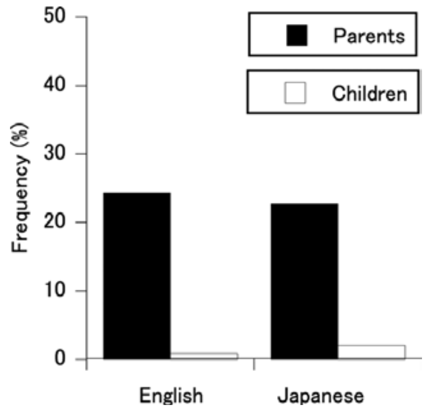


Figure 1. The average frequency of overall backchannels among English- and Japanese-speaking parents and children.

and 22.71 and 4.16%, respectively, in Japanese-speaking parents and children. With regard to parents' response behaviors toward children, the results showed that more than 20% of all speaker changes occurred through non-lexical backchannels, phrasal backchannels, or repetition, regardless of language background. The results also showed that children from either background did not frequently use backchannels or repetitions.

Table 2 shows the frequency of each type of backchannel in Japanese- and English-speaking parents. The ratio of each type of backchannel, repetitions, and repetitions to overall responses was counted. For Japanese-speaking parents, non-lexical backchannels and repetitions were preferred to phrasal backchannels, which was statistically significant ($\chi^2 = 64.26$, $df = 2$, $p < 0.01$). For English-speaking parents, non-lexical backchannels were preferred to phrasal backchannels and repetitions, which was also statistically significant ($\chi^2 = 65.81$, $df = 2$, $p < 0.01$).

Figure 2 shows the frequency of non-lexical backchannels in English- and Japanese-speaking parents and children. The ratio of non-lexical backchannels to all speaker changes for each speaker was counted. For English-speaking parents, the frequency of EM01 was the greatest (22.29%) and the frequency of EF01 was the lowest (3.60%). For Japanese-speaking parents, the frequency of JF03 was the greatest (15.00%) and the frequency of JF01 was the lowest (3.16%). In other words, more than 20% of all speaker changes was non-lexical backchannels produced by parents for EM01 dyads, and 15% of all speaker changes was non-lexical backchannels produced by parents for JF03 dyads. EM01 parents frequently produced "oh" or "uh huh" and JF03 parents frequently produced "un (uh huh)" that functioned as a continuer (see more details in Excerpts 1 and 2). With regard to children, the frequency of non-lexical backchannels was less than 6%, regardless of their language background.

Excerpt 1 is a conversation between a father and son from an English-speaking family (EM01). The child's utterances were transcribed as it sounded by the annotator. In this conversation, the father kept using the non-lexical backchannel "uh huh" that functioned as a continuer in lines 2, 6, and 8. Excerpt 2 is a conversation between a mother and daughter from a Japanese-speaking family (JF03). The mother and daughter played cooking with toys. The mother

Participants	Non-lexical backchannels	Phrasal backchannels	Repetitions
Japanese-speaking parents	44.37%	11.59%	44.04%
English-speaking parents	51.60%	30.75%	17.65%

Table 2. The average frequency of each type of backchannels (%).

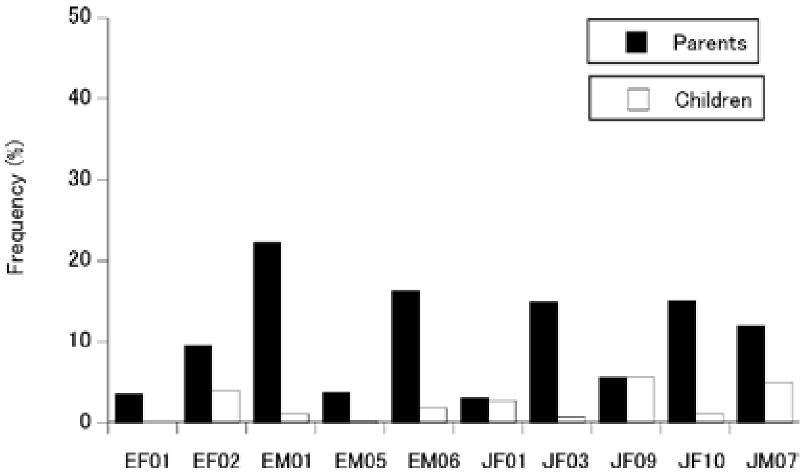


Figure 2. The frequency of non-lexical backchannels among English- and Japanese-speaking parents and children.

asked the girl what she wanted to use and wash for cooking. The girl could not answer the questions directly, but the mother kept using the non-lexical backchannel “un (uh huh)” that functioned as a continuer in lines 14, 20, 22, 24, 26, and 28.

Note: In the following excerpts, C refers to child, F to father, and M to mother.

(1) Excerpt 1 (EM01)

1 C: Dubaah yee

2 F: **Uh huh**

3 C: Noo Tow

4 F: Toby that’s right

5 C: Noh tooh

6 F: **Uh huh**

7 C: Tooh tooh tooh

8 F: Toby **uh huh**

9 C: No tooh eh tooh no pooh pooohp

(2) Excerpt 2 (JF03)

10 M: jyaa tugi hora nani tsukau

Well, what do you want to use next?

11 C: anka hoshitto aka

I want red

12 M: un?

Huh?

13 C: aka hoshii akahoshiide

I want red, I want red

14 M: **Un.**

Uh huh

15 C: aka hoshii

I want red

16 M: dore araimasuka

Which one do you wash?

17 C: aka hoshi aka

I want red, I want red

18 M: aka hoshiine

You want red

19 C: aka aka

Red, red

20 M: **Un.**

Uh huh

21 C: hoshii

Want

22 M: **Un.**

Uh huh

23 C: akatte

Red

24 M: **Un.**

Uh huh

25 C: akatte

Red

26 M: **Un.**

Uh huh

27 C: iiyogiini

iiyogini

28 M: **Un.**

Uh huh

Table 3 shows the variety of non-lexical backchannels among English- and Japanese-speaking parents. For English-speaking parents, the frequent vocalic forms were "yes, yeah" (35.61%), "oh" (34.15%), and "uh huh" (17.07%). For Japanese-speaking parents, the frequent vocalic forms were "un" (56.25%), "hai" (23.96%), and "a=, a" (10.42%). The variety of non-lexical backchannels of children was also observed. For English-speaking children, the frequent vocalic forms were "hm" (34.78%), "yes, yeah" (26.09%), and "oh" (17.39%). English-speaking children seldom produced "uh huh," as opposed to English-speaking parents. Conversely, for more than half of all the non-lexical backchannels, Japanese-speaking children produced "un" similar to Japanese-speaking parents.

Figure 3 shows the frequency of phrasal backchannels among English- and Japanese-speaking parents and children. The ratio of phrasal backchannels to all speaker changes for each speaker was counted. For English-speaking parents, the frequency of EM01 was the greatest (18.37%), and the frequency of EF01 was the lowest (1.94%). It was the same tendency as the frequency of non-lexical backchannels. In other words, EM01 produced both non-lexical and phrasal backchannels frequently and EF01 did not produce either non-lexical or phrasal backchannels frequently. English-speaking children did not produce any phrasal backchannels.

English-speaking parents		**Japanese-speaking parents**	
Vocalic form	**Frequency (%)**	**Vocalic form**	**Frequency (%)**
yes, yeah	73 (35.61%)	un	54 (56.25%)
oh	70 (34.63%)	hai	23 (23.96%)
uh huh	35 (17.07%)	a, a=	10 (10.42%)
hm	16 (7.80%)	uwa	6 (6.25%)
uh	7 (3.41%)		

Table 3. The variety of non-lexical backchannels with English-speaking and Japanese-speaking parents.

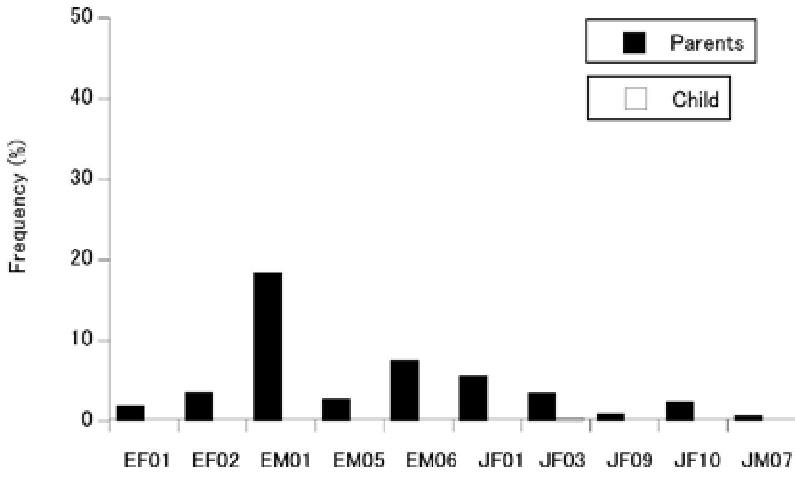


Figure 3. The frequency of phrasal backchannels among English- and Japanese-speaking parents and children.

Japanese-speaking parents rarely produced phrasal backchannels (less than 6%). Similarly, Japanese-speaking children also seldom produced phrasal backchannels.

Table 4 shows the variety of phrasal backchannels used by English- and Japanese-speaking parents. Among English-speaking parents, the frequent phrasal backchannels were "That's right, right" (34.95%), "OK" (33.98%), and "Good girl/Good boy" (17.48%). For Japanese-speaking parents, the frequent phrasal backchannels were "so, sone (It is so)" (38.24%), "sugoi (great)" (23.53%), and "soo desu ka (Is that so?)" (20.59%). As noted in Iwasaki [13], phrasal backchannels are often treated as reactive expressions. English-speaking parents used phrasal backchannels such as "Good girl/Good boy" and "That's good" to praise a child and "That's right, right" to show agreement. Similarly, Japanese-speaking parents also used phrasal backchannels, such as "so, sone" to show agreement, and "sugoi" to praise a child.

Excerpt 3 is a conversation between a father and child from an English-speaking family. The father asked the child about a character in the picture book, and the child tried to answer the question. The father provided the same phrasal backchannels—"That's right"—to show agreement in lines 30, 32, and 34.

English-speaking parents		**Japanese-speaking parents**	
Vocalic form	**Frequency (%)**	**Vocalic form**	**Frequency (%)**
That's right, right	36 (34.95%)	so, sone "it is so"	13 (38.24%)
OK	35 (33.98%)	sugoi "great"	8 (23.53%)
Good girl, Good boy	18 (17.48%)	sodesuka "is that so?"	7 (20.59%)
That's good, That sounds good	4 (3.88%)	honto "really?"	3 (8.82%)
Alright	4 (3.88%)		

Table 4. The variety of phrasal backchannels with English-speaking and Japanese-speaking parents.

(3) Excerpt 3 (EM01)

29 C: Poo

30 F: Uh huh **that's right** it's Thomas and who else who's that

31 C: Ah kah

32 F: An incredible **that's right**

33 C: Oh wooh woo

34 F: Roller wall yes **that's right**

Figure 4 shows the frequency of repetitions among English- and Japanese-speaking parents and children. The ratio of repetitions to all speaker changes for each speaker was counted. For English-speaking parents, the frequency of EM06 was the greatest (8.70%), and the frequency of EM05 was the lowest (4.02%). For Japanese-speaking parents, the frequency of JF03 was the greatest (16.92%), and the frequency of JF09 was the lowest (4.25%). Japanese-speaking parents frequently repeated the words their children produced in order to show understanding, evaluate what their children said, or correct their mistakes. It needs to be noted that children were sometimes asked to repeat what their mother/father had said; this was not counted as repetition produced by the children.

Excerpt 4 is a conversation between a mother and child from a Japanese-speaking family. The mother repeated the words "throw it away" that the child uttered in order to confirm that this was what the child requested in lines 35 and 36. She added the question "You don't need it anymore?" with the same meaning but a different way of asking to make sure once again in line 36. Excerpt 5 is another conversation between a mother and a child from Japanese-speaking family. The mother repeated the words "throw it way," changing a grammatical tense, in order to correct what the child uttered in lines 44 and 45. After the mother

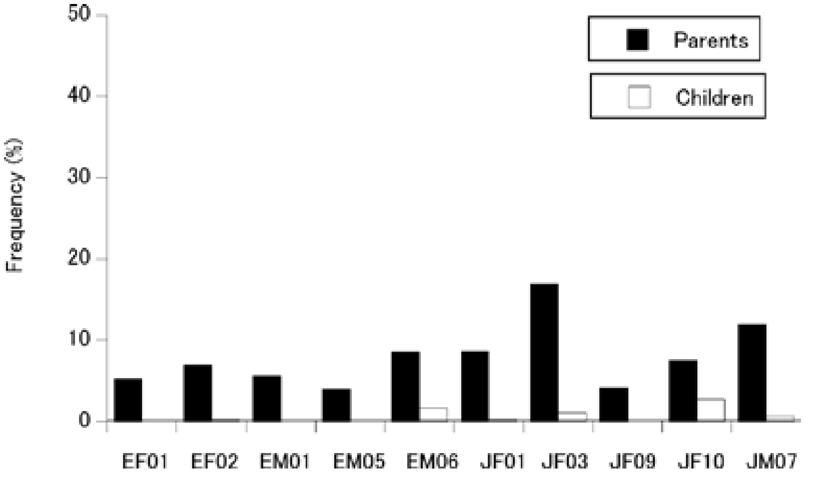


Figure 4. Repetitions among English- and Japanese-speaking parents and children.

asked whether her child wants to come with her, the child said her name "Mi." The mother repeated her name "Mi" and added the content word "iku (goes)" for better grammatical sense in lines 54 and 55.

(4) Excerpt 4 (JF10)

35 C: **poi suru**

Throw it away.

36 M: **poi suru** no mou iranai no sore?

Throw it away. You don't need it anymore?

37 C: un iranai.

Yes, I don't need it.

38 M: he

Oh.

39 C: gomi haitteru?

Is there trash?

40 M: un. Gomi haitteru aa jyaa poi shitoite hai arigatou.

Yes, there is trash. Well, throw it away. Yes, thank you.

42 C: dekita

I did it.

43 M: un. Sugoine. Dekita.

Yes, great. You did it.

(5) Excerpt 5 (JF01)

44 C: **poi**

Throw it away.

45 M: hai **poi shita**

Yes, **threw it away.**

46 C: un nai

Yes. Not be found.

47 M: nani ga nai?

What is not found?

48 C: **kami**

Paper

49 M: **kami ga nai.** kami aru yaro.

Paper is not found. *There is paper.*

50 C: ame

Candy

51 M: ame naiyo. A kore nani

Candy is not found. What is this?

52 C: un

Un

------------<6 lines omitted>---

53 M: issho ni kuru?

Do you want to come with me?

54 C: Un. **Mi**

Yes. **Mi**

55 M: **Mi chan iku.** a mazu kore mo nainai senaikan

Mi chan goes. *Well, we have to throw it away first.*

56 C: Un.

Yes.

Repetitions by Japanese-speaking parents were further explored. Their repetitions were coded into two categories: exact repetitions and local repetitions. Exact repetition was when parents repeated an entire utterance in an exact way. Local repetition was when parents added, removed, and substituted content words, function words, and the sentence-final particle "ne," which often occurs in Japanese, as listed in the following examples. Japanese speakers frequently use "ne" in conversations to build affective common ground between the speaker and the listener for cooperation [23]. As Uyeno [24] noted, speakers use the sentence-final particle "ne" to show agreement of propositional content. In this study, almost half of all repetitions were exact repetitions. With regard to local repetition, parents frequently repeated what a child had said and added the sentence-final particle "ne" or content words. Local repetitions included the following:

- Addition of content words
- Addition of function words
- Addition of the sentence-final particle "ne"
- Addition of content words and the sentence-final particle "ne"
- Addition of function words and the sentence-final particle "ne"
- Substitution of content words

- Removal of content words
- Removal of function words

5. Discussion

This study explored the responses of listeners in conversational speech between English- and Japanese-speaking parents and their two-year-old children. Responses of a mother/father toward a child or a child toward a mother/father were classified into three categories: non-lexical backchannels, phrasal backchannels, and repetition. The ratio of overall responses to all speaker changes was counted. The results showed that both English- and Japanese-speaking parents used all three categories, which amounted to more than 20% of all speaker changes. There was no difference in the frequency of overall responses between English- and Japanese- speaking parents. Previous studies that explored backchannels in adult-adult conversation showed that Japanese listeners used backchannels more frequently than English speakers [8, 11, 14]. Our findings are not consistent with previous studies in that there was no difference in the frequency of overall responses between English- and Japanese-speaking parents. It is probably because this study explored response behaviors in conversations between parents and children, where parents frequently use backchannels and repetitions to encourage their children to continue talking, show understanding, and correct mistakes, which might be universal across languages. Interestingly, there was a language/culture difference in the type of response behaviors exhibited; non-lexical backchannels and repetitions were preferred to phrasal backchannels among Japanese-speaking parents, while non-lexical backchannels were preferred to phrasal backchannels and repetitions among English-speaking parents. With regard to children's response behaviors, this study did not find frequent use of backchannels and repetitions. Language development of all children in this study was at the two-word stage, when a child uses simple phrases and begins to develop complex phrases. However, they did not use backchannels and repetitions as frequently as the adult speakers. As Hess and Johnston [19] noted, backchannel response behaviors of listeners that provide collaborative feedback could be among the last skills that children acquire during language development. At which age they begin to use these response behaviors needs to be further explored. The findings of the present study are expected to be useful in understanding response behaviors as a conversational skill in spoken communication between parents and their children.

6. Conclusion

This study determined that there was no difference in the frequency of overall responses between English- and Japanese-speaking parents. This study also suggested that there was a language/culture difference in the type of response behaviors between English- and Japanese-speaking parents. Although this study did not reveal children's response behaviors, this study found that there were similarities and differences of parents' response behaviors between two different languages. Studies with children with older age will clarify how parents' response behaviors influence the acquisition of response behaviors during language development.

Acknowledgements

This work was supported by JSPS KAKENHI (Grant Number JP26770194).

Author details

Yuko Yamashita

Address all correspondence to: yama-y@shibaura-it.ac.jp

Shibaura Institute of Technology, Tokyo, Japan

References

[1] Ferguson CA. Talking to children: A search for universals. In: Greenberg JH, editor. Universals of Human Language. Stanford, CA: Stanford University Press; 1978

[2] Fernald A, Taeschner T, Dunn J, Papousek M. A cross-language study of prosodic modifications in mothers' and fathers' speech to preverbal infants. Journal of Child Language. 1989;**16**(3):477-501

[3] Fernald A, Morikawa H. Common themes and cultural variations in Japanese and American mothers' speech to infants. Child Development. 1993;**64**(3):637-656

[4] Choi S. Caregiver input in English and Korean: Use of nouns and verbs in book-reading and toy-play contexts. Journal of Child Language. 2000;**27**(1):69-96

[5] Yngve V. On getting a word in edgewise. In: Papers from the Sixth Regional Meeting of the Chicago Linguistic Society. Chicago, IL: Chicago Linguistic Society; 1970. pp. 567-577

[6] Clancy PM, Thompson SA, Suzuki R, Tao H. The conversational use of reactive tokens in English, Japanese, and Mandarin. Journal of Pragmatics. 1996;**26**:355-387

[7] Lambertz K. Back-channelling: The use of yeah and mm to portray engaged. Griffith Working Papers in Pragmatics and Intercultural Communication. 2011;**4**(1/2):11-18

[8] Maynard S. Analyzing interactional management in native/non-native English conversation. International Review of Applied Linguistics in Language Teaching. 1997;**35**(1):37-60

[9] Heinz B. Backchannel responses as strategic responses in bilingual speakers' conversations. Journal of Pragmatics. 2003;**35**(7):1113-1142

[10] Maynard S. Conversation management in contrast: Listener responses in Japanese and American English. Journal of Pragmatics. 1990;**14**(1):397-412

[11] Mizutani N. Aizuchi to ootoo. In: Mizutani O, editor. Hanashi kotoba no hyoogen. Tokyo: Chikuma Shoboo; 1983. pp. 37-44

[12] Miller L. Listening behavior in conversations between Japanese and Americans. In: Blommaert J, Verschueren J, editors. Intercultural and International Communication. Amsterdam: John Benjamins; 1988. pp. 111-130

[13] Iwasaki S. The Northridge earthquake conversations: The floor structure and the 'loop' sequence. Journal of Pragmatics. 1997;**28**:661-693

[14] White S. Backchannels across cultures: A study of Americans and Japanese. Language and Society. 1989;**18**:59-76

[15] Maynard S. On back-channel behavior in Japanese and English casual conversation. Linguistics. 1986;**24**:1079-1108

[16] Saft S. Exploring Aizuchi as resources in Japanese social interaction: The case of a political discussion program. Journal of Pragmatics. 2007;**39**(7):1290-1312

[17] Minami M. Social interaction and discourse style: Culture-specific parental styles of interviewing and children's narrative structure. In: The 4th International Pragmatics Conference; 26 July 1993; Kobe, Japan

[18] Miyata S, Nisisawa H. The acquisition of Japanese backchanneling behavior: Observing the emergence of Aizuchi in a Japanese boy. Journal of Pragmatics. 2007;**39**(7):1255-1274

[19] Hess LJ, Johnston JR. Acquisition of back channel listener responses to adequate messages. Discourse Processes. 1988;**11**(3):319-335

[20] Kajikawa S, Amano S, Kondo T. Speech overlap in Japanese mother-child conversations. Journal of Child Language. 2004;**31**:215-230

[21] Hasan AS. Analysing bilingual classroom discourse. International Journal of Bilingual Education and Bilingualism. 2006;**9**(1):7-18. DOI: 10.1080/13670050608668627

[22] Yamashita Y, Nakajima Y, Ueda K, Shimada Y, Hirsh D, Seno T, et al. Acoustic analyses of speech sounds and rhythms in Japanese-and English-learning infants. Frontiers in Psychology. 2013;**4**(57)

[23] Cook HM. The sentence-final particle *ne* as a tool for cooperation in Japanese conversation. In: Hoji H, editor. Japanese/Korean Linguistics. Chicago, IL: University of Chicago Press; 1990. pp. 29-44

[24] Uyeno T. A study of Japanese modality: A performative analysis of sentence particles [dissertation]. University of Michigan; 1971

Chapter 12

Variables That Influence Articulation Accuracy in Children with Down Syndrome and Specific Language Disorder: Similarities and Differences

Miriam Zarzo-Benlloch, José F. Cervera-Mérida and Amparo Ygual-Fernández

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69933

Abstract

Research about speech sound disorders (SSD) in children with Down syndrome (DS) and children with specific language impairment (SLI) suggests similar linguistic profiles with weakness in phonology skills. The question is if these similarities are superficial or share deficits in levels and underlying skills to its speech disorders: phonological memory (PM), coordination motor skills, and articulatory muscular system. Our research involved 24 children divided into four groups: SLI, DS, and two groups of typical development. SLI group presented a mild-moderate speech disorder and DS group moderate-severe. Following skills were evaluated: nonverbal intelligence, PM, and oral motor coordination (oral-DDK). The Iowa Oral Performance Instrument (IOPI) was used for the measurement of physiological variables (strength and endurance of tongue and lips). Percentage of consonants correct (PCC) was found. Phonological memory, motor coordination, and physiological variables are factors associated with SSD in teenagers with DS. However, SSD in children with SLI only are associated to phonological memory. Motor coordination and physiological variables are not involved in their SSD of mild and moderate-severe levels. We have objectively measured the strength and endurance of tongue and lips. This may have clinical implications. It is necessary to assess objectively all the variables affecting articulatory accuracy to design intervention programs in SSD.

Keywords: speech sound disorder, specific language impairment, Down syndrome, oral-diadochokinetic, tongue strength

1. Introduction

Research about speech sound disorders in children with Down syndrome (DS) and children with specific language impairment (SLI) suggests similar linguistic profiles with weakness in phonology skills [1, 2]. The question is if these similarities are superficial or share deficits in different levels and underlying skills to their speech disorders.

The widespread problem of language disorder in children with SLI, according to some researchers, can be explained by the deficit in speech processing skills (perceptual skills, phonological memory, praxis, or motor programming), which hinders the phonological development, vocabulary learning, morphosyntactic processing, and production of words [3, 4]. It is the main handicap that may be interfering with articulatory accuracy, revealing a slowing of the typical development which can also present different evolutionary patterns with idiosyncratic itineraries. Van der Lely [5] proposed that the phonological deficit could attend with other grammatical alterations (morphological, syntactic), although it does not mean a causal relationship between them, although they can act in a reciprocal manner. Other studies suggest that not all children with SLI presented a phonological deficit [6, 7].

On the other hand, various factors that affect speech and development of the language of people with DS have been described in the literature. In addition to cognitive deficit that is the main factor, hearing loss, anatomical alterations, and failures in speech processing, among others, have an effect on speech. However, it is difficult to determine the influence needed for each factor, also can vary from one person to another, but it is known that difficulties in speech are not highly correlated with language or cognition, which may indicate that these problems are rooted in other factors [8]. The speech of children with DS often presents inconsistent errors, both developmental and devious, which reduce the intelligibility producing negative effects on social and labor activities [9–13]. This issue requires several levels of analysis.

1.1. Phonological short-term memory

The first level of study is focused toward phonological short-term memory (PM) which plays a crucial role in the segmentation of speech and further construction of accurate phonological representations, which will have implications in speech and in development of other areas of language (e.g. vocabulary) in the acquisition of phonological awareness and literacy development [14–16].

Traditionally, this cognitive function has been evaluated with pseudo-words repetition tasks (PWR), but it is debated whether it is really a unique and reliable measure of phonological memory [6], since, in addition, its execution is influenced by input processing, phonological awareness, and vocabulary skills and motor programs [17]. Recent research notes that high variability in speech errors is associated with low scores in RPW tasks [18].

Numerous studies conclude that children with SLI have low performance in these tasks in comparison with children of same chronological age and, in some cases, their own linguistic age, which is interpreted as a deficit in PM that seems to persist through time [16, 19–21]. This limitation may influence the quantity and / or quality of stored phonological information which, in turn, can affect language development [16, 22].

http://dx.doi.org/10.5772/intechopen.69933

Although difficulties may be due to linguistic skills usually reduced, poor performance can be found even in children with SLI that have reached levels close to normal language, suggesting it is a good phenotypic marker of SLI in ages ranging from 4 to 6 years [23–26]. The reason for this age range is because in preschool the PM seems to be more related to oral language ability. However, after 6 years of age, this ability can be more tied to development of literacy [27, 28].

The evidence shows that alterations in memory have their greatest effect with longer stimulus [29–31]. In addition, some studies have found that phonological complexity and lexical and sublexical phonological awareness mediate on accuracy of repetitions [17, 20, 32].

An alternative explanation for the low yields obtained in PWR tasks is that children with SLI have a deficit in phonological processing beyond a specific limitation in memory, at the stage of coding, storage, or retrieval of phonological stimuli [3, 15, 33]. Consequently, representation of any pseudo-word will be low in quality, increasing difficulties with the length of stimuli.

On the other hand, research has exposed that the deficit in the PM is also one of the characteristics of people with DS and therefore presented a speech widely variable [34–36]. The findings of some studies suggest that it is a specific deficit for verbal information, since they do not seem to show poor performance on tests of visuospatial short-term memory, and is not caused, mainly, by hearing loss or speech production difficulties [37–40].

Effect of stimulus length has also been found in the population with DS, even when performance is compared to children matched in linguistic age [34, 37]. Other works have not observed this effect so clearly [36, 38], but we have to think about some limitations that could be masking the results: in one of the studies, only stimuli of one or two syllables were compared, and on the other, the control group was of preschool age, where it is common to find it hard to repeat pseudo-words of four syllables. Moreover, some researchers have found that the lexical effects influence either the population with DS and preschoolers with typical development, both of them benefiting from the linguistic knowledge. The difference is that people with DS need to lean more on the lexical knowledge, even though it does not mean that they benefit to a greater extent than the control group.

1.2. Coordination motor skills

Oral motor skills are another factor that could explain the articulatory accuracy difficulties, since there are evidences which connect neuromotor maturation with phonological development [41]. One way that has been suggested to evaluate it is oral-diadochokinetic rates tasks (oral-DDK) that measure the speed with which a subject is capable of producing, repeatedly and with precision, sequences of nonsense syllables that are alternating movements of articulators' different organs [42–44].

The majority of studies on motor coordination skills assessed through oral-DDK tasks have included children with verbal dyspraxia. In this condition, it is characteristic to find a deficit which is reflected in low yields obtained in oral-DDK (reduced rates, sequencing and precision errors), both compared to children with typical development [45, 46] and children with speech and language disorders [45]. Other works have studied children with phonological and articulation disorders, noting difficulties in sequencing and accuracy of sounds during the repetition of syllabic scripts (e.g. replacement of /k/ for /t/), but not in fluency and intelligibility [41, 47, 48]. Finally, a study compared children with SLI with two control groups matched for chronological age and linguistic age, wherein the SLI group always showed poor performance, suggesting it is a marker of SLI in combination with others [49].

Most of the researches, conducted on people with DS, have found decreased rates with higher accuracy errors, less consistency of production, and a greater number of attempts when oral-DDK tasks are carried out [50–52]. McCann and Wrench [53] observed similar rates to those obtained in children with typical development, although productions were more inaccurate. This suggests that motor speech disorder is not only the difficulty in execution (dysarthria) but also the difficulty in planning or programming of spatial-temporal parameters in sequences of movement (dyspraxia).

1.3. Articulatory muscular system

The effector organs of articulation are dependent on muscle function. Research on aspects such as endurance and strength of lips and tongue in children with speech disorders is scarce, mainly, due to doubts about reliability of measurements of performance in children and lack of comparative data in children with typical development.

Potter and Short [54] examined tongue strength in 150 children and teenagers (between 3 and 16 years of age), no history of speech disorders, using Iowa Oral Pressure Instrument (IOPI). In their study they concluded that strength of tongue increases with age and in men is slightly higher than women between 14 and 16 years of age.

Some works do not find alterations in children with phonological disorder, but find them in children with verbal dyspraxia, concluding that oral performance variable is a differentiator between these two groups [55, 56]. There is no reason to think about a possible disturbance in this level of speech production in children with SLI, as it is suggested by the data provided in this research.

Differences in anatomy and physiology of the organs of people with DS (hypotonia, reduced range of motion, etc.) are well-known factors that could be the basis of reduced intelligibility [52, 57–59]. However, there are no clear conclusions about its impact on the specific speech difficulties [8]. Thus, some authors point out that these differences do not explain the entire speech disorder [2, 60].

In our research, we have analyzed variables related to articulatory accuracy in the population with SLI and DS: phonological processing skills, motor coordination, and physiological variables, using Medical IOPI device that allows obtaining objective measures of the strength and endurance of lips and tongue.

2. Method

2.1. Participants

The sample was 24 participants divided into four groups: (1) six children with SLI matched in chronological age ($p = 0.29$) and nonverbal intelligence with a control group of six children with typical development (Typical Development Control 2); (2), six teenagers with DS matched in chronological age with another control group of six subjects with typical development (Typical Development Control 1) (p = 0.87). This decision was taken because the research includes the variables of physiological and motor coordination which are related to age-dependent maduration factors.

SLI group presented a severity level of mild-moderate speech disorder (percentage of consonants correct, PCC = 0.80) and DS group moderate-severe (PCC = 0.65), compared to their controls groups that reached the highest articulatory accuracy. Groups' characteristics are described in **Table 1**.

It was established as common inclusion criteria that participants had Spanish as their first language and they used it at school. The control groups were matched in chronological age to two study groups and they had no history of language disorders or learning disabilities.

2.2. Instruments

To assess PM, a PWR task was used [61]. It consists of repeating two lists of 40 pseudo-words with high-frequency and low-frequency syllables. Each list contained four groups of 10 pseudo-words for two, three, four, and five syllables. Each pseudo-word was equal to another pseudo-word of the other list in number of syllables, syllabic structure, accentuation pattern, and order in which syllables were placed with their different structures.

Oral-DDK: they were used to assess oral motor coordination skills. They consist of issuing a number of nonsense syllables involving opposing movement patterns, accurately and quickly. One syllable ([pa], [ta], and [ka]), two syllables ([pata], [paka], [taka]), and three syllables ([pataka]) were used.

Oral performance measurement: Medical IOPI device (Iowa Oral Performance Instrument, model 2.3) has been used to objectively measure lingual and labial resistance (maximum pressure in kilopascals, kPa, time in seconds that a pressure equal to 50% of the maximum force can be sustained).

Pronunciation task: Stimuli AF125 composed by a set of 125 images designed to induce a representative sample of the Spanish phonological system and to find the percentage of correct consonants (PCC) was used with the Ánfora software [62–64]. It contains a comprehensive repertoire of syllabic types in Spanish, repeated at least four times, with words of syllabic

	N	Age (months)		Age range (months)		IQ nonverbal		PCC		
		M	SD	Min.	Max.	M	SD	M	SD	S.SD[1]
SLI	6	72	13.06	52	86	109.17	12.64	0.80	0.13	MM
CG 2	6	68	4.85	60	73	103.67	13.79	1	0.01	–
DS	6	173	23.2	135	208	65	0	0.65	0.20	MS
CG 1	6	170.33	13.64	148	184	102.17	13.18	1	0	–

Notes: M, media; SD, standard deviation; PCC, percentage of consonants correct; S.SD, severity speech disorder; MM, mild-moderate; MS, moderate-severe. [1]Shriberg y Kwiatkowski, 1982.

Table 1. Participants.

structures common in the language. All language phonemes appear at least three times in each position and in the most common phonetic environments.

Raven's progressive matrices test [65]: It is a nonverbal intelligence test applied to control this variable and perform the pairing of SLI group.

3. Procedures

All participants in this study have been subjected to all assessment protocol that was applied in three sessions of 30 minutes: in the first, PWR together with oral-DDK were applied; in the second session, AF125 pronunciation task and oral performance was measured with Medical IOPI device. Finally, Raven's progressive Matrices test was applied to obtain IQ.

The application of PWR task was divided into two parts because it is a fairly long task and requires sustained attention. Each pseudo-word was read by the evaluator twice, slowly, clearly, and respecting accentuation. The instruction given to child was: *I'll say a few words that mean nothing. You should pay attention because you will have to repeat them as I do*. The scoring method used was that of whole words, that is, each repeated item is evaluated as a whole and noted down as right or wrong production compared to the target, regardless of the number of phonological errors and without penalizing accentuation and/or articulation errors. Productions were recorded to listen to them carefully and to record the percentage of successful responses.

The measurement of oral-DDK consisted of two phases: First of all came the training, where the examiner showed a child how to do repetitions and they practiced together. After that, the child was able to produce oral-diadochokinetic without help, with precision and speed, until the evaluator indicated him to stop. The **order** given was: Quiero que digas unos sonidos lo más rápido posible. Primero lo haré yo y luego tú. El primer sonido es… (I want you to say sounds as soon as possible. I will do it first, then you. The first sound is…). If the Item was annulled after several attempts or stopped before the indication of the evaluator, is because the child could not make changes of articulation place. The Time-by-count method has been used to record the time each subject takes to produce 20 repetitions for each isolated syllable ([pa], [ta], and [ka]), 15 for two syllables([pata], [paká], [taka]), and finally, 10 repetitions for three syllables ([pataka]). The productions were recorded to count the number of syllables and to write down exact time using a wave's editor.

Oral performance measurement also had a first phase of training in which a child was acquainted with Medical IOPI device. Once the participants were prepared and their maximum tongue strengths were measured, in kPa, by placing the balloon on the top of the tongue and pressing it against the palate with the greatest possible strength for approximately 2 seconds. Then, orbicular muscle strength was measured by positioning the balloon of IOPI device on front side of the mouth, between teeth and lips, to exercise force. Finally, tongue endurance was assessed by quantifying time in seconds that each participant was able to maintain a pressure equal to 50% of its maximum value in tongue strength, placing the balloon in the same position as in the first measurement. Three measures of each valued appearance were taken at periods between

30 and 60 seconds, and the maximum value obtained was recorded. If a decreasing trend was observed in the values obtained in these three measurements, the rest time had to be increased.

AF125 pronunciation test was administered in a single application. This task is to present images under the general order: *Dime qué es esto o cómo se llama (Tell me what this is or what this is called).* If the child did not respond, the examiner had to tell him the right word and he would ask him later. The evaluation continued during two more items, and then the examiner was retreated to retrieve the words that the child had not acted upon. If this was not possible after the third attempt, this word had to be ruled out of the sample. Productions were transcribed to software Ánfora. If the pronunciation was distorted, but it was intelligible, it was noted. If the pronunciation was distorted, but it was intelligible, it was noted. If the pronunciation was unintelligible, the option "nonparsable" appeared marked in the program. From the analysis of speaking sample, software Ánfora calculated the percentage of consonants correct (PCC = consonants pronounced error-free/total sample consonants). It means consonant pronounced error-free and in correct position. Values are included between 1, perfect pronunciation, and 0.

Finally, Raven test-scale Color was applied (series A, Ab, and B) to children from 4 to 10 years of age. General scaling, series A, B, C, D, and E, was applied to older participants.

4. Results

Two objectives of comparison have been raised: SLI group and CG2 (younger); SD group and CG1 (older). To find the differences between the study groups, the data was analyzed through Mann-Whitney U contrasts for independent samples. In addition, the range test with Wilcoxon sign for related samples was applied to check differences in the PWR task between high-frequency and low-frequency syllables.

Homoscedasticity condition is met in most of the variables examined in the study group SLI-CG2 (tongue strength, $p = 0.31$; lips strength, $p = 0.76$; tongue endurance, $p = 0.94$; repetitions [ta], $p = 0.08$; repetitions [ka], $p = 0.14$; repetitions [taka], $p = 0.28$; repetitions [pataka], $p = 0.18$; PWR with high-frequency syllables, $p = 0.11$), and also in the DS-CG1 group (IQ, $p = 0.84$; tongue strength, $p = 0.62$; lips strength, $p = 0.82$; tongue endurance, $p = 0.68$; repetitions [pa], $p = 0.89$; repetitions [ta], $p = 0.28$; repetitions [ka], $p = 0.47$; repetitions [pata], $p = 0.94$; repetitions [paka], $p = 0.70$; repetitions [taka], $p = 0.69$; repetitions [pataka], $p = 0.85$; PWR with high-frequency syllables, $p = 0.45$; PWR with low-frequency syllables, $p = 0.22$).

In objective 1, averages obtained in oral performance variable are similar between the two groups, except in the force of tongue where scores are more distant (**Figure 1**). Results of the comparative analysis (**Table 2**) prove absence of significant differences in the measures taken. This indicates that participants with SLI do not present alterations in peripheral component of speech, at least in the three studied variables.

In oral motor coordination variable, SLI children tend to spend more time in oral-DDK, both repeat isolated syllables as in two and three syllables (**Table 2** and **Figure 2**). Results also reflect a progressive times increase as repetitions require more number of opposing movements of

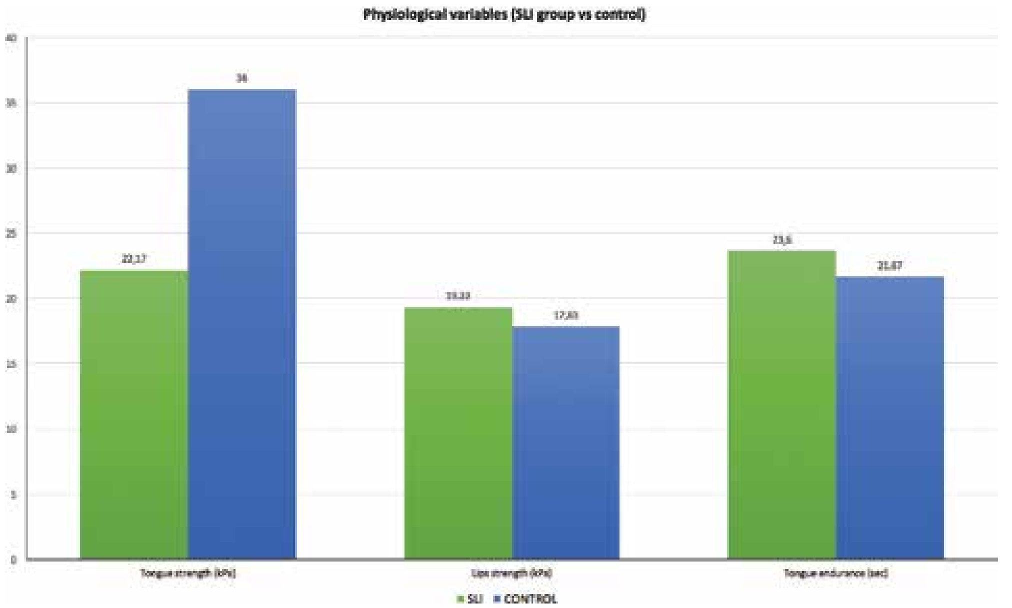


Figure 1. Mean scores in physiological variables (SLI group vs control).

	SLI		**CG 2**		***U***	**Z**	***p***	***r***
	M	**SD**	**M**	**SD**				
Tongue strength (kPa)	22.17	10.82	36.00	12.60	6	−1.92	0.65	–
Lip strength (kPa)	19.33	4.27	17.83	2.93	11	−1.13	0.30	–
Tongue endurance (seg)	23.60	6.80	21.67	7.84	12.5	−0.45	0.66	–
Oral-DDK (seg)								
[pa]	4.92	0.57	4.46	0.57	8	−1.60	0.10	–
[ta]	4.95	0.50	4.73	0.87	15	−0.48	0.63	–
[ka]	5.59	1.39	5.11	0.89	11	−0.73	0.53	–
[pata]	8.98	2.22	7.76	1.88	12	−0.96	0.33	–
[paka]	10.60	2.01	8.76	2.19	10	−1.28	0.24	–
[taka]	11.84	3.60	8.72	2.59	5	−1.49	0.13	–
[pataka]	11.26	2.85	9.75	2.84	10	−2.90	0.76	–
PWR (%)								

http://dx.doi.org/10.5772/intechopen.69933

	SLI		CG 2		*U*	Z	*p*	*r*
	M	**SD**	**M**	**SD**				
High-frequency syllables	60.98	11.71	96.59	2.78	0	−2.90	0.02*	0.83
Low-frequency syllables	46.25	16.18	88.75	5.42	0	−2.89	0.02*	0.83

Notes: Oral-DDK, oral-diadochokinetic tasks; PWR pseudowords repetition. * p < 0.05.

Table 2. Values and statisticians to Objective 1 (Differences between SLI group and control group).

lips and tongue in both groups. Statistical analysis (**Table 2**) shows that differences are not significant; therefore, pronunciation errors cannot be explained by an affectation of general motor coordination.

Finally, you can see in **Figure 3** that the averages obtained by the SLI group in RPW task are lower than that of the control group. The contrast of hypotheses (**Table 2**) shows significant differences ($p = 0.02$) with a large effect size ($r = 0.83$) in both lists: They obtained lower percentages in low-frequency syllables. This significant difference is more pronounced in SLI group ($p = 0.02$; $r = 0.63$). The data suggest that deficits in PM justify an important part of pronunciation errors.

During the Objective 2, the SD group reached an average score in oral performances lower than the control scores of the control group (**Figure 4**). Mann-Whitney U (**Table 3**) confirms that the differences are statistically significant in tongue ($p = 0.00$) and lips ($p = 0.04$) strenght.

Average times obtained by the SD group were greater than the CG1 in oral-DDK tasks (**Figure 5**); statistical analysis (**Table 3**) shows significant differences in all repetitions with

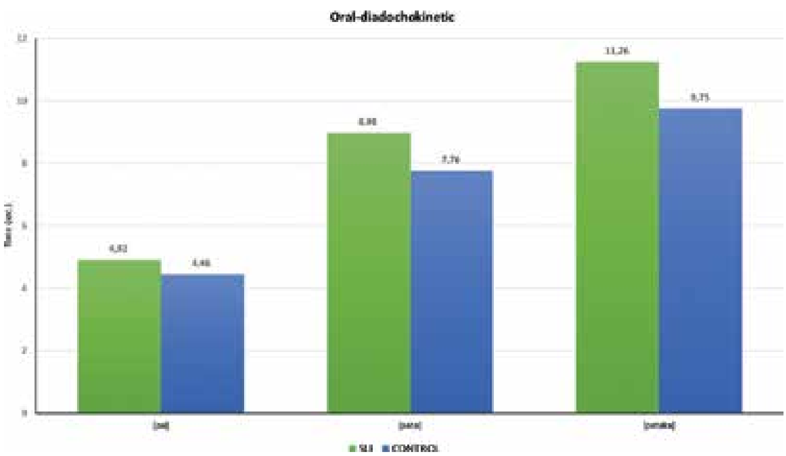


Figure 2. Mean scores in oral-diadochokinetic tasks (SLI group vs control).

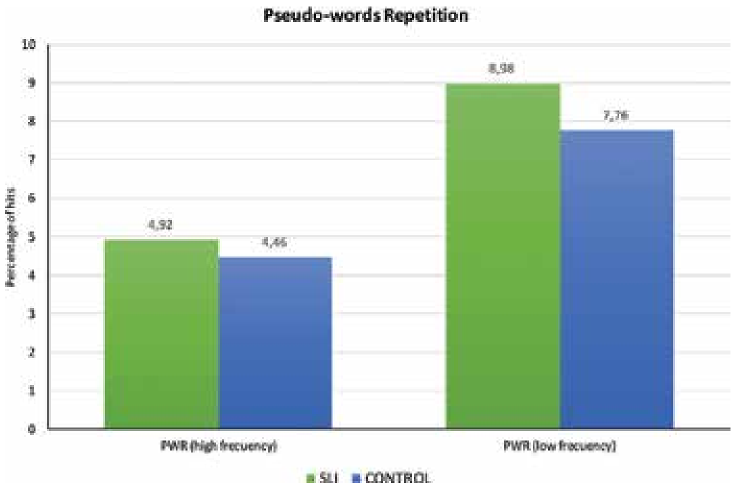


Figure 3. Percentage of hits in repetition pseudo-words task (PWR) (SLI group vs control).

elevated effect sizes. This suggests that motor maturation is not expected for age and can be a variable that is interfering in the articulatory accuracy.

Finally, success rate of the SD group in PWR does not exceed 50% compared to almost 100% of the CG1 group (**Figure 6**): Comparative analysis (**Table 3**) tested hypothesis of difference in our list of high-frequency and low-frequency syllables with large effect sizes. Wilcoxon test was applied in the same way as it was applied in the objective 1, obtaining significant differences (p = 0.04) with high effect size (r = 0.58). Success rate in PWR with high-frequency syllables was significantly higher than with the low-frequency syllables list. Therefore, deficits in PM constitute another factor that interferes with correct pronunciation in the SD group.

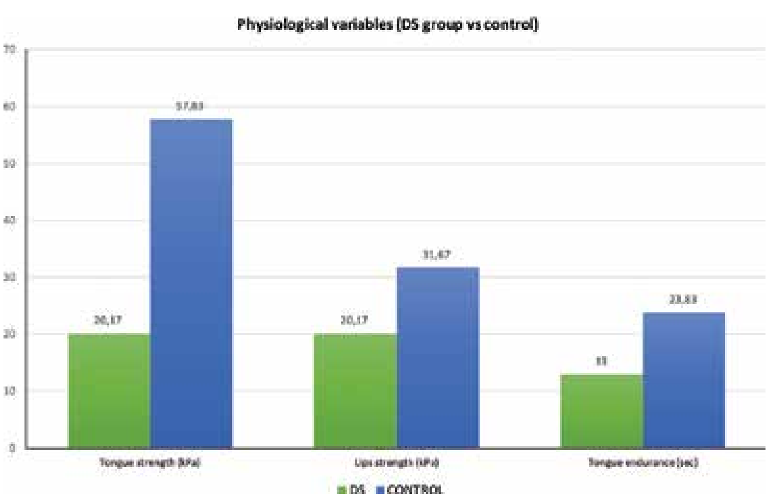


Figure 4. Mean scores in physiological variables (Down syndrome group vs control).

	SD		CG 1		*U*	Z	*p*	*r*
	M	SD	M	SD				
Tongue strength (kPa)	20.17	10.34	57.83	11.91	0.00	−2.88	0.00*	0.83
Lip strength (kPa)	20.17	9.60	31.67	4.27	5.50	−2.00	0.04*	0.58
Tongue endurance (seg)	13.00	8.10	23.83	6.68	5.50	−2.00	0.04*	0.58
Oral-DDK tasks (seg)								
[pa]	4.71	1.63	2.77	0.33	2.00	−2.56	0.01*	0.74
[ta]	6.00	1.44	2.84	0.39	1.00	−2.72	0.00*	0.79
[ka]	6.67	1.35	3.18	0.32	0.00	−2.72	0.00*	0.79
[pata]	13.10	10.43	4.15	0.54	1.00	−2.55	0.01*	0.74
[paka]	12.86	9.36	4.76	0.80	1.00	−2.55	0.01*	0.74
[taka]	9.78	1.46	4.59	0.75	0.00	−2.32	0.02*	0.67
[pataka]	16.47	7.08	5.28	0.95	0.00	−2.55	0.01*	0.74
PWR (%)								
High-frequency syllables	49.24	16.43	99.24	1.86	0.00	−2.98	0.00*	0.86
Low-frequency syllables	40.42	13.55	96.67	3.03	0.00	−2.89	0.00*	0.84

Notes: Oral-DDK, oral-diadochokinetic tasks; PWR pseudowords repetition. * $p < 0.05$.

Table 3. Values and statisticians to Objective 2 (Differences between SD group and control group).

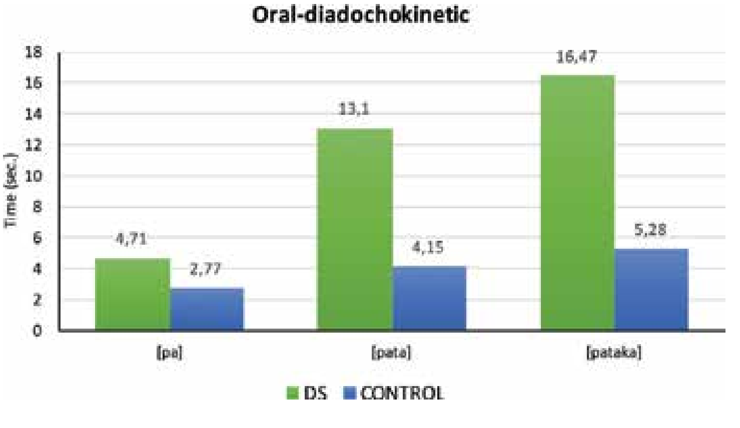


Figure 5. Mean scores in oral-diadochokinetic tasks (Down syndrome group vs control).

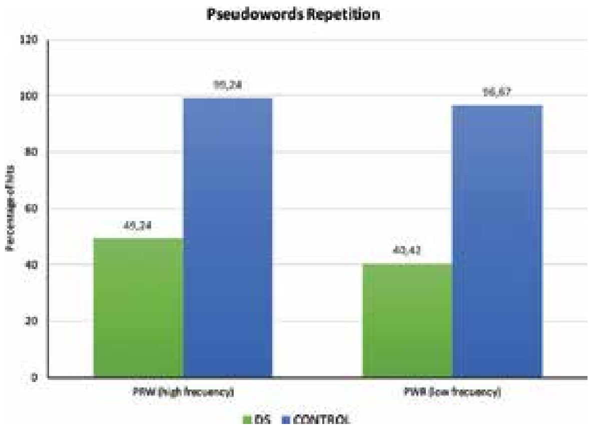


Figure 6. Percentage of hits in repetition pseudo-words task (RPW) (Down syndrome group vs control).

5. Discussion

Results confirm the existence of phonological short-term memory deficit with effects of use frequency, according to investigations conducted with SLI children [16, 19–21] and DS [34–38]. These results indicate that PM test cannot be used as a single measure of phonological short-term memory, because other levels of speech processing and phonological awareness are also involved; therefore, it is difficult to determine direct influences on articulatory accuracy as well as design tasks that only evaluate phonological memory.

The groups studied are not affected alike in PM test. This raises the question of whether it is a matter of severity, because it seems that poor performance has repercussions on the level of speech disorder severity or, on the contrary, there are qualitative differences in speech processing or even other variables that influence phonological memory, for example vocabulary size [66], perhaps because it influences the constant improvement of phonological categories. It would also be interesting to examine whether the limitation in the phonological memory occurs due to issues of quantity and/or quality of the information stored.

Literature found about neuromotor maturation in SLI population is sparse. We have recorded oral-diadochokinetic rates similar to typical development group, although with difficulties in sequencing and precision of sounds, as other works of articulation or phonological disorders [41, 47]. Buiza et al. [49] proposed that low yields obtained in this variable is a good marker of SLI, but our results do not allow to support this idea because although SLI children execution is qualitatively different from typical development children, oral-diadochokinetic rates are similar. However, measures and analyses used in our study are different, therefore comparisons should be made with caution. More conclusive data have been obtained in children with verbal dyspraxia in which motor coordination skills deficit is primary [45, 46].

Publications aimed at this level in people with Down syndrome come to similar results: reduced oral-diadochokinetic rates with more attempts, less consistency of production, and more sequencing errors [50–52]. Data confirm that there is a difficulty in motor programming and sequencing of speech which could explain low scores in articulatory precision. This agrees with the contribution by Wertzner et al. [41] that found an interrelation between neuromotor maturation and phonological development.

Finally, we have not found involvement of peripheral variable in participants with SLI, which confirms an aspect apparently clear among professionals, but that does not translate into clinical practice. Intervention programs, that have an impact on this level of production, are still applied [67] when there is insufficient evidence supporting its use to produce effects in speech [68].

Data concerning population with DS are consistent with previous research [52, 57–59]: there are significant differences in values of oral performance, but it is discussed to what extent it interferes in articulatory accuracy [8]. Studies with different experimental designs and other kind of analysis are required to determine this with certainty.

In summary, in children with SLI, deficits in phonological short-term memory could explain many of the articulatory accuracy errors, since significant differences were not found in other analyzed variables. It would be necessary to clarify the type of specific difficulties in speech processing to design specific psycholinguistic intervention programs for each child. That is the only variable that differs with respect to control group, it suggests that PWR task could be a useful language disorders screening measure, as proposed by other authors [69]. In subjects with DS, articulatory difficulties are not explained by a specific involvement, since there have been significant differences in all analyzed variables. As a result, intervention programs that are designed should address all levels, not only linguistic but also physiological and motor coordination. However, in both populations it is difficult to determine how much each variable affects the pronunciation.

6. Conclusions

While in children with DS seems that the phonological memory, the motor coordination, and the physiological variables could be factors associated with articulatory difficulties, in children with SLI would be involved the first of them. We cannot ensure that variables behave the same way in children with severe speech disorders, since our participants ranged between mild and moderate levels.

These findings have implications in clinical practice. In children with SLI, nonspeech oral motor treatments are not justified to improve speech disorder, because it is clear that there is no involvement at this level, and scientific evidence does not support its use as standard treatment. We suggest the need to clearly evaluate where the difficulties are in the speech processing level and to design programs that affect specific deficits of each person.

On the other hand, children with DS seem to need a broader treatment, that is, treatment not only for speech deficits but also for oral motor and coordination skills. But, before intervening in this last aspect, clinicians must determine if physiological deficiencies are sufficient to interfere with speech and find scientific support for programs that work in this level, so it is recommended to follow principles of practice based on evidence.

Intervention programs cannot be designed depending on the severity of the articulatory disorder because the same symptoms may be due to alterations in different levels of processing. It is necessary to further research in these two population groups to define processes, mechanisms, and skills underlying speech disorders.

Author details

Miriam Zarzo-Benlloch[1], José F. Cervera-Mérida[2] and Amparo Ygual-Fernández[1]*

*Address all correspondence to: amparo.ygual@uv.es

1 Universitat de Valencia, Valencia, Spain

2 Universidad Católica de Valencia San Vicente Mártir, Valencia, Spain

References

[1] Laws G, Bishop D. A comparison of language abilities in adolescents with Down syndrome and children with specific language impairment. Journal of Speech Language and Hearing Research. 2003;**46**(6):1324-1339. DOI: 10.1044/1092-4388(2003/103)

[2] Laws G, Bishop D. Verbal deficits in Down's syndrome and specific language impairment: A comparison. International Journal of Language & Communication Disorders. 2004;**39**(4):423-451. DOI: 10.1080/13682820410001681207

[3] Chiat S. Mapping theories of developmental language impairment: Premises, predictions and evidence. Language and Cognitive Processes. 2001;**16**(2-3):113-142. DOI: 10.1080/01690960042000012

[4] Ziegler JC, Pech-Georgel C, George F, Lorenzi C. Noise on, voicing off: Speech perception deficits in children with specific language impairment. Journal of Experimental Child Psychology. 2011;**110**(3):362-372. DOI: 10.1016/j.jecp.2011.05.00

[5] van der Lely HKJ. Domain-specific cognitive systems: Insight from Grammatical-SLI. Trends in Cognitive Sciences. 2005;**9**(2):53-59. DOI: 10.1016/j.tics.2004.12.002

[6] Ebbels SH, Dockrell JE, van der Lely HKJ. Non-word repetition in adolescents with specific language impairment (SLI). International Journal of Language & Communication Disorders. 2012;**47**(3):257-273. DOI: 10.1111/j.1460-6984.2011.00099.x

[7] Ramus F, Marshall CR, Rosen S, van der Lely HKJ. Phonological deficits in specific language impairment and developmental dyslexia: Towards a multidimensional model. Brain. 2013;**136**(2):630-645. DOI: 10.1093/brain/aws356

[8] Kent RD, Vorperian HK. Speech impairment in Down syndrome: A review. Journal of Speech Language and Hearing Research. 2013;**56**(1):178-210. DOI: 10.1044/1092-4388(2012/12-0148)

[9] Cleland J, Wood S, Hardcastle W, Wishart J, Timmins C. Relationship between speech, oromotor, language and cognitive abilities in children with Down's syndrome. International Journal of Language & Communication Disorders. 2010;**45**(1):83-95. DOI: 10.3109/13682820902745453

[10] Dodd B, Thompson L. Speech disorder in children with Down's syndrome. Journal of Intellectual Disability Research. 2001;**45**(4):308-316. DOI: 10.1046/j.1365-2788.2001.00327.x

[11] Roberts J, Long SH, Malkin C, Barnes E, Skinner M, Hennon EA, Anderson K. A comparison of phonological skills of boys with fragile X syndrome and Down syndrome. Journal of Speech Language and Hearing Research. 2005;**48**(5):980-995. DOI: 10.1044/1092-4388(2005/067)

[12] van Bysterveldt AK. Speech, phonological awareness and literacy in New Zealand children with Down syndrome [thesis]. Christchurch: University of Canterbury; 2009

[13] Wong B, Brebner C, McCormack P, Butcher A. Word production inconsistency of Singaporean-English-speaking adolescents with Down Syndrome. International Journal of Language & Communication Disorders. 2015;**50**(5):629-645. DOI: 10.1111/1460-6984.12164

[14] Baddeley A, Gathercole S, Papagno C. The phonological loop as a language learning device. Psychological Review. 1998;**105**(1):158-173. DOI: 10.1037/0033-295X.105.1.158

[15] Chiat S. The developmental trajectory of nonword repetition. Applied Psycholinguistics. 2006;**27**(4):552-556. DOI: 10.1017/S014271640623039X

[16] Claessen M, Leitão S, Kane R, Williams C. Phonological processing skills in specific language impairment. International Journal of Speech-Language Pathology. 2013;**15**(5):471-483. DOI: 10.3109/17549507.2012.753110

[17] Gallon N, Harris J, van der Lely H. Non-word repetition: An investigation of phonological complexity in children with Grammatical SLI. Clinical Linguistics & Phonetics. 2007;**21**(6):435-455. DOI: 10.1080/02699200701299982

[18] Macrae T, Tyler AA, Lewis KE. Lexical and phonological variability in preschool children with speech sound disorder. American Journal of Speech-Language Pathology. 2014;**23**(1):27-35. DOI: 10.1044/1058-0360(2013/12-0037)

[19] Archibald LM, Gathercole SE. Short-term and working memory in specific language impairment. International Journal of Language & Communication Disorders. 2006;**41**(6): 675-693. DOI: 10.1080/13682820500442602

[20] Coady JA, Evans JL, Kluender KR. Role of phonotactic frequency in nonword repetition by children with specific language impairments. International Journal of Language & Communication Disorders. 2010;**45**(4):494-509. DOI: 10.3109/13682820903222783

[21] Vandewalle E, Boets B, Ghesquière P, Zink I. Development of phonological processing skills in children with specific language impairment with and without literacy

delay: A 3-year longitudinal study. Journal of Speech Language and Hearing Research. 2012;**55**(4):1053-1067. DOI: 10.1044/1092-4388(2011/10-0308)

[22] Casalini C, Brizzolara D, Chilosi A, Cipriani P, Marcolini S, Pecini C, et al. Non-word repetition in children with specific language impairment: A deficit in phonological working memory or in long-term verbal knowledge? Cortex. 2007;**43**(6):769-776. DOI: 10.1016/S0010-9452(08)70505-7

[23] Bishop DV, McDonald D, Bird S, Hayiou ME. Children who read words accurately despite language impairment: Who are they and how do they do it? Child Development. 2009;**80**(2):593-605. DOI: 10.1111/j.1467-8624.2009.01281.x

[24] Coady JA, Evans JL. Uses and interpretations of non-word repetition tasks in children with and without specific language impairments (SLI). International Journal of Language & Communication Disorders. 2008;**43**(1):1-40. DOI: 10.1080/13682820601116485

[25] Conti-Ramsden G. Processing and linguistic markers in young children with specific language impairment (SLI). Journal of Speech Language and Hearing Research. 2003;**46**(5):1029-1037. DOI: 10.1044/1092-4388(2003/082)

[26] de Bree E, Wijnen F, Gerrits E. Non-word repetition and literacy in Dutch children at-risk of dyslexia and children with SLI: Results of the follow-up study. Dyslexia. 2010;**16**(1):36-44. DOI: 10.1002/dys.395

[27] Catts HW, Adlof SM, Hogan TP, Weismer SE. Are specific language impairment and dyslexia distinct disorders? Journal of Speech Language and Hearing Research. 2005;**48**(6):1378-1396. DOI: 10.1044/1092-4388(2005/096)

[28] Rispens J, Parigger E. Non-word repetition in Dutch-speaking children with specific language impairment with and without reading problems. British Journal of Developmental Psychology. 2010;**28**(1):177-188. DOI: 10.1348/026151009X482633

[29] Botting N, Conti-Ramsden G. Non-word repetition and language development in children with specific language impairment (SLI). International Journal of Language & Communication Disorders. 2001;**36**(4):421-432. DOI: 10.1080/13682820110074971

[30] Gathercole SE. Nonword repetition and word learning: The nature of the relationship. Applied Psycholinguistics. 2006;**27**(4):513-543. DOI: 10.1017.S0142716406060383

[31] Girbau D, Schwartz RG. Phonological working memory in Spanish-English bilingual children with and without specific language impairment. Journal of Communication Disorders. 2008;**41**(2):124-145. DOI: 10.1016/j.jcomdis.2007.07.001

[32] Jones G, Tamburelli M, Watson SE, Gobet F, Pine JM. Lexicality and frequency in specific language impairment: Accuracy and error data from two nonword repetition tests. Journal of Speech Language and Hearing Research. 2010;**53**(6):1642-1655. DOI: 10.1044/1092-4388(2010/09-0222)

[33] Bowey JA. Clarifying the phonological processing account of nonword repetition. Applied Psycholinguistics. 2006;**27**(4):548-552. DOI: 10.1017/S0142716406220393

[34] Abdelhameed H, Porter J. Verbal short-term memory performance in pupils with Down syndrome. International Journal of Disability, Development and Education. 2010;**57**(4):427-438. DOI: 10.1080/1034912x.2010.524446

[35] Jarrold C, Thorn AC, Stephens E. The relationships among verbal short-term memory, phonological awareness, and new word learning: Evidence from typical development and Down syndrome. Journal of Experimental Child Psychology. 2009;**102**(2):196-218. DOI: 10.1016/j.jecp.2008.07.001

[36] Pérez D, Mendoza E, Carballo G, López MD, Muñoz JC. Repetición de pseudopalabras en niños con Síndrome de Down. Onomázein. 2012;**2**(26):377-390

[37] Brock J, Jarrold C. Serial order reconstruction in Down syndrome: Evidence for a selective deficit in verbal short-term memory. Journal of Child Psychology and Psychiatry. 2005;**46**(3):304-316. DOI: 10.1111/j.1469-7610.2004.00352.x

[38] Cairns P, Jarrold C. Exploring the correlates of impaired non-word repetition in Down syndrome. British Journal of Developmental Psychology. 2005;**23**(3):401-416. DOI: 10.1348/026151005X26813

[39] Jarrold C, Baddeley AD, Phillips CE. Verbal short-term memory in Down syndrome: A problem of memory, audition, or speech? Journal of Speech Language and Hearing Research. 2002;**45**(3):531-544. DOI: 10.1044/1092-4388(2002/042)

[40] Laws G. Working memory in children and adolescents with Down syndrome: Evidence from a colour memory experiment. Journal of Child Psychology and Psychiatry. 2002;**43**(3):353-364. DOI: 10.1111/1469-7610.00026

[41] Wertzner HF, Alves RR, de Oliveira Ramos AC. Análise do desenvolvimento das habilidades diadococinéticas orais em crianças normais e com transtorno fonológico. Revista da Sociedade Brasileira de Fonoaudiologia. 2008;**31**(2):136-142. DOI: 10.1590/S1516-80342008000200007

[42] Fletcher SG. Time-by-count measurement of diadochokinetic syllable rate. Journal of Speech Language and Hearing Research. 1972;**15**(4):763-770. DOI: 10.1044/jshr.1504.763

[43] Williams P, Stackhouse J. Rate, accuracy and consistency: Diadochokinetic performance of young, normally developing children. Clinical Linguistics & Phonetics. 2000;**14**(4):267-293. DOI: 10.1080/02699200050023985

[44] Yaruss JS, Logan KJ. Evaluating rate, accuracy, and fluency of young children's diadochokinetic productions: A preliminary investigation. Journal of Fluency Disorders. 2002;**27**(1):65-86. DOI: 10.1016/S0094-730X(02)00112-2

[45] Lewis BA, Freebairn LA, Hansen AJ, lyengar SK, Taylor HG. School-age follow-up of children with childhood apraxia of speech. Language Speech and Hearing Services in Schools. 2004;**35**(2):122-140. DOI: 10.1044/0161-1461(2004/014)

[46] Tükel S, Björelius H, Henningsson G, McAllister A, Eliasson AC. Motor functions and adaptive behaviour in children with childhood apraxia of speech. International Journal of Speech-Language Pathology. 2015;**17**(5):470-480. DOI: 10.3109/17549507.2015.1010578

[47] Dodd B, McIntosh B. The input processing, cognitive linguistic and oro-motor skills of children with speech difficulty. International Journal of Speech-Language Pathology. 2008;**10**(3):169-178. DOI: 10.1080/14417040701682076

[48] Henry CE. The development of oral diadochokinesia and non-linguistic rhythmic skills in normal and speech-disordered young children. Clinical Linguistics & Phonetics. 1990;**4**(2):121-137. DOI: 10.3109/02699209008985476

[49] Buiza JJ, Rodríguez-Parra MJ, González-Sánchez M, Adrián JA. Specific language impairment: Evaluation and detection of differential psycholinguistic markers in phonology and morphosyntax in Spanish-speaking children. Research in Developmental Disabilities. 2016;**58**:65-82. DOI: 10.1016/j.ridd.2016.08.008

[50] Brown-Sweeney SG, Smith BL. The development of speech production abilities in children with Down syndrome. Clinical Linguistics & Phonetics. 1997;**1**(5):345-362. DOI: 10.1080/02699209708985200

[51] Rupela V, Manjula R. Diadochokinetic assessment in persons with Down syndrome. Asia Pacific Journal of Speech, Language and Hearing. 2010;**13**(2):109-120. DOI: 10.1179/136132810805335092

[52] Rupela V, Velleman SL, Andrianopoulos MV. Motor speech skills in children with Down syndrome: A descriptive study. International Journal of Speech-Language Pathology. 2016;**18**(5):483-492. DOI: 10.3109/17549507.2015.1112836

[53] McCann J, Wrench A. A new EPG protocol for assessing DDK accuracy scores in children: A Down's syndrome study. In: Trouvain J, Barry WJ, editors. Proceedings of the 16th International Congress of the ICPhS; 2007 Aug 6-10; Saarbrücken, Germany. Dudweiler: Pirrot GmbH; 2007. p. 1985-1988.

[54] Potter NL, Short R. Maximal tongue strength in typically developing children and adolescents. Dysphagia. 2009;**24**(4):391-397. DOI: 10.1007/s00455-009-9215-2

[55] Bradford A, Murdoch B, Thompson E, Stokes P. Lip and tongue function in children with developmental speech disorders: A preliminary investigation. Clinical Linguistics & Phonetics. 1997;**11**(5):363-387. DOI: 10.1080/02699209708985201

[56] Murdoch BE, Attard MD, Ozanne AE, Stokes PD. Impaired tongue strength and endurance in developmental verbal dyspraxia: A physiological analysis. European Journal of Disorders of Communication. 1995;**30**(1):51-64. DOI: 10.3109/13682829509031322

[57] Bunton K, Leddy M. An evaluation of articulatory working space area in vowel production of adults with Down syndrome. Clinical Linguistics & Phonetics. 2011;**25**(4):321-334. DOI: 10.3109/02699206.2010.535647

[58] Kumin L. Inteligibilidad del habla en las personas con Síndrome de Down: Un marco para señalar factores específicos útiles en la evaluación y tratamiento. Revista Síndrome de Down. 2002;**19**(72):14-23

[59] Venail F, Gardiner Q, Mondain M. Problemas otorrinolaringológicos y trastornos del habla en los niños con síndrome de Down: fisiopatología, rasgos clínicos, tratamientos. Revista Síndrome de Down. 2005;**22**(84):20-26

[60] Connaghan K. Jaw stiffness during speech in children with suspected hypo-and hypertonic [thesis]. Washington: University of Washington; 2004

[61] Aguado G. Contribuciones al diagnóstico del trastorno específico del lenguaje por medio de la repetición de pseudopalabras. 2011. Available from: http://dadun.unav.edu/handle/10171/19266 [Accessed: December 1, 2016]

[62] Cervera JF. Diseño, implementación y estudio de validez de Ánfora: análisis fonológico asistido por ordenador aplicado a la logopedia [thesis]. Valencia: Universidad Católica de Valencia San Vicente Mártir; 2012

[63] Ygual A, Cervera JF, Rosso P. Utilidad del análisis fonológico en la terapia del lenguaje. Revista de Neurologia. 2008;**46**(1):97-100

[64] Shriberg LD, Kwiatkowski J. Phonological disorders III. A procedure for assessing severity of involvement. Journal of Speech and Hearing Disorders. 1982;**47**(3):256-270. DOI: 10.1044/jshd.4703.256

[65] Raven JC. Test de Matrices Progresivas Raven. Madrid: Ediciones TEA; 2003

[66] Munson B, Kurtz BA, Windsor J. The influence of vocabulary size, phonotactic probability, and wordlikeness on nonword repetitions of children with and without specific language impairment. Journal of Speech Language and Hearing Research. 2005;**48**(5):1033-1047. DOI: 10.1044/1092-4388(2005/072)

[67] Lof GL, Watson MM. A nationwide survey of nonspeech oral motor exercise use: Implications for evidence-based practice. Language Speech and Hearing Services in Schools. 2008;**39**(3):392-407. DOI: 10.1044/0161-1461(2008/037)

[68] Ygual A, Cervera JF. Eficacia de los programas de ejercicios de motricidad oral para el tratamiento logopédico de las dificultades de habla. Revista de Neurologia. 2016;**62**(1):59-64

[69] Guiberson M, Rodríguez BL. Classification accuracy of nonword repetition when used with preschool-age Spanish-speaking children. Language Speech and Hearing Services in Schools. 2013;**44**(2):121-132. DOI: 10.1044/0161-1461(2012/12-0009)

Section 3

New Ideas About Speech and Language Assessment

Cross-Cultural Adaption of the GRBAS and CAPE-V Scales for Portugal and a New Training Programme for Perceptual Voice Evaluation

Luis M.T. Jesus, Ana Inês Tavares and Andreia Hall

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69644

Abstract

Several methods have been proposed for the perceptual evaluation of voice quality, but the GRBAS and Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) scales are the most widely used and recommended as part of standardised voice evaluation protocols. In this study, cross-cultural adaptation and translation of the GRBAS (the first translation from the original Japanese version) and CAPE-V scales to European Portuguese were carried out following international guidelines. Results from a study of the intra- and inter-rater reliability of the perceptual evaluation of voices with the GRBAS and CAPE-V scales, before and after a training programme, designed according to the most recent American Speech-Language-Hearing Association and Japan Society of Logopedics and Phoniatrics guidelines, are also reported.

Keywords: voice, voice disorders, perceptual voice evaluation, GRBAS, CAPE-V, American Speech-Language-Hearing Association, simulation training

1. Introduction

Phonation results from the interaction of the vocal folds with the airflow and the air column above them [1, 2]. When air particles pass through the glottis and their speed increases, this reduces the pressure between the vocal folds triggering a suction effect that brings the vocal folds closer to each other, followed by an elastic recoil that promotes a new glottic adduction, thus enabling the production of voice. The sound that results from the vibration of the vocal folds, which is modified by the resonance cavities, is called voice. This audible sound is the product of a complex relation between the pressure and velocity of expiratory airflow, intensity, the different patterns of abduction and adduction of the vocal folds, the vocal tract configuration and resulting resonances [3].

Voice disorders can have a significant negative impact on a person's life, because the voice is an important tool for communication [4]. There is a voice perturbation whenever the vocal quality, intensity, fundamental frequency (f_0) or vocal flexibility are altered for the age, sex and culture of the speaker ([5], p. 5). Any difficulty or alteration in the vocal emission that prevents the natural production of the voice is called dysphonia. Dysphonia manifests itself through the following changes: Perturbations in vocal quality, emission effort, vocal fatigue, loss of vocal power, uncontrolled variations of fundamental frequency, lack of intensity and projection, loss of vocal efficiency, low vocal resistance and unpleasant sensations during vocal emission. These result in the alteration of one or several acoustic characteristics of the voice.

1.1. Vocal evaluation

Vocal evaluation is considered the first stage of intervention and rehabilitation. Voice assessment has the following main objectives [3]: To know the vocal behaviour of the person, identify the causes of the vocal problem, describe the vocal characteristics of the individual, identify vocal habits, to characterise the relation between body and personality. Perceptual evaluation of voice is routinely used in clinical practice but still poses some inter- and intra-subject problems because it is subjective and often not correlated with the severity of the pathology [6].

According to Chan and Yiu [7], the perceptual evaluation is a subjective process, in which the intra- and inter-rater reliability can vary. Pontes et al. [8] also point out that the perceptual evaluation of vocal quality assumes a subjective character, which varies according to the evaluator, with its internal standards on voice quality, with their perception skills, discrimination and experience with regard to the evaluation of voice. Nevertheless, auditory perception-based assessments can be performed rapidly, are non-invasive, do not require electronic equipment, so results are readily available [9].

Several scales have been proposed for the perceptual evaluation of voice quality [10], but the GRBAS ([11], pp. 181–209; [12], pp. 83–84) and Auditory-Perceptual Evaluation of Voice (CAPE-V) [13–15] are the most widely used [16] and recommended as part of standardised voice evaluation protocols [3, 17–19].

The GRBAS scale ([11], pp. 181–209; [12], pp. 83–84) defines five parameters for vocal quality classification: Grade (G), Rough (R), Breathy (B), Astenic (A), Strain (S). The parameter G corresponds to the grade of alteration of vocal quality; R is psychoacoustic vocal fold vibration irregularity impression, corresponding to the vocal fold vibration irregularity, fluctuation in the value of f_0 and amplitude of the sound of the glottal source; the parameter B refers to the psychoacoustic impression of air passage through the glottis, thus relating to turbulence; the parameter A assesses the weakness or lack of energy in the voice, thus characterising a weak intensity of source sound glottic, or lack of harmonics; finally, the S that characterises the state hyperfunction of phonation. The scale is scored from 0 to 3 for each of its five parameters: 0, normal or absence of hoarseness; 1, slight; 2, moderate; 3, severe.

The CAPE-V scale [13–15] uses six features to evaluate voice quality: Overall severity, roughness, breathiness, strain, pitch, loudness. The parameter *overall severity* captures a global impression of voice disturbance, *roughness* allows clinicians to register source irregularities, the perception of *breathiness* results from air escape, and *strain* is related to the perception of vocal effort. The perceived f_0 and intensity are registered as the *pitch* and *loudness* parameters, respectively. Comments about *resonance* and *additional features*, such as *falsetto* or *tremor*, can also be registered. The scale is scored from 0 to 100 on 100-mm Likert scales for each of its six parameters: Mildly Deviant (MI), Moderately Deviant (MO), and Severely Deviant (SE) qualitative attributes are distributed uniformly along the scale, and the consistent (C) and intermittent (I) labels can be associated with each parameter.

The first European Portuguese (EP) translation [20] of the CAPE-V included six new EP sentences designed to elicit the production of every oral vowel in EP, easy onset with/s/, only voiced phonemes, hard glottal attack, nasal phonemes and voiceless stops ([20], p. 971). The proposed new sentences (thoroughly reviewed by a Speech Scientist, a Linguist and three experienced speech and language therapists (SLTs)) and used in its original form in the study reported in this book chapter were: <A Marta e o avô vivem naquele casarão rosa velho> [ɐ ˈmaɾtɐ i u ɐˈvo ˈvivɐ̃j nɐˈkelɨ kɐzɐˈɾɐ̃w ˈʁɔzɐ ˈvɛʎu]; <Sofia saiu cedo da sala> [suˈfiɐ sɐˈiw ˈsedu dɐ ˈsalɐ]; <a asa do avião andava avariada> [ɐ ˈazɐ du ɐviˈɐ̃w ɐ̃ˈdavɐ ɐvɐɾiˈadɐ]; <agora é hora de acabar> [ɐˈgɔɾɐ ɛ ˈɔɾɐ dɨ ɐkɐˈbaɾ]; <a minha mãe mandou-me embora> [ɐ ˈmiɲɐ mɐ̃j mɐ˜domɨ ẽˈbɔɾɐ]; <o Tiago comeu quatro peras> [u tiˈagu kuˈmew kuˈatɾu ˈpeɾɐʃ].

1.2. Auditory-perceptual training of evaluators

The continuous training of the evaluators is recommended, in order to guarantee the reliability and validity of a perceptual evaluation of voice. Both the intra- and inter-rater reliability may vary because perceptual voice assessment is a subjective process, but it is generally accepted that the inter-rater reliability is a greater concern. Kreiman et al. [21, 22] argued that reliability variation can be attributed to the different internal standards acquired by evaluators.

Helou et al. [23] conducted a study with 10 experienced evaluators and 10 inexperienced evaluators, who rated 10 male voices and 10 female voices with CAPE-V. The results revealed that inexperienced evaluators rate voices more severely than the experienced evaluators. Inexperienced evaluators also had lower intra- and inter-rater reliability than those with experience. Experienced evaluators rated the voices similarly.

Studies by Kreiman et al. [21] and Gerratt et al. [24] used natural voice samples and/or voice samples synthesised as anchors, and showed that inter- and intra-rater reliability in the perceptual assessment of voice improved with training.

Anchors are considered references that listeners (evaluators) can use to compare with the signals they are invited to judge [7]. In the study by Eadie and Smith [25], 20 inexperienced and 20 experienced evaluators rated 20 samples of normal voices. The results of this study showed that the anchors reduce inter-rater variability.

Silva et al. [26] analysed the impact of auditory-perceptual training on the evaluation of voice performed by speech and language therapy students. Seventeen students analysed samples of normal and dysphonic voices with the GRBAS scale. All students had auditory training during a total of nine weekly sessions, each about 15 min long. The evaluation of voice samples was performed before and after the training, and in four other moments during the meetings. Student ratings were compared with an assessment by three voice specialists. The results showed that the students' success rate at the pre-training moment was considered between regular and good. A maintenance of the number of hits throughout the evaluations performed, for most of the scale parameters, was also observed. Regarding the post-training moment, a better analysis was observed, mainly for the Astenic (A) parameter.

Training judges/listeners has been shown to 'increase the extent to which they share common standards for different' ([10], p. 63) voice qualities, so the current study also includes the intra- and inter-rater reliability analysis of the perceptual evaluation of voices with the GRBAS and CAPE-V scales, before and after a training programme.

1.3. Cross-cultural adaptation and translation of the GRBAS and CAPE-V scales

To the best of our knowledge, there are no standard assessment instruments to perceptually evaluate voice quality in EP, so clinicians in Portugal use various translations of GRBAS ([27, 28], pp. 66–69) and CAPE-V [29], and generally have no access to EP versions of the original instructions published by the Japan Society of Logopedics and Phoniatrics ([11], pp. 181–209) or the American Speech-Language-Hearing Association [13]. They therefore use various procedures and non-standardised definitions of the parameters [30–32]. This results in different voice assessment methods hamper the development, objectivity and specificity of therapeutic plans, thus compromising the efficiency and efficacy of intervention strategies.

We believe the access to the original author's definitions of core concepts behind the development of health instruments, contributes towards the standardisation of evaluations procedures, and considerable improvements in intra- and inter-rater reliability. The translation and adaptation processes of the whole tool (not just the score sheets) should follow international guidelines [33] for cross-cultural adaptation of health assessment instruments. Evidence-based practice would thus be enhanced, and comparisons across countries would be facilitated. A broader evidence base for effective service delivery planning based on results from large-scale randomised controlled trials requires that the same assessment instruments are validated in different cultures.

Cross-cultural adaptation of instruments is necessary when the new target population differs from the original in which the assessment tool is used regarding culture or cultural background, country and language. There are specific guidelines [34, 35] to conserve the sensibility of the assessment tool in the original culture [36]. The steps that must be followed, if relevant to the specific assessment tool, are [37, 38]: translation, synthesis of the translations, back-translation, committee review and pre-testing.

The first stage of a cross-cultural adaptation must be the production of several translations by, at least, two independent translators. In a second stage, the two translators synthesise the results of the translations, producing one common translation [37]. It is then necessary to back-translate the assessment tool (third stage), which means translating back from the final language into the source language, producing as many back-translations as translations, based on the synthesised translation [36]. In the fourth stage, an expert committee compares the source and the final version. The fifth stage consists of a cognitive debriefing that tests alternative wording, understandability, and interpretation of the translation [35].

In this study, the cross-cultural adaptation and translation of the GRBAS and CAPE-V scales to EP were carried out following these international guidelines [33].

2. Method

Ethical approval was obtained from all authorities required by Portuguese bylaws for clinical research: National data protection committee, independent ethics committees. Informed consent was collected from all participants prior to any data collection.

2.1. Cross-cultural adaptation and translation of the GRBAS and CAPE-V scales

The American Speech-Language-Hearing Association (ASHA) Special Interest Division 3 was contacted by the first author of this book chapter, and the 'Request to Translate & Distribute' CAPE-V was granted to the University of Aveiro by ASHA on 28 January 2008. The Portuguese version of the CAPE-V has been available from the Advanced Communication and Swallowing Assessment (ACSA) http://acsa.web.ua.pt/platform since 2010.

At a later stage, the same author (Luis M.T. Jesus) contacted the Japan Society of Logopedics and Phoniatrics (JSLP), and the University of Aveiro was granted permission to complete a new translation and adaptation of the GRBAS on the 10 January 2013. Professor Eiji Yumoto, on behalf of the JSLP, concluded that there were no detailed descriptions of the GRBAS scale in other languages besides Japanese, so he generously granted the University of Aveiro access to a detailed description of the GRBAS scale, published in 1979 by the JSLP. This book [11] was written in Japanese, and Professor Minoru Hirano described the scale only briefly in his publication ([12], pp. 83–84).

The work reported in this book chapter reports work that is part of the validation process of a voice evaluation protocol developed by our research team [18–20] and freely available from the ACSA platform. University of Aveiro's Voice Evaluation Protocol [18] includes the assessment of voice quality, glottal attack, respiratory support, respiratory-phonatary-articulatory coordination, digital laryngeal manipulation (laryngeal crepitation) and laryngeal tension. It also allows the self-assessment of voice quality and instrumental evaluation. Results from various instrumental evaluation techniques (videostroboscopy, aerodynamics, electroglottography and electromyography) can be registered by the protocol, including an extensive acoustic analysis based on sustained productions of /a, i, u, ɔ/, CAPE-V sentences and reading a passage. The complete protocol provides data to test different methods applied to voice function assessment. The focus of our research was performance improvement of assessment methods used by voice clinicians.

2.2. Training programme

The user interface, terminology, audio and video samples of the GRBAS CD and DVD developed by JSLP [39] were used as a standard reference to design (according to the most recent ASHA and JSLP guidelines), the training programme described in the subsequent text.

Forty-five EP speakers from the Advanced Voice Function Assessment Databases (AVFAD) (see Jesus et al. [40] in this book for a detailed description) were used as auditory stimuli. Fifteen participants were selected for anchors, 15 for training and 15 for evaluation.

The voices from the AVFAD were selected based on the auditory perception in a quiet room by a speech and language therapist (the second author of this book chapter) using *VLC media player 2.1.3. rincewind* running on a laptop connected to a pair of *NGS 2.1* loudspeakers. The same speech and language therapist classified the representative samples (anchors) of all selected voices with the GRBAS and CAPE scales.

Judges listened to sustained productions of vowels/a, i/played in a quiet environment with the same volume through a pair of *Sennheiser HD380Pro* headphones connected to the internal soundcard of a laptop computer.

Ten female speech and language therapists were asked to rate the severity of dysphonic voice stimuli using the GRBAS and CAPE-V scales. Each judge first evaluated 15 voices without any training and then went through a training programme based on two 1-h sessions.

During the first session, judges read detailed written instructions and the original description of the scale, and then, classified anchor voices that included several grades of severity for vocal quality. During the second session, a new set of voices (training voices) were classified, and judges could listen to one anchor for each five voices that were classified. At the end of the second session, all judges had access to a feedback document, but they could not change their classifications. One week later, the same judges classified a new set of 15 voices.

IBM SPSS Statistics 23 was used to calculate the Intraclass Correlation Coefficient (ICC) of responses and to run a one-way analysis of variance (ANOVA) with repeated measures.

3. Results

3.1. Cross-cultural adaptation and translation of the GRBAS and CAPE-V scales

Two EP translations of the original American English CAPE-V scoresheet and instructions were produced by two independent translators. This led to the detection of errors and divergent interpretations of ambiguous items in the original tool [33]. The translators were fluent in both languages (with the target language as their mother tongue), knowledgeable of the two cultures, and experts in the content measured by the instrument (they were both SLTs). Then, both translators synthesised the results of the translations, producing one common translation, which was used to back-translate the assessment tool, producing as many back-translations as translations (two). An expert committee compared the source and the final versions and produced a pre-final version for field testing, based on all translations and back-translations.

During CAPE-V's cognitive debriefing (final stage of the cross-cultural adaptation and translation), alternative wording and interpretation of the translation were tested in five clients with voice pathology by the second author of this book chapter (a SLT), at the University of Algarve. Finally, the translation was revised taking into account the feedback obtained.

Hirano's ([12], pp. 83–84) GRBAS description was translated by the same group of experts involved in CAPE-V's cross-cultural adaption, using exactly the same process and stages [33].

A professional Japanese translator (Tomoko Suga) certified by the Japanese embassy in Lisbon (Portugal) translated the original Takahashi ([11], pp. 181–209) instructions. The translator was fluent in both languages (Japanese and EP) and knowledgeable of the two cultures. Since the original Japanese used by Takahashi ([11], pp. 181–209) is quite different, in some respects, from what is used nowadays and scientific terminology has changed considerably, only the core descriptions by Takahashi ([11], pp. 181–209) were retained in the Portuguese version, and the translation had to be thoroughly revised by an expert committee that included the original Japanese translator, the first author of this book chapter and an SLT blind to the purposes of the study.

The same group of five clients with voice pathology recruited for CAPE-V's cognitive debriefing was involved in Takahashi's ([11], pp. 181–209) and Hirano's ([12], pp. 83–84) GRBAS analysis of the level of comprehensibility of the instructions and the final items, cognitive equivalence of the translation, translation alternatives and items that were eventually inappropriate or confusing.

CAPE-V's cognitive debriefing results showed no inconsistencies but GRBAS' instructions analysis revealed that the number of vowels required by later protocol is not the same as currently suggested by ASHA [13] or in most recent voice assessment procedure based on sustained vowels.

According to Takahashi ([11], pp. 181–209), clinicians should perceptually evaluate five sustained vowels [a, ɛ, i, ɔ, u] and choose to register, on a table that is part of the score sheet, the one that they attribute the highest GRBAS parameters scores.

The use of sustained vowels usually results in articulatory stability and allows the clinician to focus on the typology a voice source signal that is more regular and stable than in connected speech, facilitating the perceptual assessment of voice quality [41, 42].

Given the fact that the CAPE-V protocol [13] proposes [a, i] as the sustained vowels to be used during assessment, and that both GRBAS and CAPE-V are used by the University of Aveiro's Voice Evaluation Protocol [18], following cognitive debriefing, these were proposed as the basis of perceptual evaluation. According to ASHA ([13], p. 3), [i] is used because it is the only sound speakers that can produce during laryngeal videoendoscopy, and /a/ is used because it differs from /i/ in terms of its degree of tenseness: /a/ is a lax vowel and /i/ is a tense vowel in most English dialects. Portuguese does not have the tense-lax contrast, but still, the close /i/ versus open /a/ distinction could be used to monitor the effect of an enlarged pharyngeal cavity for close vowels ([43], p. 627) and the lowering of laryngeal structures ([43], p. 633) for open vowels.

The translations were revised taking into account the results from the cognitive debriefing process, and the assessment tools can now be administered to a representative sample of the population. Both Takahashi's ([11], pp. 181–209) and Hirano's ([12], pp. 83–84) instructions in Portuguese are now included in the University of Aveiro's Voice Evaluation Protocol [18] manual and available from the ACSA platform.

3.2. Training programme

The GRBAS CD and DVD [39] were thoroughly analysed (see **Figure 1**); terminology, audio and video samples therein were used as a standard reference to design the training programme (described earlier).

This resulted in a first prototype of a *PowerPoint* presentation, shown in **Figure 2**, based on Japanese audio and video samples [39] that guided the final *PowerPoint* presentation design that then used audio samples from the Portuguese AVFAD [40].

The anchors were available during the training programme on a *PowerPoint 2010* presentation with a total of 15 slides formatted as shown in **Figure 3**.

The ICC is a measure of inter-rater reliability that describes the similarity between the responses observed within a given set. The ICC value varies between 0 and 1, the closer to 1, the more consistent are the results.

The ICC mean of 10 raters for the parameters of the GRBAS scale is presented in **Table 1**.

All ICC values (pre- and post-training) are very high which indicates a good agreement between judges. We could only observe a post-training increase of ICC values for the *Strain* parameter which suggests that the training programme was not very effective. However, since the pre-training values are already very high, it is harder to observe an increase of the values after training as a result of the training programme. The *Strain* parameter is the only one with a mean ICC value below 0.900 pre-training, so a possible cause for the difficulty in observing the expected effect of training in the other parameters could be related to the fact that the ICC values pre-training are above a certain threshold. Still, even with evaluator distinct pre-training standards (different GRBAS parameter values), all changed classifications post-training.

Figure 1. Case (left) and drill (right) user interfaces from the GRBAS DVD [39].

Figure 2. GRBAS *PowerPoint* prototype presentation using samples from JSLP [39].

Figure 3. Screenshot from the *PowerPoint* presentation used to run the training programme. Samples (anchors) of female voices with GRBAS and CAPE-V classifications are shown.

	Pre-training	Post-training
G	0.963	0.959
R	0.949	0.947
B	0.907	0.886
A	0.937	0.832
S	0.886	0.907

Table 1. ICC for the parameters of the GRBAS scale pre- and post-training.

	Time	Judge	Time × Judge
G	0.000	0.008	0.000
R	0.000	0.598	0.000
B	0.001	0.069	0.000
A	0.000	0.000	0.001
S	0.000	0.002	0.006

Table 2. *p*-Values of the repeated measure ANOVA for the parameters of the GRBAS scale with the judges as between subject factor and time as within subjects factor.

We also ran a one-way ANOVA with repeated measures for the GRBAS scale. This analysis allowed us to test if the evaluators changed the classifications as a function of time (pre- to post-training) and how this change relates to possible differences between them. The results are shown in **Table 2**.

From **Table 2**, it can be seen that time is a significant effect for all parameters and the interaction also. As for the differences between raters, as a main effect, only for the *Rough* and the *Breathy* parameters, these are not significant.

The ICC mean of 10 raters for the parameters of the CAPE-V scale is presented in **Table 3**.

	Pre-training	Post-training
Overall severity	0.975	0.970
Roughness	0.961	0.942
Breathiness	0.899	0.946
Strain	0.926	0.916
Pitch	0.895	0.788
Loudness	0.913	0.782

Table 3. ICC for the parameters of the CAPE-V scale pre- and post-training.

Similar to what was observed for the GRBAS scale, all ICC values (pre- and post-training) are quite high which indicates a good agreement between judges. We could only observe a post-training increase of ICC values for the *Breathiness* parameter which suggests that the training programme was not very effective. However, when analysing the CAPE-V parameter values, all evaluators changed in the same direction from pre- to post-training, that is, all 10 evaluators either presented higher or lower values post-training for a specific parameter.

We also ran a one-way ANOVA with repeated measures for the CAPE-V scale. The results are shown in **Table 4**.

From **Table 4**, it can be seen that both the effects and their interaction are significant for all the parameters.

	Time	Judge	Time × Judge
Overall severity	0.000	0.027	0.000
Roughness	0.000	0.022	0.000
Breathiness	0.000	0.000	0.000
Strain	0.000	0.000	0.000
Pitch	0.042	0.004	0.021
Loudness	0.022	0.001	0.015

Table 4. *p*-Values of the repeated measure ANOVA for the parameters of the CAPE-V scale with the judges as between subject factor and time as within subjects factor.

4. Conclusions

One of the major contributions of this work was the development of the first non-Japanese version of the original manual of the GRBAS scale and the first Portuguese version of the detailed design considerations, description and instructions of CAPE-V. This research followed international guidelines for the translation and cultural adaptation of health assessment tools.

The GRBAS and CAPE-V scales are now part of the following comprehensive and unique set of resources developed for clinicians at the University of Aveiro in Portugal: A standardised voice case history form [44, 45]; a voice evaluation protocol [18]; a reference voice database [40]. All of these are freely available from the ACSA platform.

The manuals developed during this project had a crucial impact on the training of judges. The ICC values were generally very high, which could be the result of the written instructions and detailed description of the scales, which is a possible cause for the small training effect. The definition of the *Breathiness* parameter benefited particularly from the availability of these instructions. Problems related to the use of the Portuguese term for *Grade* 'grau de rouquidão' being erroneously interpreted as the CAPE-V term 'rouquidão' (*Roughness*), as previously reported by Jesus et al. ([16], p. 62), have been circumvented by the manual, training and samples of voices that represent specified grades of severity.

We also ran a one-way ANOVA with repeated measures for the GRBAS and CAPE-V scales. This analysis allowed us to test if the evaluators changed the classifications as a function of time (pre- to post-training) and how this change relates to possible differences between them.

Regarding the analysis of variance, taking into account the time factor as the main object of study, results showed pre- to post-training differences. The evaluators had individual and distinct standards, and changed the classifications, allowing us to conclude that their internal standards have been modified.

Increasing the level of experience of the evaluators, or the number of training sessions, could have contributed to reducing the variability of the results.

Acknowledgements

This book chapter is dedicated to Lília Brinca.

The authors would like to thank the Otorhinolaryngology teams from Hospital de Santo António, Hospital de São João and Hospital Pedro Hispano. We would also like to thank all the undergraduate and postgraduate students that contributed along the years to data collection and annotation. A special thanks to our colleague Maria Teresa Roberto.

This research was partially funded by National Funds through FCT (Foundation for Science and Technology) in the context of the projects UID/MAT/04106/2013 and UID/CEC/00127/2013.

The AVFAD project was supported by the School of Health Sciences (ESSUA), University of Aveiro, Portugal.

This work was developed as part of the M.Sc. in Speech and Hearing Sciences at the University of Aveiro, Portugal: Tavares, A. (2014). Avaliação Percetiva da Voz: GRBAS e CAPE-V [Perceptual Evaluation of Voice: GRBAS and CAPE-V]. M.Sc. Thesis, Mestrado em Ciências da Fala e da Audição [M.Sc. in Speech and Hearing Sciences], University of Aveiro, Portugal.

The AVFAD are freely distributed through the ACSAhttp://acsa.web.ua.pt/platform.

Author details

Luis M.T. Jesus[1*], Ana Inês Tavares[2] and Andreia Hall[1]

*Address all correspondence to: lmtj@ua.pt

1 University of Aveiro, Aveiro, Portugal

2 University of Algarve, Algarve, Portugal

References

[1] Titze I, Alipour F. The Myoelastic Aerodynamic Theory of Phonation. Denver: The National Center for Voice and Speech; 2006

[2] Seikel J, King D, Drumright D. Anatomy & Physiology for Speech, Language, and Hearing. 4th ed. Clifton Park. Delmar; 2010

[3] Barsties B, Bodt M. Assessment of voice quality: Current state-of-the-art. Auris Nasus Larynx. 2015;**42**:183-188

[4] Brinca L, Pinto P, Tavares A, Batista A, Gonçalves I, Moreno M. The prevalence of laryngeal pathologies in an academic population. Journal of Voice. 2015;**29**(1):130.e1-130.e9

[5] Aronson A, Bless D. Clinical Voice Disorders. New York, NY: Thieme; 2011

[6] Oguz H, Demirci M, Safak M, Arslan N, Islam A, Kargin S. Effects of unilateral vocal cord paralysis on objective voice measures obtained by Praat. European Archives of Otorhinolaryngology. 2007;**264**:257-261

[7] Chan K, Yiu E. The effect of anchors and training on the reliability of perceptual voice evaluation. Journal of Speech, Language, and Hearing Research. 2002;**45**:111-126

[8] Pontes P, Vieira V, Gonçalves M, Pontes A. Características das vozes roucas, ásperas e normais: análise acústica espectográfica comparativa. Revista Brasileira de Otorrinolaringologia. 2002;**68**(2):182-188

[9] Webb A, Carding P, Deary I, MacKenzie K, Steen N, Wilson J. The reliability of three perceptual evaluation scales for dysphonia. European Archives of Oto-Rhino-Laryngology. 2004;**261**:429-434

[10] Kreiman J, Gerratt B. Perceptual assessment of voice quality: Past, present, and future. Perspectives on Voice and Voice Disorders. 2010;**20**:62-67

[11] Takahashi H. Assessment of auditory impression of dysphonia. In: The Japan Society of Logopedics and Phoniatrics, editor. Voice Examination Methods. Tokyo: Interna; 1979

[12] Hirano M. Acoustic analysis of the voice signal. In: Clinical Examination of Voice. New York, NY: Springer-Verlag; 1981

[13] ASHA. CAPE-V Form and Procedures. American Speech-Language-Hearing Association (ASHA) Special Interest Division 3, Voice and Voice Disorders; 2006

[14] Kempster G, Gerratt B, Abbott K, Kraemer J, Hillman R. Consensus auditory-perceptual evaluation of voice: Development of a standardized clinical protocol. American Journal of Speech-Language Pathology. 2009;**18**:124-132

[15] Zraick R, Kempster G, Connor N, Thibeault S, Klaben B, Bursac Z, Thrush C, Glaze L. Establishing validity of the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V). American Journal of Speech-Language Pathology. 2011;**20**(1):14-22

[16] Jesus L, Barney A, Couto P, Vilarinho H, Correia A. Voice quality evaluation using CAPE-V and GRBAS in European Portuguese. In: Proceedings of the 6th International Workshop on Models and Analysis of Vocal Emissions for Biomedical Applications (MAVEBA 2009); Florence, Italy. 2009. pp. 61-64

[17] Dejonckere P, Bradley P, Clemente P, Cornut G, Crevier-Buchman L, Friedrich G, Woisard V. A basic protocol for functional assessment of voice pathology, especially for investigating the efficacy of (phonosurgical) treatments and evaluating new assessment techniques. Guideline elaborated by the Committee on Phoniatrics of the European Laryngolo. European Archives of Oto-Rhino-Laryngology. 2001;**258**(2):77-82

[18] Jesus L, Vilarinho H, Santos R. Protocolo de Avaliação da Qualidade Vocal da Universidade de Aveiro [University of Aveiro's Voice Evaluation Protocol]. University of Aveiro, Portugal.

2010-2015. INPI Registration Number 463522 and IGAC Registration 27/05/2010 (Version 2 IGAC Registration Number 355/2012 and Version 2.3.6 IGAC Registration Number 3474/2015). Available from: Advanced Communication and Swallowing Assessment (ACSA) http://acsa.web.ua.pt/

[19] Alves M. Validade e Fiabilidade do Protocolo de Avaliação da Qualidade Vocal da Universidade de Aveiro [Validity and reliability of University of Aveiro's Voice Evaluation Protocol] [M.Sc. thesis]. Mestrado em Ciências da Fala e da Audição [M.Sc. in Speech and Hearing Sciences]. Portugal: University of Aveiro; 2015

[20] Jesus L, Barney A, Santos R, Caetano J, Jorge J, Couto P. Universidade de Aveiro's voice evaluation protocol. In: Proceedings of Interspeech; Brighton, UK. 2009. pp. 971-974

[21] Kreiman J, Gerratt B, Precoda K, Berke G. Individual differences in voice quality perception. Journal of Speech and Hearing Research. 1992;**35**:512-520

[22] Kreiman J, Gerratt B, Kempster G, Erman A, Berke G. Perceptual evaluation of voice quality: Review, tutorial, and a framework for future research. Journal of Speech and Hearing Research. 1993;**36**(1):21-40

[23] Helou L, Solomon N, Henry L, Coppit G, Howard R, Stojadinovic A. The role of listener experience on Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) ratings of post-thyroidectomy voice. American Journal of Speech-Language Pathology. 2010;**19**:248-258

[24] Gerratt B, Kreiman J, Barroso N, Berke G. Comparing internal and external standards in voice quality judgments. Journal of Speech and Hearing Research. 1993;**36**(1):14-20

[25] Eadie T, Smith K. The effect of listener experience and anchors on judgments of dysphonia. Journal of Speech, Language, and Hearing Research. 2011;**54**:430-447

[26] Silva R, Zenari M, Nemr K. Impacto de treinamento auditivo na avaliação perceptivo-auditiva da voz realizada por estudantes de Fonoaudiologia. Revista da Sociedade Brasileira de Fonoaudiologia. 2012;**24**(1):19-25

[27] Pinho S, Pontes P. Escala de Avaliação Perceptiva da Fonte Glótica: RASAT. São Paulo: INVOZ; 2002

[28] Pinho S, Pontes P. Músculos Intrínsecos da Laringe e Dinâmica Vocal. Série Desvendando os Segredos da Voz Vol. 1. Rio de Janeiro: Revinter; 2008

[29] Behlau M. Consensus auditory-perceptual evaluation of voice (CAPE-V), ASHA 2003. Revista da Sociedade Brasileira de Fonoaudiologia. 2004;**9**(3):187-189

[30] Silvestre I, Guimarães I, Teixeira A. Voice quality on women with vocal nodules diagnosis: Preliminary study. Otorrinolaringologia e Cirurgia Cérvico-Facial (Revista Portuguesa). 2011;**49**(2):69-77

[31] Freitas S, Pestana P, Almeida V, Ferreira A. Audio-perceptual evaluation of Portuguese voice disorders—An inter- and intrajudge reliability study. Journal of Voice. 2014;**28**(2):210-215

[32] Brinca L, Batista A, Tavares A, Pinto P, Araújo L. The effect of anchors and training on the reliability of voice quality ratings for different types of speech stimuli. Journal of Voice. 2015;**29**(6):776.e7-776.e14

[33] Valente A, Jesus L, Roberto M, Leahy M, St. Louis K. Cross-cultural adaptation of the Public Opinion Survey of Human Attributes (POSHA-S): The European Portuguese (EP) translation and adaptation process as a model. In: Santiago D, editor. Stuttering: Risk Factors, Public Attitudes and Impact on Psychological Well-Being. New York, NY: Nova Science; 2015. pp. 93-110

[34] Hutchinson A, Bentzen N, Zahn C, editors. Cross Cultural Health Outcome Assessment: A User's Guide. Ruinen: European Research Group on Health Outcomes; 1997

[35] Wild D, Grove A, Martin M, Eremenco S, McElroy S, Lorenz A, Erikson P. Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: Report of the ISPOR Task Force for Translation and Cultural Adaptation. Value in Health. 2005;**8**(2):94-104

[36] Geisinger K. Cross-cultural normative assessment: Translation and adaptation issues influencing the normative interpretation of assessment instruments. Psychological Assessment. 1994;**6**(4):304-312

[37] Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the Process of Cross-Cultural Adaptation of Self-Report Measures. Spine. 2000;**25**(24):3186-3191

[38] Guillemin F, Bombardier C, Beaton DE. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. Journal of Clinical Epidemiology. 1993;**46**(12):1417-1432

[39] JSLP. GRBAS CD and DVD. The Japan Society of Logopedics and Phoniatrics (JSLP), editor. Tokyo: Interuna Publishers; 2005

[40] Jesus L, Belo I, Machado J, Hall A. The Advanced Voice Function Assessment Databases (AVFAD): Tools for voice clinicians and speech research. In: Fernandes F, editor. Advances in Speech-language Pathology. Rijeka: InTech; 2017 pp.

[41] Revis J, Giovanni A, Wuyts F, Triglia J. Comparison of different voice samples for perceptual analysis. Folia Phoniatrica et Logopaedica. 1999;**51**(3):108-116

[42] Morsomme D, Jamart J, Wéry C, Giovanni A, Remacle M. Comparison between the GIRBAS scale and the acoustic and aerodynamic measures provided by EVA for the assessment of dysphonia following unilateral vocal fold paralysis. Folia Phoniatrica et Logopaedica. 2001;**53**(6):317-325

[43] Pinho C, Jesus L, Barney A. Weak voicing in fricative production. Journal of Phonetics. 2012;**40**(5):625-638

[44] Jesus L, Vilarinho H, Ferreira M. Protocolo de Anamnese Vocal (Jovens e Adultos) da Universidade de Aveiro [University of Aveiro's Standard Voice Case History Form]. University of Aveiro, Portugal. 2010. INPI Registration Number 463523 and IGAC

Registration 27/05/2010. Available from: Advanced Communication and Swallowing Assessment (ACSA) http://acsa.web.ua.pt/

[45] Ferreira M, Jesus L, Couto P, Vilarinho H. University of Aveiro's Standardised Voice Case History Form. Revista de Saúde Pública 48 (Special Number); 2014. p. 297

The Advanced Voice Function Assessment Databases (AVFAD): Tools for Voice Clinicians and Speech Research

Luis M.T. Jesus, Inês Belo, Jessica Machado and Andreia Hall

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69643

Abstract

A new open access resource called Advanced Voice Function Assessment Databases (AVFAD) was developed, based on a sample of 709 individuals (346 clinically diagnosed with vocal pathology and 363 with no vocal alterations) recruited in Portugal. All clinical conditions were registered according to the Classification Manual of Voice Disorders-I. Participants were audio-recorded, producing the following vocal tasks: Sustaining vowels /a, i, u/; reading of six CAPE-V sentences; reading a phonetically balanced text; spontaneous speech. The AVFAD are comprised of 8648 uncompressed audio files and an additional database file with 19 Praat Voice Report parameter values and 16 clinical data entries per participant. An annotated segment of the vowel /a/ for each participant was analysed automatically with a Praat script. Radial graphs were generated considering that all variables had an approximately normal distribution, and using previously calculated average and standard deviation values for all parameters. The normal and pathological f0 mean, Jitter ppq5, Shimmer apq11 and Harmonics-to-Noise-Ratio characteristics were compared. An additional analysis of the relation between the acoustic parameters and gender, age group, smoking habits, body mass index and voice usage, was considered. The AVFAD will allow future cooperative work and testing of non-invasive methods for voice pathology diagnosis.

Keywords: voice, voice disorders, database, assessment, multi-dimensional acoustic voice analysis, Praat, classification manual of voice disorders-I, Portuguese

1. Introduction

The multidimensionality of voice requires the use of several types of evaluation and measures to allow the correct characterization of vocal quality [2]. The instrumental evaluation of voice

[29] is considered as one of the most important elements for a correct vocal diagnosis and must precede intervention. It should include perceptive, acoustic, physiological, aerodynamic evaluation, and an auto-assessment of vocal quality.

Acoustic voice analysis [20, 21] is an effective and noninvasive tool that can be used to confirm an initial diagnosis and provide an objective determination of the impairment [38]. It is also an important tool to an early detection and treatment of laryngeal tumors that can reduce both morbidity and mortality.

The collection of voice databases for testing and comparing the analysis methods is regarded as an important research area. However, despite the variety of models and methods developed by signal processing engineers, voice clinicians still express their disappointment with regard to the performance of the existing approaches for assessing voice quality.

Reference acoustic databases allow the standardization of acoustic analysis, benchmarking and comparing the performance of different voice analysis techniques. They also allow to differentiate normal voice and pathological voice, to evaluate and monitor it clinically, and to diminish the subjectivity that underlies the acoustic-perceptual analysis [22] by establishing a correlation between quantitative data. Results can be interpreted reliably, as long as they are collected by the same equipment, and the same data collection methods and recording techniques are used [43]. However, the reliability of acoustic analysis of the voice signal is still hindered by the "scarcity of sufficiently comprehensive databases" [38, p. 4].

A database of normal and pathological voices is a reference for the identification of clinically relevant perturbations in voice quality and data collection and analysis suitability developed for specific applications [26, p. 131].

The most widely used clinical graphical and numerical representation of normal and pathological voices [47] is the Multidimensional Voice Program (MDVP), and even when the acoustic analysis of voice is performed with freeware [30], reference values from the MDVP can be found in the manuals. However, these values should be used with great caution because they are based only in 15 normal voices [47, p. 227] and "may not be appropriate for various age-sex subpopulations. At this time, the MDVP normative values should be regarded as preliminary and not as commonly recognized criteria by which abnormality is established. However, the concept of an integral database is important" [26, p. 135].

There have been various scientific studies along the past 40 years that compare, acoustically, normal and disordered voices [8, 10, 16, 27, 31, 37]. For Portuguese, there have been some voice research on vocal quality [3, 6, 33, 34, 41, 42, 49], distinction between pathological voice and normal voice through acoustic analysis [5, 12, 13, 21, 36] and the prevalence of laryngeal disorders [7, 39]. However, there are no known open access databases that allow the comparison of voice studies.

The University of Aveiro in Portugal collected, annotated and analyzed the Advanced Voice Function Assessment Databases (AVFAD), an open access resource that facilitates vocal evaluation, representing the first normative database for EP. Databases collected by clinicians enable the interpretation of automatically extracted descriptors of the speech signal and lead to the development of models for the interaction of these descriptors.

http://dx.doi.org/10.5772/intechopen.69643

One of the purposes of this book chapter is to compare, acoustically, participants with normal voice to participants with voice pathology, regarding the parameters fundamental frequency (f0) mean (Hz), Jitter ppq5 (%), Shimmer apq11 (%) and Harmonics-to-Noise Ratio (HNR) in dB. An additional analysis of the relation between these two groups and participants' demographic data was considered, including gender, age group, smoking habits, body mass index (BMI), and voice usage. Generally, the main goal was to study EP speakers' acoustical characteristics and verify if it is possible to differentiate voice disorders through an acoustical analysis of voice.

The normative voice data presented in this book chapter is important to typify voice pathologies and when evaluating treatment success. For instance, it has long been known [32] that the voices of speakers with organic disorders of the larynx have higher Jitter and Shimmer and a lower HNR relative to the voices of normal speakers [8].

The AVFAD are distributed freely using a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, through the Advanced Communication and Swallowing Assessment (ACSA) platform at http://acsa.web.ua.pt/.

2. Method

The work reported in this book chapter is part of a larger ongoing project of the University of Aveiro in Portugal, which aims to build and validate a comprehensive set of resources for voice clinicians, including a standardized voice case history form [11, 24], a voice evaluation protocol [1, 25] and a reference voice database (AVFAD).

The sample used in this study includes 709 individuals, 346 of whom clinically diagnosed with vocal pathology and 363 with no vocal alterations, matched for gender and chronological age. Healthy controls were recruited at hospitals, from the University of Aveiro (UA) staff and students, and institutions with UA protocols. The recruitment process took place in the otorhinolaryngology departments of three hospitals that have a long-standing cooperation with the UA. Local clinicians discussed with the research team their medical diagnosis, and sociodemographic and anthropometric information were collected.

All clinical conditions were classified with the wording and numeric coding system proposed by Verdolini et al. [46]. The Classification Manual of Voice Disorders-I (CMVD-I) "lists most conditions that may negatively affect a patient's ability to produce voice, based on current understanding" [46, p. 2]. CMVD-I's Dimension 1 uses nine categories to classify these conditions [46, p. 4]. The 346 participants clinically diagnosed with vocal pathology are distributed as uniformly as possible distributed through these categories. Participants were recruited through a convenience sampling method, fulfilling a set of predefined inclusion criteria: aged 18 or older; Portuguese nationality; and EP as mother tongue.

Verdolini et al.'s [46] classification was derived from notes on diagnosis collected from the local hospitals voice clinicians, which were carefully analyzed by two independent speech and language therapists (SLTs), which reached a consensus after clarifying some participant's diagnosis with original clinical team.

Chronological age and gender matching participants with vocal pathology and healthy participants was implemented in 5-year clusters [15], that is, each participant with vocal pathology with a certain age and gender was matched to a control with the same gender and age within a 5-year range. For example, participants with vocal pathology aged 18–22 years were matched to controls within the same age range.

Informed consent was collected from all participants prior to any data collection, authorizing the use of recordings for the present study and also for other studies and by other researchers in the area of voice. The following participants' clinical and demographic data were then registered: smoking habits, age group, BMI, gender, and voice usage.

All participants were sitting in a comfortable chair, so they were as static as possible during the recording. A microphone was held on a tripod placed at a distance of 30 cm [44] from the participant's mouth (on-axis to the lips). Acoustic signals resulting from different voice assessment tasks were recorded via a Behringer ECM 8000 omnidirectional electret microphone connected to an audio interface (Presonus AudioBox USB; AudioBox Driver Version 1.57.0.5385; 16 bits and 48,000 Hz sampling frequency), using Praat version 5.3.56 [4].

Participants were recorded, producing the following vocal tasks: production of sustained vowels /a, i, u/—three repetitions each; reading of the six Portuguese CAPE-V sentences [19]—three repetitions each; reading a phonetically balanced text [23] and spontaneous speech.

Raw recordings were segmented into eleven.wav files (one for each speech sample), using Audacity 2.0.5 and Praat 5.4.04. The /a/ vowel repetition considered to be closer to the speaker's natural voice and produced with a comfortable pitch and volume was selected for analysis, and an interval corresponding to one hundred consecutive cycles, two hundred milliseconds after phonation began, was annotated and analyzed automatically (through a script written specifically for this purpose) with Praat version 5.4.08.

Firstly, for all files and for a 75-ms section of Praat's editor window, the incorrect identification of the periods by the program (e.g., situations in which period-doubling or period-halving occurred) was monitored for each participant. Those whose samples did not allow the correct identification of the periods or did not present a segment in which it was possible to identify, in the same sequence, 100 cycles of oscillation of the vocal folds were dropped out of the final version of the database. It was possible to identify all the participants that had to be dropped out based on these criteria, since the following parameters were also extracted automatically (also available within Praat's Voice Report): number of pulses; number of periods; mean period; standard deviation of period; fraction of locally unvoiced frames; number of voice breaks; and degree of voice breaks. These parameters were not included in the final database.

The parameterization of the Praat scripting language function used to extract the data were voiceReport $ = Voice report… analysisStart analysisEnd 75 500 1.3 1.6 0.03 0.45, where each of the parameters evoked had the following correspondence with the designations used in the system Of Praat menus (View & Edit → Pitch → Pitch settings… and Advanced Pitch settings…): time range (s): analysisStart-analysisEnd (beginning and end of the / a / segment that was noted previously); pitch range (Hz): 75–500; maximum period factor: 1.3; maximum amplitude factor: 1.6; silence threshold: 0.03; and voicing threshold: 0.45.

http://dx.doi.org/10.5772/intechopen.69643

The following Praat Voice Report function default parameters were extracted with the script and stored in the databases: f0 median (Hz); f0 mean (Hz); f0 std (Hz) ; f0 min (Hz); f0 max (Hz); Jitter local (%); Jitter local_abs (s); Jitter rap (%); Jitter ppq5 (%); Jitter ddp (%); Shimmer local (%); Shimmer local dB (dB); Shimmer apq3 (%); Shimmer apq5 (%); Shimmer apq11 (%); Shimmer dda (%); Autocorrelation mean; NHR mean; and HNR mean (dB).

The normal and pathological acoustic characteristics were compared using IBM SPSS Statistics 22, in order to explore differences between the parameters through the Mann-Whitney U test. In this book chapter, the following parameters are analyzed: f0 mean, Jitter ppq5, Shimmer apq11, and HNR.

An additional analysis of the relation between the acoustic parameters and gender, age group, smoking habits, BMI and voice usage was considered using the Kruskal-Wallis test. The participants ages were grouped for the purpose of this analysis and with the additional objective of analyzing voice changes across the life span [17], according to the following classification [45, p. 3]: young adulthood (18–45 years of age); middle adulthood (46–65 years of age); and older adulthood (older than 65). The BMI values were grouped into three categories according to WHOS's [48, p. 9] criteria: underweight (less than 18.5); normal range (18.5–24.99); overweight (25.00–29.99); and obese (greater or equal than 30.00).

Radial graphs were generated in Excel 2013, considering that all variables had an approximately normal distribution, and using previously calculated average and standard deviation values for all parameters. After the standardization of each variable, a grey circular area was drawn for each gender, corresponding, in each direction, to the average range of two standard deviations (that is, about 95% of normal distribution) of the healthy population. Applying that same standardization to each individual, a polygon in the radial graph was drawn, which allows the visualization of variables that are out of the expected range. The goal of radial graphs "is not only to determine if changes occur in the magnitude of certain parameters, but also to determine if there are configurational adjustments in a multi-dimensional profile" [26, p. 131] of voice.

Ethical approval was obtained from all authorities required by Portuguese bylaws for clinical research: national data protection committee; independent ethics committees.

3. Results

Data were collected during more than 150 sessions, over a period of three years (2012–2015). The AVFAD are comprised of 8648 data files (709 participants × (11.wav files + 1 annotated Praat binary file) + 140 background noise.wav files) and an additional Excel 2013 database file with 19 Praat Voice Report parameter values and 14 clinical data entries per patient, including: File ID; Visit date; Visit place; Age; Sex; Weight; Height; Surgery (Without laryngeal surgery; With laryngeal surgery); SLT Intervention (Without intervention; Under intervention; Postintervention); Smoking (Nonsmoker; Former smoker; Smoker); Singing (Nonsinger; Regular use of singing voice); Job; Diagnosis (CMVD-I Dimension 1 numeric system); Diagnosis (CMVD-I Dimension 1 word system) and Notes.

The AVFAD include 709 participants, from 18 to 93 years old, of whom 346 (49%) had a medical diagnosis of vocal pathology and 363 (51%) did not present any vocal pathology; 499 (70%) were females, and 210 (30%) were males, which are typical male/female ratios in Portuguese hospitals where the present study was conducted. Within the group diagnosed with vocal pathology, there are 26 different diagnoses based on Verdolini et al. [46] classification, including 249 (72%) female and 97 (28%) male participants. The control group was composed of 250 (69%) females and 113 (31%) males.

The acoustic parameters f0, Jitter ppq5, Shimmer aqp11, and HNR were compared between the participants without vocal pathology and the group of participants with a diagnosis of vocal pathology. The analysis considered gender, since it is generally accepted that the difference in anatomic structures affect the parameter f0. **Table 1** shows the results for males.

The results show that for all of the assessed parameters, there were statistically significant differences ($p < \alpha$) between the two groups. Normal participants presented lower f0, Jitter ppq5 and Shimmer aqp11 values, and higher value HNR values, as expected.

Table 2 shows the results for females.

Results showed that there are statistically significant differences ($p < \alpha$) between the groups in three parameters: Jitter ppq5, Shimmer apq11, and HNR. The fundamental frequency was unaffected by pathology in females.

Generally, the results showed that in both genders, there was a difference between normal participants' voices and pathological voices in most parameters that should be further considered and analyzed. For that purpose, multiple comparisons between normal participants and each of the six groups of pathology (nodules; polyp(s); cyst; Reinke's Edema; Reflux; Unilateral Vocal Fold Paralysis—UVFP) with the largest dimension were performed. The Bonferroni correction to control the chance of overall false-positive results leads to $\alpha = 0.05/6 = 0.0083$.

Table 3 presents the results of the comparison between normal and each type of pathological voices for male participants. Note that only the Reflux group has n ≥ 20.

The results show that the differences presented before, when pathological voices were analyzed as a single group, are just noticeable for two diagnosis, in the same two parameters. Males with Reinke's Edema or Reflux showed a statistically significant decrease in Shimmer apq11 and HNR, when compared to normal voices.

	Normal	**Vocal pathology**	**U test**	***p*-value**
f0 mean (Hz)	120.68 ± 22.30	138.28 ± 40.09	4082.0	0.001*
Jitter ppq5 (%)	0.247 ± 0.190	0.354 ± 0.289	4132.0	0.002*
Shimmer apq11 (%)	4.403 ± 2.652	8.297 ± 3.392	2638.5	<0.001*
HNR (dB)	16.315 ± 3.267	13.168 ± 4.105	2854.5	<0.001*

Nonparametric Mann-Whitney U test; *statistical significant differences for $\alpha = 0.05$.

Table 1. Descriptive (Mean ± Std. dev.) and inferential statistics for the male gender.

	Normal	Vocal pathology	U test	*p*-value
f0 mean (Hz)	193.45 ± 28.47	198.80 ± 42.73	29883.5	0.441
Jitter ppq5 (%)	0.214 ± 0.126	0.447 ± 0.484	15658.5	<0.001*
Shimmer apq11 (%)	5.174 ± 2.696	9.816 ± 4.884	9792.5	<0.001*
HNR (dB)	17.335 ± 3.958	11.774 ± 3.422	8876.5	<0.001*

Nonparametric Mann-Whitney U test; *statistical significant differences for $\alpha = 0.05$.

Table 2. Descriptive (Mean ± Std. dev.) and inferential statistics for the female gender.

Table 4 presents the results of the comparison between normal and each type of pathological voices for female participants. Note that all groups have n≥20.

The results of the multiple comparisons show several statistically significant differences between normal and all the pathological groups. The parameters Jitter ppq5, Shimmer aqp11, and HNR are affected by pathology, that is, all the pathology groups presented statistically significant differences from the normal group. As far as the parameter f0 is concerned, results are not consistent across pathologies. The participants diagnosed with Nodules and Reinke's Edema presented statistically significant differences in comparison with the normal group, when all the other groups did not. In other words, based in this sample of female voices, Polyp(s), Cyst, Reflux, and UVFP seem to cause alterations in Jitter pqp5, Shimmer apq11, and HNR but not in f0, and Nodules and Reinke's Edema cause alterations in all the parameters.

Figures 1–4 present additional information and provide a visual representation that allows the comparison of the previous acoustic parameters between the normal participants, and the participants diagnosed with the six most prevalent pathologies. Note that the boxes in **Figures 1–4** represent the 25–75th percentile range, black lines in the boxes represent medians, and whiskers correspond to the furthest observation within the ±1.5 interquartile range; outliers are represented as circles and extremes (>3 interquartile range from the box) as asterisks.

Based on these results, it is possible to conclude that males with a diagnosis of Reinke's Edema or Reflux presented a higher Shimmer aqp11 and lower HNR than the males without any vocal pathology. For females, there was no consistency in the behavior of f0, because it was only affected by the diagnosis of Nodules or Reinke's Edema. All the other parameters (Jitter ppq5, Shimmer apq11 and HNR) showed a consistent behavior: the group without vocal pathology showed, in comparison with all the other groups, lower values of Jitter ppq5 and Shimmer aqp11 and higher values of HNR.

The influence of age, BMI, smoking habits, and voice usage of participants on the acoustic characteristics of voice was also investigated. **Table 5** shows the results for age, grouped by gender and diagnosis.

The results showed some significant differences between the groups (young adulthood; middle adulthood and older adulthood) for the variable age. These differences are noticed in f0, independently of the gender or diagnosis, also in Shimmer apq11 in all participants except males with normal voice and in HNR in the group of females with normal voice.

	Nodules		**Polyp(s)**		**Cyst**		**Reinke's Edema**		**Reflux**		**UVFP**	
	***n* = 2**		***n* = 7**		***n* = 3**		***n* = 8**		***n* = 29**		***n* = 2**	
	U	***p*-value**	**U**	***p*-value**	**U**	***p*-value**	**U**	***p*-value**	**U**	***p*-value**	**U**	***p*-value**
f0 (Hz)	30.0	0.076	352.0	0.626	153.0	0.774	301.0	0.115	1375.0	0.182	19.0	0.044
Jitter ppq5 (%)	90.0	0.623	272.0	0.167	46.0	0.032	310.5	0.140	1176.0	0.019	16.0	0.038
Shimmer apq11 (%)	73.0	0.392	202.0	0.30	89.0	0.161	198.0	0.008*	606.0	<0.001*	6.0	0.022
HNR (dB)	106.0	0.881	238.0	0.078	37.0	0.021	192.0	0.007*	812.0	<0.001*	11.0	0.013

Nonparametric Mann-Whitney U test; *statistical significant differences for $\alpha = 0.0083$ (Bonferroni correction).

Table 3. Multiple comparisons between normal and pathological voices for the male gender.

	Nodules		**Polyp(s)**		**Cyst**		**Reinke's Edema**		**Reflux**		**UVFP**	
	***n* = 26**		***n* = 20**		***n* = 20**		***n* = 22**		***n* = 71**		***n* = 24**	
	U	***p*-value**	**U**	***p*-value**	**U**	***p*-value**	**U**	***p*-value**	**U**	***p*-value**	**U**	***p*-value**
f0 (Hz)	2211.0	0.007*	2297.0	0.546	1948.0	0.100	1121.5	<0.001*	8117.0	0.272	2134.0	0.020
Jitter ppq5 (%)	1744.0	<0.001*	984.0	<0.001*	1165.5	<0.001*	1158.5	<0.001*	5506.0	<0.001*	1016.0	<0.001*
Shimmer apq11 (%)	1197.0	<0.001*	685.0	<0.001*	778.5	<0.001*	1270.0	<0.001*	2716.0	<0.001*	739.5	<0.001*
HNR (dB)	1264.0	<0.001*	547.0	<0.001*	688.0	<0.001*	836.0	<0.001*	2366.0	<0.001*	1056.0	<0.001*

Nonparametric Mann-Whitney U test; *statistical significant differences for $\alpha = 0.0083$ (Bonferroni correction).

Table 4. Multiple comparisons between normal and pathological voices for the female gender.

http://dx.doi.org/10.5772/intechopen.69643

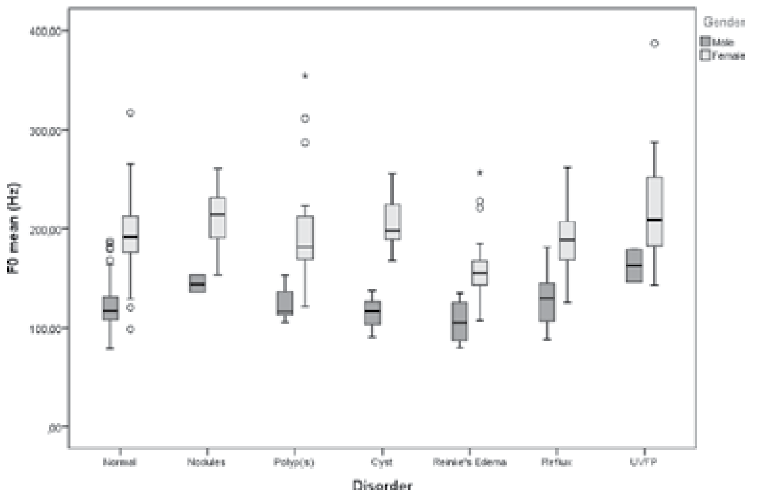


Figure 1. Fundamental frequency by voice disorder for both genders.

Table 6 shows the influence of smoking habits on the acoustic parameters, by gender and diagnosis.

The results show significant differences between groups (nonsmoker; former smoker; smoker) in f0 for females and males with normal voice and Shimmer apq11 for males with normal voice.

Table 7 shows the influence of BMI on the acoustic parameters by gender and diagnosis.

The results show that BMI only had an influence on females with normal voice. All the others did not show statistical differences between groups (underweight; normal range; overweight; obese).

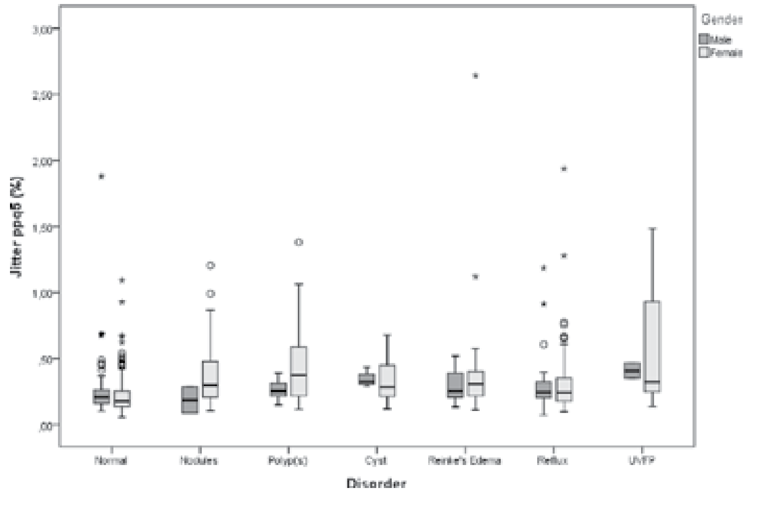


Figure 2. Jitter ppq5 by voice disorder for both genders.

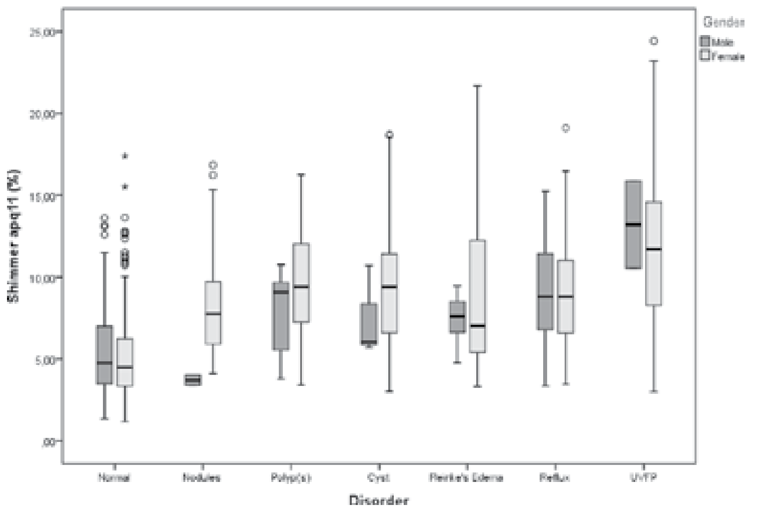


Figure 3. Shimmer apq11 by voice disorder for both genders.

Table 8 shows the influence of voice usage on the acoustic parameters, by gender and diagnosis.

For the variable voice usage, the results showed that there are no differences between groups (singers and nonsingers), except for the parameter Jitter ppq5 in males with vocal pathology.

Figure 5 shows examples of radial graphs for two participants, randomly chosen and included in AVFAD database: the male participant FAX and the female participant MLY. Through the analysis of the graphics, it is possible to verify that only the NHR and autocorrelation mean parameters of FAX are out of the normal range (grey circular area), but a much broader range of parameters for MLY are not within the reference interval.

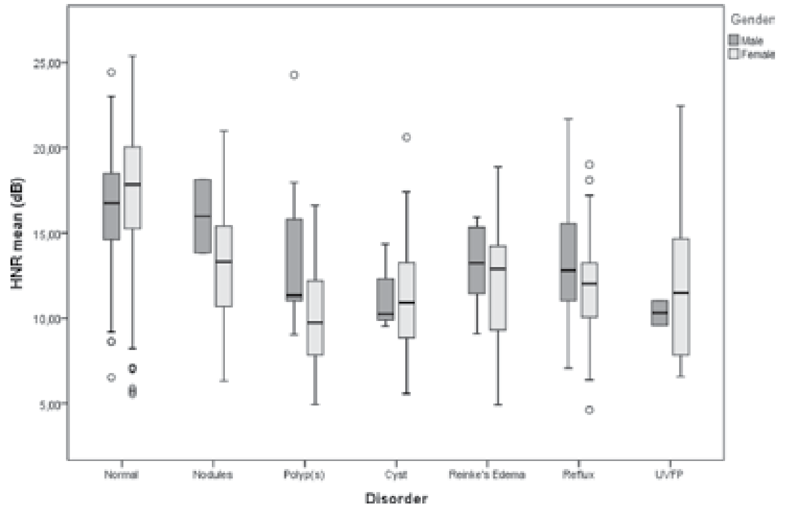


Figure 4. HNR by voice disorder for both genders.

	♂ **Male**				♀ **Female**			
	Normal		**Vocal pathology**		**Normal**		**Vocal pathology**	
	χ^2	***p*-value**	χ^2	***p*-value**	χ^2	***p*-value**	χ^2	***p*-value**
f0 mean (Hz)	27.817	0.000*	8.229	0.016*	10.277	0.006*	11.050	0.004*
Jitter ppq5 (%)	1.976	0.372	3.765	0.152	6.630	0.036	2.300	0.317
Shimmer apq11 (%)	9.842	0.007*	2.940	0.230	27.521	0.000*	9.945	0.007*
HNR (dB)	0.313	0.855	2.572	0.276	11.990	0.002*	5.942	0.051

Nonparametric Kruskal-Wallis Test; *statistical significant differences for $\alpha = 0.05$.

Table 5. Inferential statistics, grouped by gender and diagnosis, for the variable age.

	♂ **Male**				♀ **Female**			
	Normal		**Vocal pathology**		**Normal**		**Vocal pathology**	
	χ^2	***p*-value**	χ^2	***p*-value**	χ^2	***p*-value**	χ^2	***p*-value**
f0 mean (Hz)	8.371	0.015*	5.839	0.054	9.590	0.008*	32.882	<0.001*
Jitter ppq5 (%)	1.240	0.538	1.587	0.452	1.499	0.473	5.688	0.058
Shimmer apq11 (%)	9.097	0.011*	0.528	0.768	0.352	0.839	2.885	0.236
HNR (dB)	3.912	0.141	0.455	0.797	0.609	0.737	0.352	0.838

Nonparametric Kruskal-Wallis Test; *statistical significant differences for $\alpha = 0.05$.

Table 6. Inferential statistics, grouped by gender and diagnosis, for the variable smoking habits.

	♂ **Male**				♀ **Female**			
	Normal		**Vocal pathology**		**Normal**		**Vocal pathology**	
	χ^2	***p*-value**	χ^2	***p*-value**	χ^2	***p*-value**	χ^2	***p*-value**
f0 mean (Hz)	6.123	0.106	5.272	0.153	9.658	0.022*	3.775	0.287
Jitter ppq5 (%)	0.725	0.867	4.968	0.174	2.028	0.567	1.515	0.679
Shimmer apq11 (%)	0.520	0.914	0.505	0.918	1.574	0.665	2.425	0.487
HNR (dB)	0.032	0.999	2.502	0.475	3.017	0.389	0.501	0.919

Nonparametric Kruskal-Wallis Test; *statistical significant for $\alpha = 0.05$.

Table 7. Inferential statistics, grouped by gender and diagnosis, for the variable BMI.

	♂ Male				♀ Female			
	Normal		Vocal pathology		Normal		Vocal pathology	
	χ^2	*p*-value	χ^2	*p*-value	χ^2	*p*-value	χ^2	*p*-value
f0 mean (Hz)	0.656	0.418	0.025	0.874	1.503	0.220	1.762	0.184
Jitter ppq5 (%)	1.510	0.219	6.567	0.010*	0.225	0.635	1.532	0.216
Shimmer apq11 (%)	2.714	0.099	2.642	0.104	0.164	0.686	0.672	0.413
HNR (dB)	3.986	0.046	3.203	0.074	2.376	0.123	0.097	0.755

Nonparametric Kruskal-Wallis Test; *statistical significant differences for $\alpha = 0.05$.

Table 8. Inferential statistics, by gender and diagnosis, for variable voice usage.

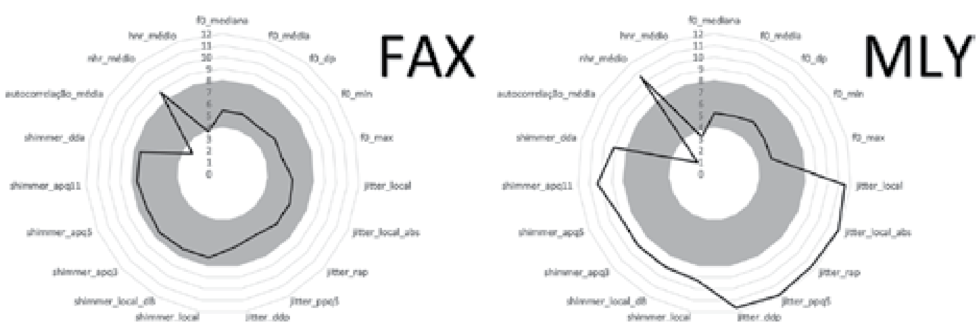


Figure 5. Radial graphs for patients FAX (male) and MLY (female).

4. Discussion

The number of patients with voice disorders has been increasing dramatically over the last decade, due mainly to unhealthy social habits and voice abuse. It has been reported that approximately 30% of the global population suffer from some kind of voice disorder during their lives. Previous studies have shown that impairment of vocal function can have a major impact on the quality of life, severely limiting communication at work and affecting all social aspects of daily life.

With an increasing concern to improve the assessment of voice for as many European languages as possible, we collected the first complete and representative EP pathological voice database. This database will be of huge significance for voice clinicians' assessment and for testing and developing innovative, automated methods and devices for voice analysis. Besides the great importance of the database for this project, it will also be of great significance for future studies in the field of voice function assessment.

The development of voice is influenced by individual characteristics, but there is no consensus among authors about which specific characteristics affect vocal quality. Gender, however, has been identified as having a significant impact [28, 17], so the male and female samples of the study were analyzed individually.

The male f0 results showed a statistically significant difference between normal and pathological voices, but literature [40] indicates that both normal and pathological voices f0 values in our databases are within the normal range. Female f0 values were also within the normal range according to previous studies [16, 40], but normal and pathological voices in the AVFAD did not present statistically significant differences. For both genders, the results support previously published scientific evidence [16, 18, 35], suggesting that the f0 parameter does not allow to distinguish between a normal and a pathological voice.

According to literature [8], the voices of speakers with organic disorders of the larynx have higher Jitter and Shimmer and a lower HNR relative to the voices of normal speakers. Thereby, the results of this study (presented in **Tables 1** and **2**) are supported by literature [32], since for both genders, normal participants had statistically significant lower values of Jitter and Shimmer. According to [14], Jitter and Shimmer could be used as an acoustic parameters to differentially diagnose vocal pathology.

For the HNR parameter, as expected, normal participants had statistically significant higher values than pathological participants. The results of this study were below the threshold (30 dB) established by Deliyski et al. [9], since the recording conditions (quiet room / audiology booth) used in their study were not reproducible in a hospital environment.

The results of multiple comparisons between normality and the six different vocal pathologies, for the male gender (as shown in **Table 3**), suggest statistically significant differences between the normal group and the Reinke's Edema group, and the normal group and the Reflux group, for Shimmer and HNR parameters. For the other groups, no statistically significant differences have been found. However, one should consider that the male pathological groups' sample size was too reduced to draw meaningful conclusions.

On the other hand, for the female gender, with much larger sample size, the results showed statistically significant differences between normality and the six pathologies, in relation to Shimmer, Jitter, and HNR parameters. When the Nodules and Reinke's Edema groups were compared to the normal group, significant differences in the f0 parameter were found as well. Accordingly, this study suggests that, in females, the studied vocal pathologies affect strongly the acoustic parameters Jitter, Shimmer, and HNR. The first two are increased, and HNR is decreased.

Concerning the four demographic characteristics in study (age group, smoking habits, BMI and voice usage), only the age group and smoking habits seem to interfere with voice quality. However, this was not the main goal of the present study and requires further investigation.

The radial graphs generated (with an Excel 2013 spreadsheet tool distributed with the AVFAD) from all the acoustic parameters automatically extracted from Praat were used in order to establish a threshold between normality and vocal pathology and are easy to interpret. It is believed that it might be a good tool helping voice clinicians to establish a diagnosis, to communicate results with other health professionals, clients and their families. It allows a quick visualization of the acoustic speech signal parameters and to verify if they are within the normal range. They are also a functional way of monitoring progress in therapy.

5. Conclusions

The empirical work developed in this project produced new insights into voice disorder assessment and provides clinicians with a critical resource for voice assessment. The voice pathology database provides a new and valuable tool for voice clinicians and for speech research. This database will enable the interpretation of automatically extracted descriptors of the speech signal. The evaluation of some specific parameters such as f0, Jitter, Shimmer and HNR has established differences of speech signal behaviors.

Acoustic databases aid professionals in the design of studies about the different pathologies, compare those pathologies with normal patterns and, furthermore, establish a threshold between normal and pathological voices. The AVFAD provide important tools for the study of voice, as they can objectively complement a differential diagnosis and help select an adequate intervention strategy.

In this study, we have analyzed the six most recurrent vocal pathologies (Reflux; Reinke's Edema; Nodules; Polyps; Cysts; UVFP) and defined standardized acoustic values for the f0 mean (Hz), Jitter ppq5 (%), Shimmer apq11 (%) and HNR (dB), correlating these with age, gender, BMI, voice usage and smoking habits.

The main conclusion drawn from this study was the existence of statistically significant differences between normal and pathological voice groups. Additionally, there are some evidences that suggest an association between age group, smoking habits, and the acoustic parameters, which should be further studied.

The radial graphs, drawn for each participant, allow a multidimensional acoustic analysis of patients and comparison with a normal (reference) range radial, giving clinician information on an individual's vocal quality, and allowing them to immediately detect changes in parameters.

One of the limitations of this study were the recording conditions. Although not optimal, they represent the real clinical setting where clinicians usually work and record their voice samples. For the male gender, some pathologies' sample size is limited and does not allow a reliable analysis of the results. We suggest that this sample may be increased in order to run a new statistical analysis and confirm the results.

In the future, considering the AVFAD database potentiality, the authors suggest their use in new voice studies, taking advantage of its complexity. For example, the other vocal tasks recorded could be analyzed. A detailed analysis of participants' clinical and demographic data is also recommended. These studies will represent a very important contribution to improve the knowledge about the acoustical characteristics of voice. Further work on performance improvement of assessment methods used by voice clinicians can be based on AVFAD samples and thus clinically applied.

http://dx.doi.org/10.5772/intechopen.69643

Acknowledgements

The authors would like to thank the Otorhinolaryngology teams from Hospital de Santo António, Hospital de São João and Hospital Pedro Hispano. We would also like to thank all the undergraduate and postgraduate students that contributed along the years to data collection, segmentation and annotation.

This research was partially funded by National Funds through FCT (Foundation for Science and Technology) in the context of the projects UID/MAT/04106/2013 and UID/CEC/00127/2013.

The AVFAD project was supported by the School of Health Sciences (ESSUA), University of Aveiro, Portugal.

This chapter was developed as part of the M.Sc. in Speech and Hearing Sciences at the University of Aveiro, Portugal: Belo I (2015). Valores de Referência de Parâmetros Acústicos para a Voz Normal no Português Europeu [Normal Voice Reference Values for Acoustic Parameters in European Portuguese], M.Sc. Thesis, University of Aveiro, Portugal; Machado J (2015). Caraterísticas Acústicas de Patologias Vocais no Português Europeu [Acoustic Characteristics of Vocal Pathologies in European Portuguese], M.Sc. Thesis, University of Aveiro, Portugal.

The AVFAD are freely distributed through the ACSA http://acsa.web.ua.pt/ platform.

Author details

Luis M.T. Jesus*, Inês Belo, Jessica Machado and Andreia Hall

*Address all correspondence to: lmtj@ua.pt

University of Aveiro, Aveiro, Portugal

References

[1] Alves M. Validade e Fiabilidade do Protocolo de Avaliação da Qualidade Vocal da Universidade de Aveiro [Validity and Reliability of University of Aveiro's Voice Evaluation Protocol] M.Sc. Thesis, Mestrado em Ciências da Fala e da Audição [M.Sc. in Speech and Hearing Sciences]. Aveiro: University of Aveiro; 2015

[2] Barsties B, Bodt M. Assessment of voice quality: Current state-of-the-art. Auris Nasus Larynx. 2015;**42**:183-188

[3] Behlau M. Consensus auditory-perceptual evaluation of voice (CAPE-V), ASHA 2003. Revista da Sociedade Brasileira de Fonoaudiologia. 2004;**9**(3):187-189

[4] Boersma P. PRAAT, a system for doing phonetics by computer. Glot International. 2001;**5**:341-345

[5] Brinca L, Batista A, Tavares A, Gonçalves I, Moreno M. Use of cepstral analyses for differentiating normal from dysphonic voices: A comparative study of connected speech versus sustained vowel in European Portuguese female speakers. Journal of Voice. 2014;**28**(3):282-286

[6] Brinca L, Batista A, Tavares A, Pinto P, Araújo L. The effect of anchors and training on the reliability of voice quality ratings for different types of speech stimuli. Journal of Voice. 2015;**29**(6):776.e7-776.e14

[7] Brinca L, Nogueira P, Tavares A, Batista A, Gonçalves I, Moreno M. The prevalence of laryngeal pathologies in an academic population. Journal of Voice. 2015;**29**(1):130.e1-130.e9

[8] Cantarella G, Baracca G, Pignataro L, Forti S. Assessment of dysphonia due to benign vocal fold lesions by acoustic and aerodynamic indices: A multivariate analysis. Logopedics Phoniatrics Vocology. 2011;**36**(1):21-27

[9] Deliyski D, Shaw H, Evans M. Adverse effects of environmental noise on acoustic voice quality measurements. Journal of Voice. 2005;**19**(15):15-28

[10] Dollinger M, Kunduk M, Kaltenbacher M, Vondenhoff S, Ziethe A, Eysholdt U, Bohr C. Analysis of vocal fold function from acoustic data simultaneously recorded with high-speed endoscopy. Journal of Voice. 2012;**26**:726-733

[11] Ferreira M, Jesus L, Couto P, Vilarinho H. University of Aveiro's standardised voice case history form. Revista de Saúde Pública. 2014;**48**(Special Number):297

[12] Freitas S, Pestana P, Almeida V, Ferreira A. Audio-perceptual evaluation of Portuguese voice disorders—An inter- and intrajudge reliability study. Journal of Voice. 2014;**28**(2):210-215

[13] Freitas S, Pestana P, Almeida V, Ferreira A. Integrating voice evaluation: Correlation between acoustic and audio-perceptual measures. Journal of Voice. 2015;**29**(3):390.e1-390.e7

[14] Gelzinis A, Verikas A, Bacauskiene M. Automated speech analysis applied to laryngeal disease categorization. Computer Methods and Programs in Biomedicine. 2008;**91**(1):36-47

[15] Gordis L. Epidemiology. 4th ed. Philadelphia: Saunders Elsevier; 2009

[16] Guimarães I, Abberton E. Fundamental frequency in speakers of Portuguese for different voice samples. Journal of Voice. 2005;**19**:592-606

[17] Hazan V. Speech communication across the life span. Acoustics Today. 2017;**13**(1):36-43

[18] Hecker M, Kreul E. Description of speech of patients with cancer of the vocal folds. Part I measures of fundamental frequency. Journal of Acoustical Society of America. 1971;**49**:1275-1282

[19] Jesus L, Barney A, Santos R, Caetano J, Jorge J, Couto P. Universidade de Aveiro's voice evaluation protocol. In: Proceedings of Interspeech. Brighton; 2009. pp. 971-974

[20] Jesus L, Castilho S, Hall A. Is the relative fundamental frequency an acoustic correlate of laryngeal tension in Portuguese speakers? In: Proceedings of the 18th International Congress of Phonetic Sciences (ICPhS 2015). Glasgow; 2015

[21] Jesus L, Martinez J, Hall A, Ferreira A. Acoustic correlates of compensatory adjustments to the glottic and supraglottic structures in patients with unilateral vocal fold paralysis. BioMed Research International. 2015;1-9, Article ID 704121

[22] Jesus L, Tavares A, Hall A. Cross-cultural adaption of the GRBAS and CAPE-V scales for Portugal and a new training program for perceptual voice evaluation In: Fernandes F, editor. Advances in Speech-Language Pathology. Rijeka: InTech; 2017

[23] Jesus L, Valente A, Hall A. Is the Portuguese version of the passage "The North Wind and the Sun" phonetically balanced? Journal of the International Phonetic Association. 2015;**45**(1):1-11

[24] Jesus L, Vilarinho H, Ferreira M. Protocolo de Anamnese Vocal (Jovens e Adultos) da Universidade de Aveiro [University of Aveiro's Standard Voice Case History Form]. Aveiro: University of Aveiro; 2010. INPI Registration Number 463523 and IGAC Registration 27/05/2010. Available from Advanced Communication and Swallowing Assessment (ACSA) http://acsa.web.ua.pt/

[25] Jesus L, Vilarinho H, Santos R. Protocolo de Avaliação da Qualidade Vocal da Universidade de Aveiro [University of Aveiro's Voice Evaluation Protocol]. Aveiro: University of Aveiro; 2010-2015. INPI Registration Number 463522 and IGAC Registration 27/05/2010 (Version 2 IGAC Registration Number 355/2012 and Version 2.3.6 IGAC Registration Number 3474/2015). Available from Advanced Communication and Swallowing Assessment (ACSA) http://acsa.web.ua.pt/

[26] Kent R, Vorperian H, Duffy J. Reliability of the multi-dimensional voice program for the analysis of voice samples of subjects with dysarthria. American Journal of Speech-Language Pathology. 1999;**8**:129-136

[27] Lazic M, Jovanovic N, Kulic M, Babac S, Jurisic V. Acoustic and perceptual characteristics of the voice in patients with vocal polyps after surgery and voice therapy. Journal of Voice. 2015;**29**(2):241-246

[28] Linville S. The aging voice. In: Kent R, Ball M, editors. Voice Quality Measurements. San Diego: Singular; 2000. pp. 359-376

[29] Ma E, Liu E. Handbook of Voice Assessments. San Diego: Plural; 2011

[30] Madill C, McCabe P. Acoustic analysis using freeware: PRAAT. In: Ma E, Liu E, editors. Handbook of Voice Assessments. San Diego: Plural; 2011. pp. 231-251

[31] Murry T. Speaking fundamental frequency characteristics associated with voice pathologies. Journal of Speech and Hearing Disorders. 1978;**43**:374-379

[32] Murry T, Doherty E. Selected acoustic characteristics of pathologic and normal speakers. Journal of Speech and Hearing Research. 1980;**23**(2):361-369

[33] Nemr K, Zenari M, Cordeiro G, Tsuji D, Ogawa A, Ubrig M, Menezes M. GRBAS and Cape-V scales: High reliability and consensus when applied at different times. Journal of Voice. 2012;**26**(6):812.e17-812.e22

[34] Nemr K, Zenari M, Souza G, Hachiya A, Tsuji D. Correlation of the Dysphonia Severity Index (DSI), Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V), and gender in Brazilians with and without voice disorders. Journal of Voice. 2016;**30**(6):765.e7-765.e11

[35] Peppard R, Bless D, Milenkovic P. Comparison of young adult singers and non-singers with vocal nodules. Journal of Voice. 1988;**2**:250-260

[36] Pontes P, Vieira V, Gonçalves M, Pontes A. Características das vozes roucas, ásperas e normais: análise acústica espectográfica comparativa. Revista Brasileira de Otorrinolaringologia. 2002;**68**(2):182-188

[37] Pribuisiene R, Uloza V, Kupcinskas L, Jonaitis L. Perceptual and acoustic characteristics of voice changes in reflux laryngitis patients. Journal of Voice. 2006;**20**:128-136

[38] Ravary L, Beet S. Automatic Speech Signal Analysis for Clinical Diagnosis and Assessment of Speech Disorders. New York: Springer; 2013

[39] Rocha L, Behlau M, Souza L. Behavioral dysphonia and depression in elementary school teachers. Journal of Voice. 2015;**29**(6):712-717

[40] Sebastian S, Babu S, Ballraj A, Oommen N. Acoustic measurements of geriatric voice. Journal of Laryngology and Voice. 2012;**2**(2):81-84

[41] Silva R, Zenari M, Nemr N. Impacto de treinamento auditivo na avaliação perceptivo-auditiva da voz realizada por estudantes de Fonoaudiologia. Revista da Sociedade Brasileira de Fonoaudiologia. 2012;**24**(1):19-25

[42] Silvestre I, Guimarães I, Teixeira A. Voice quality on women with vocal nodules diagnosis: Preliminary study. Otorrinolaringologia E Cirurgia Cérvico-Facial (Revista Portuguesa). 2011;**49**(2):69-77

[43] Stemple J, Roy N, Klaben B. Clinical Voice Pathology: Theory and Management. 5th ed. San Diego: Plural; 2014

[44] Švec J, Granqvist S. Guidelines for selecting microphones for human voice production research. American Journal of Speech-Language Pathology. 2010;**19**(4):356-368

[45] UN. Provisional Guidelines on Standard International Age Classifications. New York: United Nations; 1982

[46] Verdolini K, Rosen C, Branski R. Classification Manual for Voice Disorders-I. Mahwah: Lawrence Erlbaum; 2006

[47] Vogel A. Multidimensional analysis of voice: Computerized speech lab. In: Ma E, Liu E, editors. Handbook of Voice Assessments. San Diego: Plural; 2011. pp. 219-230

[48] WHO. Obesity: Preventing and Managing the Global Epidemic. Geneva: World Health Organization (WHO); 2000

[49] Yamasaki R, Madazio G, Leão S, Padovani M, Azevedo R, Behlau M. Auditory-perceptual evaluation of normal and dysphonic voices using the voice deviation scale. Journal of Voice. 2017;**31**(1):67-71

Risk Factors for Speech-Language Pathologies in Children

Daniela Regina Molini-Avejonas,
Laís Vignati Ferreira and
Cibelle Albuquerque de La Higuera Amato

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.70107

Abstract

Risk factors are understood to encompass "aspects of individual behavior or lifestyle, environmental exposure, hereditary or congenital characteristics that are associated with a health related condition". These are conditions that increase the chances of the child presenting speech-language disorders and that can be avoided, controlled, or treated. Risk is defined as the chance of a child exposed to certain factors (environmental or biological) to acquire or develop speech-language disorders. The objectives of the present study were: to identify the risk factors for speech-language disorders in children up to five years of age and to verify the relationship between risk factors and speech-language diagnostic hypotheses. The aspects of being male gender, prematurity, shyness, being an only child or youngest child, presenting deleterious oral habits, having a family history of speech-language disorders, and use of licit or illicit drugs during pregnancy seem to be the factors that should draw the attention of the health professionals in child development. Therefore, the monitoring of children who have these risk factors should be performed in order to promote the necessary stimulation and the construction of healthy environments.

Keywords: risk factors, language development, child development, language development disorders, speech disorders

1. Introduction

Speech therapy, as a communication science, has a broad perspective on health systems and services at the three levels of care (primary, secondary, and tertiary). Practices in the aspects of language, voice, hearing, and oral motricity should be addressed to people and social groups, not only with a clinical perspective, but also through the development of promotion, prevention, attention, and health education actions, which are aligned with the indicators of quality of life and health of the population for which the care proposal [1] will be elaborated.

To this end, rather than planning models for identifying the prevalence and incidence of language disorders in children, one must identify the risk factors for these disorders. In the national literature, it is possible to find studies with this theme, but often associated with a specific pathology, such as stuttering and phonological disorders [2, 3].

Risk factors are understood to encompass "aspects of individual behavior or lifestyle, environmental exposure, hereditary, or congenital characteristics that are associated with a health related condition" (Health Sciences Descriptors, DECS) [4]. These conditions that increase the chances of the child presenting speech-language disorders and that can be avoided, controlled, or treated. Risk is defined as the chance of a child exposed to certain factors (environmental or biological) to acquire or develop speech-language disorders [5].

Pre-, peri-, and post-natal events, such as prematurity, low birth weight, complications in pregnancy and childbirth, are considered biological risks for these disorders. Among the environmental risk factors, low socioeconomic status, schooling, and fragility in family ties are mentioned. There is often a concomitance of the two types of risk, causing a cumulative effect [5, 6].

For the identification of risk factors, understanding as essential for the design of care processes for the population, the Protocol for the Identification of Risk Factors for Language and Speech Disorders (PIFRAL) was proposed [7]. This protocol consists of a form with 29 items administered to parents/guardians of children (Annex A) and includes sociodemographic issues (age, gender, declared race and schooling of the child, age, schooling and profession of parents, place of residence), about the family information (number of siblings, birth order, twinning, time spent with the children, language used at home), on pre-, peri-, and post-natal periods, and temperament of the child [7]. The results of the pilot study indicated that the PIFRAL can be used as a tool to identify the risk factors for speech-language disorders. The main factors identified in the population were family history, intercurrences during pregnancy, prematurity, low birth weight, prolonged hospitalizations, being an only child, male gender, and deleterious oral habits. The authors of the study mentioned above pointed out the need to carry out a new analysis with the increase of the sample of children with speech-language alterations, in order to observe if the results will be maintained or if there will be changes in the frequency of occurrence of risk factors for speech-language disorders in children [7].

The objectives of the present study were: to identify the risk factors for speech-language disorders in children up to five years of age and to verify the relationship between risk factors and speech-language diagnostic hypotheses.

2. Methods

Descriptive, retrospective, and prospective study, developed with the children attending the Laboratório de Investigação Fonoaudiológicaem Atenção Primária à Saúde (Laboratory

http://dx.doi.org/10.5772/intechopen.70107

of Speech and Language Research in Primary Health Care, LIFAPS) of the Department of Physiotherapy, Speech-Language and Hearing Science and Occupational Therapy of the School of Medicine of University of São Paulo (FMUSP), from March 2010 to July 2014.

The study was approved by the Research Ethics Committee of FMUSP, process n° 057/11, and by all parents/guardians that signed the Free and Informed Consent Form (consent form).

The study involved 238 children and their parents and/or guardians, who searched for speech and language therapy at the referred school-clinic. The inclusion criteria were age group up to five years old and with established diagnostic hypothesis in the areas of hearing, voice, speech, language, and myofunctional orofacial system. Children whose parents did not sign the consent form and/or whose medical records had incomplete information were excluded.

In the clinical care routine of the LIFAPS, where speech-language screening occurs, the parents/guardians of the children enrolled were asked to respond to the PIFRAL [7] form, individually by interviews with the speech-language therapist.

The diagnostic hypothesis was established through the evaluation of the language (phonology, fluency, pragmatic, and semantic), cognitive, hearing, communicative, voice, and orofacial myofunctional abilities.

The diagnostic hypotheses (DH) were categorized into: language disorder typical of the autism spectrum (LDAS); language disorder (acquisition and/or development of receptive and/or expressive language (LD); phonological disorder (PD); oral-motor disorders (OD); language disorder characteristic of neurological impairment or syndrome (LDNS), voice disorder (VD); fluency disorder (FD); and language impairment due to hearing loss (LIHL).

Descriptive statistics were used to analyze the sociodemographic profile and frequency of occurrence of risk factors and diagnostic hypothesis; the Student's t-test was used to analyze the relationship between risk factors and diagnostic hypotheses.

3. Results

3.1. Sociodemographic profile

The predominant age group of the participating children was between 2 and 5 years of age, of the male gender, of the race declared as white and of the socioeconomic level C. The informant was most often the mother (**Table 1**).

Most of the children participating in the study enrolled school (78.2%) and the majority of mothers (85.1%) and parents (73.1%) had completed high school (**Table 2**).

3.2. Factors related to family

Of the 238 children, 156 had siblings. In most cases, the participating child was the youngest son (**Table 3**).

Demographic information	Classification	N	%
Age group	0–12 months	01	0.4
	1–2 years old	13	5.5
	2–5 years old	*224*	***94.1***
Gender	Male	*171*	***71.8***
	Female	*67*	28.1
Race	White	*158*	***66.4***
	Yellow	03	1.3
	Brown	50	21.0
	Black	27	11.3
Degree of relatedness of the informant with the child	Mother	*213*	***89.5***
	Father	19	8.0
	Grandmother	05	2.1
	Aunt	01	0.4
Socioeconomic level (ABEP) [30]	A1	03	1.3
	A2	08	3.4
	B1	*18*	*7.6*
	B2	*52*	*21.8*
	C1	60	**25.2**
	C2	41	17.2
	D	47	19.7
	E	08	3.4

Table 1. Description of the 238 children who participated in the study.

Level of education	Classification	n	%
Mother	Until EMI (municipal elementary school)	40	16.8
	From EMC (middle and higher education)	194	**85.1**
	Was not able to inform	3	1.3
	Did not attend	1	0.4
Father	Until EMI	47	19.7
	From EMC	174	73.1
	Was not able to inform	16	6.7
	Did not attend	1	0.4

Table 2. Level of education of the 238 parents.

Position among siblings	Total n (%)
First born	26 (10.9)
Middle child	18 (7.6)
Youngest	112 **(47.1)**
Only child	80 (33.6)
Not informed	2 (0.8)
Total	228

Table 3. Distribution of the subjects according to the position among the children.

Only 4.2% of the children were twins; and the vast majority were Brazilian Portuguese speakers (98.7%). Parents spent between 4 and 8 hours per day with the children (**Table 4**).

3.3. Factors related to child's health

The categorization of the frequency of risk factors was performed according to the period of occurrence: pre-, peri-, or post-natal (**Table 5**). The occurrence percentages were lower than 40%, except for the presence of deleterious oral habits (51.3% of subjects).

In the pre-natal period, the predominant risk factor was the presence of family history (39.5%) and intercurrences during pregnancy (37.0%) (**Table 6**).

In the peri-natal period, the predominant risk factor was prematurity (18.1%) (**Table 7**).

In the post-natal period, the predominant risk factor was deleterious oral habits (51.3%). It is interesting to note that in 39% of the children there was only one risk factor (**Table 8**).

There was, therefore, a higher concentration of the occurrence of risk factors in the peri-natal period.

The temperaments affective (53.8%) and shy (19.7%) had the highest frequency (**Tables 9** and **10**). All types of temperament were explained to parents and they should choose only one, which best describes the child.

Hours/day	n	%
None	1	0.4
Less than 4h	33	13.9
From 4 to 8h	119	**50.0**
From 8 to 16h	85	35.7

Table 4. Descriptive distribution of the time parents spend with children.

Period	Risk factors	No		Yes		Was not able to inform	
		n	%	n	%	n	%
Pre-natal	Family history (language change)	142	59.7	94	39.5	2	0.8
	Use of drugs, medicines, alcohol, or tobacco during pregnancy	184	77.3	53	22.3	1	0.4
	Intercurrences	148	62.2	88	37.0	2	0.8
Peri-natal	Prematurity	191	80.2	43	18.1	4	1.7
	Low birthweight	112	47.1	20	8.4	106	44.5
	APGAR below 4 in the 1st min and below 6 in the 5th min	90	37.8	4	1.7	144	60.5
Post-natal	Hospitalizations	156	65.5	82	34.5	0	0
	Genetic syndrome	213	89.5	25	10.5	0	0
	Neurological or psychiatricpathology	197	82.8	41	17.2	0	0
	Chronic disease	201	84.5	37	15.5	0	0
	Exposure to some type of violence	201	84.5	37	15.5	0	0
	Oral habits	116	48.7	122	51.3	0	0

Table 5. Information on the risk factors in the pre-, peri-, and post-natal periods of the 238 children.

http://dx.doi.org/10.5772/intechopen.70107

Pre-natal factors	n	%
Name	77	32.4
Family history (language disorder)	94	**39.5**
Substance use	53	22.3
Complications	88	**37.0**
Background + substances	21	8.8
Background + intercurrences	35	14.7
Substances + intercurrences	31	13.0
All	13	5.5

Table 6. Distribution of the occurrence of pre-natal risk factors.

Peri-natal factors	n	%
None	188	79.0
Prematurity	43	**18.1**
Lowweight	20	8.4
APGAR	4	1.7
Prematurity + low weight	15	6.3
Prematurity + APGAR	2	0.8
Low weight + APGAR	1	0.4
All	1	0.4

Table 7. Distribution of the occurrence of peri-natal risk factors.

Post-natal factors	n	%
None	48	20.2
Hospitalizations	82	34.5
Genetic syndrome	25	10.5
Neurological or psychiatric pathology	41	17.2
Chronic disease	37	15.5
Exposure to some type of violence	37	15.5
Oral habits	122	**51.3**
Two factors associated	63	26.5
Three factors associated	19	8.0
Four factors associated	15	6.3

Table 8. Distribution of the occurrence of post-natal risk factors.

Temperament	N	%
Hard	31	13.0
Affective	128	53.8
Fearful	20	8.4
Agressive	25	10.5
Shy	47	19.7

Note: There was a significant statistical difference between the majority of DH and the male gender: more boys presented speech-language disorders than girls. There was no significance in the DH fluency disorder to hearing disorder (**Table 10**).

Table 9. Occurrence of subjects' each type of temperament.

	Gender		Student t-test
	Male	**Female**	**p value**
LDAS	16	3	<0.001*
LD	67	34	<0.001*
PD	43	10	<0.001*
OD	16	3	<0.001*
LDNS	4	9	0.006*
LIHL	2	0	0.02*
FD	3	2	0.21
VD	4	2	0.09
More than one DH	16	4	<0.001*
Total	171	77	<0.001*

*Significant values for the confidence interval of 5%.

Table 10. Association between the diagnostic phonoaudiological hypothesis and the gender.

3.4. Relationship between the diagnostic hypotheses and the study variables

In the association between DH and socioeconomic level, there was no statistical significance in four HD; however, there was a significant difference between the two groups of socioeconomic level: those who were at the lower levels had more speech-language disorders than those at the higher levels (**Table 11**).

In the group, there was a bigger occurrence of children with one or more siblings presenting speech-language disorders when compared to the "single child" category (**Table 12**).

For the comparative analysis between DH and number of risk factors, the 238 children were divided into 3 groups: a group with up to 3 risk factors, a group with 4–7 risk factors and a

	Socioeconomic level		Student t-test
	A or B	C, D, or E	p value
LDAS	10	9	0.17
LD	20	80	<0.001*
PD	21	31	0.003*
OD	10	9	0.17
LDNS	4	9	0.006*
LIHL	1	1	0.5
FD	3	2	0.21
VD	3	3	0.5
More than one DH	8	12	0.01*
Total	80	156	<0.001*

*Significant values for the confidence interval of 5%.

Table 11. Association between the diagnostic hypothesis and the socioeconomic level.

group with 8 and 9 risk factors. There were no children with more than 10 risk factors. The different DH were related to each other, in an association with a number of risk factors.

For up to three risk factors, the hypotheses that presented significant relation were: LDNS and PD, LDNS and LD, OD and PD, and OD and LDNS (**Table 13**).

	Number of siblings		Student t-test
	None	One or more	p value
LDAS	7	11	0.04*
LD	35	66	<0.001*
PD	16	37	<0.001*
OD	5	14	0.001
LDNS	6	7	0.17
LIHL	2	0	0.02*
FD	3	2	0.21
VD	1	5	0.008*
More than one DH	5	15	<0.001*
Total	80	157	<0.001*

*Significant values for the confidence interval of 5%.

Table 12. Association between the diagnostic hypothesis and the number of siblings.

Up to three risk factors							
	PD	**LCNS**	**FC**	**AADREL**	**AMOS**	**ALPA**	**AV**
LDAS	0.37	0.18	0.44	0.49	0.49	0.35	0.45
PD	–	**0.02***	0.44	0.12	**0.003***	0.23	0.49
LDNS		–	0.06	**0.02***	**0.02***	0.34	0.10
FD			–	0.43	0.42	0.19	0.46
LD				–	0.49	0.31	0.44
OD					–	0.29	0.43
LIHL						–	0.09
VD							–
*Significant values for the confidence interval of 5%.							

Table 13. Comparative analysis of the number of risk factors (up to three factors) according to the diagnostic hypothesis through the Student t-test.

In the group of children with four to seven risk factors, there was a significant association between: LDNS and LDAS, PD and LD, PD and OD, PD and LDNS, LDNS and OD (**Table 14**).

In the group of children with eight and nine risk factors, no significant relationships were observed between the different DH.

From four to seven risk factors							
	PD	**LDNS**	**FD**	**LD**	**OD**	**LIHL**	**VD**
LDAS	0.31	**0.04***	0.49	0.42	0.44	0.31	0.43
PD	–	**0.03***	0.40	**0.05***	**0.004***	0.22	0.37
LDNS		–	0.12	0.06	**0.04***	0.4	0.05
FD			–	0.43	0.45	0.32	0.5
LD				–	0.39	0.27	0.09
OD					–	0.28	0.25
LIHL						–	0.19
VD							–
*Significant values for the confidence interval of 5%.							

Table 14. Comparative analysis of the number of risk factors (four to seven factors) in relation to the diagnostic hypothesis through the Student t-test.

4. Discussion

4.1. Sociodemographic characterization

The sample analyzed for the current study had a 40% increase in participants compared to the pilot study [7]. The sociodemographic characterization presented some changes in relation to the sample of the mentioned study, but the risk factors for speech-language disorders related to the family, the child's health and the environment remained, reaffirming what are the risk factors that deserve attention of health professionals during child development. The characteristics that persisted in the current study in relation to the previous study [7] were age range, male gender prevalence, and shy and affective temperament. These data corroborate previous studies [8–13].

Boys are more likely to have speech and language difficulties compared to girls though scientists are undecided as to why. Research works are still being carried into the reasons for this distinction between the sexes. Boys are 2.6 times more likely to be identified with language disorders than girls, indicating the strong gender discrepancy found consistently in epidemiological studies [12].

One point that differed to the previous study was the socioeconomic level of the family members who sought speech and hearing care. The highest frequency of search was of individuals in class C2 (25.2%), followed by B2 (21.8%), and D (19.7%). The socioeconomic level is a factor that may increase the risk for speech-language disorders. There was a significant relationship between language disorders and social disadvantage. Children with high socioeconomic disadvantage were 2.30 times more likely to have language disorders than children with low levels of socioeconomic disadvantage [12]. Of the environmental factors, both parents' education and social class correlated positively with the child's language comprehension in a previous study [14]. Regression analyses showed that the mother's social status had predictive value on the child's language comprehension at 36 month of age. This result is in agreement with earlier reports [15, 16]. The father's educational level and social class was also correlated with the child's language comprehension; however, these factors did not reach predictive value at the population level [14].

The higher the family income, the better the phrasal structure elaborated by the child. Family income may also be associated with the quantity and quality of stimuli provided by the parents to the child [17]. It is now established that the quality of early parent-child relationships does have an influence on later child cognitive and language development [18]. More remains to be learned, however, about the mechanisms of this effect, the interplay between the parenting relationships and what aspects may be most amenable to intervention [19]. As well as mother-child, the importance of father-child relationships has become increasingly evident [20]. One study found that the child's lexical skills were higher when the father was at home at least part-time during the early developmental years [14]. Extant studies [21] have shown that fathers use more questions and require clarification when talking with their young children, which may partly explain the results. Furthermore, the authors found that the father's social status and working from home were predictive factors for children's lexical development. The results may emphasize the changing and less stereotyped role of the father as a supportive and active person in their children's development [14].

4.2. Frequency of occurrence of the risk factors studied

Regarding behavior, we highlight the greater occurrence of shy and affective temperaments. Research studies characterize affective temperament as being more conducive to development, although further studies are still necessary so that this correlation can be effectively considered;

and, the data suggest that the shyness may be a reflection of the speech-language disorder itself [22]. Studies have also indicated a link between positive temperament traits and vocabulary. For instance, children rated as high in positive affectivity had larger receptive vocabularies at 13 months of age than children who scored lower on this trait [23]. Similarly, high levels of affect—extraversion at 2 years of age—have been found to predict advanced language skills into middle childhood [24]. Other studies, however, have not found the same strong support for the link between temperament and language development. In a study of Swedish infants, for example, researchers found no relation between difficult temperament and vocabulary or shared book reading [25]. Furthermore, whereas some studies have indicated that traits like shyness may be related only to productive vocabulary, and so may be more related to performance than actual ability [26], others have found associations between temperament and receptive, but not expressive, vocabulary [27]. Thus, whether and how temperament in young children is related to their language abilities remain unclear. One reason for these mixed findings may be that other characteristics, such as cognitive ability, moderate role of temperament in language development [28].

There was a greater occurrence of youngest children, followed by single children. The effect of a child's birth order on emerging language seems to be still under debate. While birth order, laziness, and bilingualism are all commonly believed to lead to speech and language delay, their contributory role has never been proved [29]. Mothers report larger receptive and expressive vocabularies in their first-borns. However, standardized testing and direct observation showed that there was no difference in either receptive or expressive vocabulary between first-borns and second-borns [30]. One study found that first-born children reached the 50-word milestone earlier than later born children. However, they found that after children had reached this 50-word milestone, there were no differences in vocabulary production between the first- and later born children. The authors concluded that it seems that the effect of birth order is limited to the onset of language production [31]. Other hypotheses considered for these results are the division of attention that the parents need to do with the birth of the youngest son and his infantilization for a longer time comparing to the oldest [7–13]. We can observe the possible relation between the treatment of the parents with the youngest child and the only child.

In the peri-natal period, there was a higher occurrence of the prematurity risk factor and may impair aspects of neural plasticity, which interferes with development as a whole, including language [7].

In the pre-natal period, family history and drug use (licit or illicit) were the most prevalent risk factors. It is known that there is a correlation between the family history and the occurrence of speech-language disorders in the following generations [2]. As for drug use, there is interference in the development of the fetus, interfering in the development of language.

In the post-natal period, the most frequent risk factors were deleterious oral habits, corroborating previous studies [32, 33] and hospitalizations for extended periods of time. Regarding the hospitalization, it is important to emphasize that the emotional state of the child and all biological factors affected in this process for a long period are related to the development of language [34].

4.3. Diagnostic hypothesis and risk factors

The different diagnostic hypotheses (DH) were related to each other, in an association with a number of risk factors. The majority of the study population presented up to three risk factors, where the following relationships were observed: OD and PD, LDNS and OD, LDNS and PD, and LDNS and LD.

The children with LDNS presented statistically, in proportional values, a greater occurrence of risk factors than the others.

Associations between OD and PD may be linked to risk factors involving deleterious oral habits, repetitive otitis, respiratory disorder [35], besides eating disorders and family aspects [36].

When correlating LDNS and OD, it can be emphasized that in several syndromes described in the literature [37, 38], one of the alterations found is in the myofunctional orofacial system. Regarding the risk factors, both pathologies presented a high index of risk factors, although LDNS had a higher incidence of these factors in general. For LDNS, the predictive factors permeated the pre- and peri-natal, whereas for OD, the environmental risks, such as deleterious oral habits, stood out.

For the correlation between LDNS and PD, we can highlight the etiological factor preponderant in relation to the population with LDNS and the environmental factors and alterations in the phonoarticulatory organs in the population with PD, already described in this study [39, 40].

As for the relationship between LDNS and OD there is a distinction between biological and environmental risks, in the correlation between LDNS and LD this also occurs. It is possible to highlight the high occurrence of biological factors (especially pre- and peri-natal) for LDNS and environmental factors for LD (such as opportunities offered by the environment).

For the range of subjects with four to seven risk factors, the following relationships were observed: LDNS and LDAS (language disorder characteristic of the autism spectrum); PD and LD, PD and OD, PD and LDNS, and LDNS and OD, the last three being also present in the population with up to three risk factors.

When thinking about the relationship between LDAS and LDNS, the etiological aspects can be highlighted. The population with LDNS presented a higher number of risk factors compared to LDAS. Children with a diagnosis of LDNS were the ones with the highest pre- and peri-natal risk, which corroborates with etiological studies of several syndromes [39, 40]. On the other hand, the diagnostic hypothesis of LDAS does not have a defined etiology, which could explain the low occurrence of risk factors in these individuals [41].

The LD population had a higher number of risk factors than those with PD. Studies indicate that in what concerns the occurrence of LD, children depend on the opportunities offered by the environment, in addition to genetic inheritance, nutrition, and social aspects [35]. As for risks for the development of PD, there are recurrent otitis, respiratory alterations, alterations in auditory processing, as well as socioenvironmental aspects, besides family members [2].

For eight to nine risk factors, no statistically significant relationships were observed.

It has not yet been possible to identify how many risk factors are related to each diagnostic hypothesis, although it can be affirmed that they may be different for each diagnostic hypothesis.

It is of great importance that this instrument can be validated, in a comparative study with the application of the protocol in parents of typical development children, since it can be a facilitating factor to encourage in practice the expanded clinical concepts determined by the Unified Health System (SUS). Being a protocol of easy application, the PIFRAL can be a potentiator of the matrix support, which aims at the qualification of interdisciplinary actions with bigger appropriation of the knowledge of the several areas, in an interdisciplinary team [42].

5. Conclusion

The aspects being male gender, prematurity, shyness, being an only child or youngest child, presenting deleterious oral habits, having a family history of speech-language disorders, and use of licit or illicit drugs during pregnancy seem to be the factors that should draw the attention of the health professionals in child development. Therefore, the monitoring of children who have these risk factors should be performed in order to promote the necessary stimulation and the construction of healthy environments.

ANNEX A

Protocol of risk factors for language disorders

Number:

1. **Age:**
2. **Gender:**
3. **Race:**
4. **Speech-languagecomplaint:**
5. **Onset age of speech-language complaints:**
6. **Are there cases of family members with the same difficulty or other hearing or communicative alterations? Which?**
7. **Child'seducation:**
8. **Parent's education:**

9. **Parent's profession**
10. **Number of siblings and their ages**
11. **Order of birth:**
12. **Twinning:**
13. **Parents age:**
14. **Maternal age atbirth:**
15. **Native language and language spoken at home:**
16. **Time that parents spend with their children:**
17. **Child's temper:**
18. **Neighborhood:**
19. **Socioeconomic status:**
20. **Did the mother present pre-natal complications??**
21. **Did the mother use drugs, medication, alcohol, or tobacco during pregnancy?**
22. **Was the child born premature and/or underweight?**
23. **Was the Apgar score less than 4 in the first minute and less than 6 at 5 minutes in life?**
24. **Did the child have to be hospitalized?**
25. **What are the child's health conditions? Does he/she have any diagnosed diseases?**
26. **Has the child ever had an auditory test? Does he/she have difficulty hearing?**
27. **Does the child have difficulty feeding or facial motor problems?**
28. **Does the child has or has ever presented habits? For how long?**
29. **Has the child ever witnessed or experienced any type of violence? (assault, fights, disappearanceofrelatives, abuse, neglect, etc.)**

Author details

Daniela Regina Molini-Avejonas[1]*, Laís Vignati Ferreira[1] and Cibelle Albuquerque de La Higuera Amato[1,2]

*Address all correspondence to: danielamolini@usp.br

1 University of São Paulo, São Paulo, Brazil

2 Mackenzie Presbyterian University, São Paulo, Brazil

References

[1] Mendes VLF. Fonoaudiologia, Atenção Básica e Saúde da Família. In: Fernandes FDM, Mendes BCA, Navas ALPGP (org.). Tratado de Fonoaudiologia. São Paulo: Roca; 2010. pp. 612-618

[2] Pagliarin KC, Brancalioni AR, Keske-Soares M, Souza APR. Relação entre gravidade do desvio fonológico e fatores familiares. Revista CEFAC. 2011;**13**(3), 414-427

[3] Oliveira CMC, et al. Análise dos fatores de risco para gagueira em crianças disfluentes sem recorrência familial. Revista CEFAC. nov-dez 2012;**14**(6):1028-1035

[4] Descritores em Ciências da Saúde (DeCS). Biblioteca Virtual em Saúde http://decs.bvs.br/

[5] Santos RS, Araújo AP, Porto MA. Early diagnosis of abnormal development of preterm newborns: Assessment instruments. Journal of Pediatrics. 2008;**84**(4):289-299

[6] Bradley H, Corwyn RF. Socioeconomic status and child development. Annual Review of Psychology. 2002;**53**:371-399

[7] Silva GMD, Couto MIV, Molini-Avejonas DR. Identificação dos fatores de risco em crianças com alteração fonoaudiológica: estudo piloto. São Paulo. CoDAS. 2013;**25**(5):456-462

[8] de Goulart BNG, Chiari BM. Prevalência de desordens de fala em escolares e fatores associados. Revista de Saúde Pública, São Paulo. October 2007;**41**(5):726-731

[9] Tamanaha AC, et al. Investigando os distúrbios de aquisição de linguagem a partir das queixas. The Revista da Sociedade Brasileira de Fonoaudiologia, São Paulo. 2011;**23**(2):124-138

[10] Hage S SRV, Faiad LNV. Perfil de pacientes com alteração de linguagem atendidos na clínica de diagnóstico dos distúrbios da comunicação. – Universidade de São Paulo – Campus Bauru. Revista CEFAC. 2005;**7**(4):433-440

[11] Cho J, Holditch-Davis D, Miles MS. Effects of gender on the health and development of medically at risk infants. Association of Women's Health, Obstetric and Neonatal Nurses. 2010;**39**(5):536-49

[12] Lindsay G, Strand S. Children with language impairment: Prevalence, associated difficulties, and ethnic disproportionality in an English population. Frontiers in Education. 2016;**1**(2):1-14

[13] Chaimay B, Thinkhamrop B, Thinkhamrop J. Risk factors associated with language development problems in childhood—A literature review. Journal of the Medical Association of Thailand. July 2006;**89**(7):1080-1086

[14] Korpilahti P, Kaljonenb A, Jansson-Verkasalo E. Identification of biological and environmental risk factors for language delay: The Let's Talk STEPS study. Infant Behavior & Development. 2016;**42**:27-35

[15] Law J, Boyle J, Harris F, Harkness A, Nye C. Prevalence and natural history of primary speech and language delay: Findings from a systematic review of the literature. International Journal of Language & Communication Disorders. 2000;**35**:165-188

[16] Nelson HD, Nygren P, Walker M, Panoscha R. Screening for speech and language delay in preschool children: Systematic evidence review for the US preventive services task force. Pediatrics. 2006;**117**(2):298-322

[17] Lemos SMA, et al. A influência do ambiente familiar e escolar na aquisição e no desenvolvimento da linguagem: revisão de literatura. Revista CEFAC. Jul-Ago 2012;**14**(4):732-741

[18] NICHD Early Child Care Research Network. Child Care and Child Development: Results from the NICHD Study of Early Child Care and Youth Development. New York, NY, USA: Guilford Press; 2005

[19] Malmberg LE, Lewis S, West A, Murray E, Sylva K, Stein A. The influence of mothers' and fathers' sensitivity in the first year of life on children's cognitive outcomes at 18 and 36 months. Child: Care, Health and Development. 2015;**42**(1):1-7

[20] Pancsofar N, Vernon-Feagans L. Fathers' early contributions to children's language development in families from low-income rural communities. Early Childhood Research Quarterly. 2010;**25**:450-463

[21] Leech KA, Salo VC, Rowe KL, Cabrera NJ. Father input and child vocabulary development: The importance of Wh questions and clarification requests. Seminars in Speech and Language. 2013;**34**:249-259

[22] Klein VC, Linhares MBM. Temperamento e desenvolvimento da criança: revisão sistemática da literatura. PsicolEstud. 2010;**15**(4):821-829

[23] Dixon W, Smith PH. Links between early temperament and language acquisition. Merrill-Palmer Quarterly. 2000;**46**:417-440

[24] Slomkowski C, Nelson K, Dunn J, Plomin R. Temperament and language: Relations from toddlerhood to middle childhood. Developmental Psychology. 1992;**28**:1090-1095

[25] Westerlund M, Lagerberg D. Expressive vocabulary in 18-month-old children in relation to demographic factors, mother and child characteristics, communication style, and shared reading. Child: Care, Health and Development. 2008;**34**:257-266

[26] Smith Watts A, Patel D, Corley R, Friedman N, Hewitt J, Robinson J, et al. Testing alternative hypotheses regarding the association between behavioral inhibition and language development in toddlerhood. Child Development. 2014;**85**:1569-1585

[27] Noel M, Peterson C, Jesso B. The relationship of parenting stress and child temperament to language development among economically disadvantaged preschoolers. Journal of Child Language. 2008;**35**:823-843

[28] Canfield CF, Saudino KJ. The influence of infant characteristics and attention to social cues on early vocabular. Journal of Experimental Child Psychology. 2016;**150**:112-129

[29] Berkowitz C. Pediatrics: A Primary Care Approach. Elsevier Health Sciences; 2000

[30] Bornstein M, Leach D, Haynes OM. Vocabulary competence in first- and second born siblings of the same chronological age. Journal of Child Language. 2004;**31**:855-873

[31] Berglund E, Eriksson M, Westerlund M. Communicative skills in relation to gender, birth order, childcare and socioeconomic status in 18-month-old children. Scandinavian Journal of Psychology. 2005;**46**(6):485-491

[32] Gonella S, et al. Prevalência de Hábitos Bucais Deletérios em escolares da rede Estadual Boa Vista – RR. Arquivo Brasileiro de Odontologia. 2012;**8**(2):1-7

[33] Valdinês GS, et al. Hábitos orais de sucção: estudo piloto em população de baixa renda. Revista Brasileira de Otorrinolaringologia. jan./fev. 2003;**69**(1):106-110

[34] Harrison LJ, McLeod S. Risk and protective factors associated with speech and language impairment in a nationally representative sample of 4- to 5-year-old children. Journal of Speech, Language, and Hearing Research, Australia. April 2010;**53**:508-529

[35] Mendes JCP, et al. Fatores associados a alteração da linguagem em crianças pré-escolares. The Revista da Sociedade Brasileira de Fonoaudiologia. 2012;**17**(2):177-181

[36] Ferrioli BHVM. Associação entre as alterações de alimentação infantil e distúrbios de fala e linguagem. Revista CEFAC, São Paulo. 2010;**12**(6):990-997

[37] Carneiro MMS, Gomes ICD. O perfil morfo-funcional oral de crianças portadoras da síndrome de moebiüs. Revista CEFAC, São Paulo. jan-mar, 2005;**7**(1):68-74

[38] Busanello AR. Síndrome de goldenhar: uma abordagem fonoaudiológica. Revista CEFAC. Mai-Jun 2012;**14**(3):566-573

[39] Silva RCL, et al. As alterações fonoaudiológicas na síndrome de Goldenhar – Relato de caso. The Revista da Sociedade Brasileira de Fonoaudiologia. 2008;**13**(3):290-295

[40] Zago MK. Variáveis maternas e paternas nas síndromes cromossômicas encontradas na base de dados do Estudio Colaborativo Latino Americano de Malformaciones Congénitas. Revista da AMRIGS, Porto Alegre. out.-dez. 2011;**55**(4):345-349

[41] Variações genéticas estruturais numa população de indivíduos com perturbações do espectro do autismo (PEA): caracterização genômica, heritabilidade e correlações clínicas. Instituto Nacional de Saúde. Boletim Epidemiológico. 2013;**4**:10-13

[42] Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Núcleo Técnico da política de Humanização. Clínica Ampliada, equipe de referência e projeto terapêutico singular. Ministério da Saúde. Secretaria de Atenção à Saúde. Núcleo Técnico da política de Humanização 2ª ed. Brasília: Ministério da Saúde; 2008

Chapter 16

Evidence for Speech Sound Disorder (SSD) Assessment

Haydée Fiszbein Wertzner, Danira T. Francisco,
Tatiane F. Barrozo and Luciana O. Pagan-Neves

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.70036

Abstract

Comprehensive studies on aspects related to the assessment of different biomedical parameters (acoustic and laryngeal signs and oral airflow amplitude), as well as parameters for speech disorders, articulation rate, speech inconsistency, and speech stimulability, are essential for better professional practice and to understand misarticulations in children with speech sound disorders (SSDs). Different equipments that enable noninvasive collection and analysis of data have become more common in speech-language pathology practice. Studies recently conducted by our research group have emphasized the evaluation of auditory-perceptual processing by means of assessments of central auditory processing, electrophysiology of hearing—considering that pure-tone, speech audiometry, and tympanometry are routinely used with children during the diagnostic phase and motor speech production performed by acoustic analysis of speech, electroglottography, aerodynamic measures, and ultrasound tongue imaging. This chapter presents the recent advances observed in studies with Brazilian-Portuguese speakers aiming to improve the assessment of speech sound disorders and to understand better the relationship between the different processing mechanisms involved in speech.

Keywords: speech sound disorder, ultrasound tongue imaging, auditory perception, speech, assessment

1. Introduction

Many studies demonstrating the need for speech-language pathologists to refine the assessment of speech sound disorders (SSDs) in children have been published. In this sense, the speech-language pathologists need to be able to specify more precisely the type of difficulty the child has. The search for more precise diagnoses that allow greater characterization of the clinical manifestations of children with SSD is constant, arising from the need to work according to the evidence-based practice. This practice emerged at the beginning of this century and refers to the combined use of different evidence to make the correct clinical decisions for a given individual [1]. The need to use clinical evidence to carry out a differential diagnosis, associated with the knowledge of speech-language therapists, appeared from the demand for more accurate diagnoses for the treatment of different human communication disorders. Recent studies in the area of speech and language disorders highlight the heterogeneity of SSD cases in terms of their manifestation, severity, and intelligibility [2–8].

SSD is defined in the diagnostic and statistical manual of mental disorders (DSM-5) [9] and ICD-10 [10] as difficulty in using age-appropriate speech sounds for an individual dialect and is the most prevalent speech and language disorder in children [11–13]. It is already known that children with SSD may present speech impairment caused by difficulty with auditory input (auditory processing of information) and/or cognitive-linguistic processing and/or motor speech processing. The interrelationship between these aspects [14–19] is the reason why studying them is of fundamental importance to better comprehend this disorder.

The greater the therapists' knowledge about instruments that can be used to describe better SSD cases, the more accurate their clinical decisions. Therefore, comprehensive studies into aspects related to evaluating different biomedical parameters (acoustic and laryngeal symptoms and signs of oral airflow amplitude), as well as of parameters of speech disorders, articulation rate, speech inconsistency and speech stimulability, are essential to better understand the changes in children with speech disorders.

In general, the diagnosis of SSD is performed by applying language and speech tests, such as spontaneous speech, picture naming, and imitation of words and sentences. These are submitted to phonological analysis to identify changes according to child age [20]. There is no requirement for specific equipment for the application of these language and speech assessments, except for the test procedures. Additionally, a camera for filming and a good quality microphone/recorder are usually used to record data collection and ensure that they can be reanalyzed as many times as necessary.

In the following studies that are going to be presented, phonological evaluations for the diagnosis of SSD were carried out based on the Phonology Test [21] from ABFW—Infantile Language Test [22], which was developed and standardized for native speakers of Brazilian-Portuguese [23]. This test includes a picture naming task composed of 34 pictures of objects with 90 consonants, and a word imitation task composed of 39 words with 107 consonants. The test allows the evaluation of the phonetic inventory and phonological processes and the results can be analyzed according to age (for children aged 4–7 years) for both the occurrence of phonological processes (**Table 1**) and sounds in the phonetic inventory [21, 23].

The application of complementary tests to verify biomedical parameters has been an increasingly used resource in speech-language pathology research and clinical practice. The aim of these tests is to refine SSD diagnoses, giving the speech-language pathologist a better understanding of the specific impairments presented by a particular individual, given that SSD is a heterogeneous disorder both in terms of its cause and its manifestation. The complementary tests most frequently used in our recent research include cognitive-linguistic, auditory-perceptual, and

Phonological processes	Example in BP		Elimination of phonological processes
	Target	Production	(in years; months)
Syllabic reduction	/ˊgato/	[ˊga]	2; 6
Consonantal harmony	/saˊpato/	[paˊpatʊ]	2; 6
Stopping	/ˊsala/	[ˊtal]	2; 6
Velar backing	/ˊt_la/	[ˊk_la]	3; 6
Palatal backing	/ˊsaco/	[ˊ⊲akʊ]	4; 6
Velar fronting	/ˊk la/	[ˊt l]	3; 0
Palatal fronting	/ˊ⊲eƱo/	[ˊseƱʊ]	4; 6
Liquid simplification	/ˊbala/	[ˊbaƱ]	3; 6
	/ˊkara/	[ˊkala]	
	/ˊpa a/	[ˊpaƱ]	
Cluster reduction	/ˊpreto/	[ˊpetʊ]	7; 0
	/ˊbluza/	[ˊbuz]	
Final consonant deletion	/ˊpta/	[ˊp Ʊt]	7; 0
	/ˊpasta/	[ˊpat]	

BP, Brazilian-Portuguese.

Table 1. Phonological processes used in Brazilian-Portuguese, age of normalization of processes, and examples.

speech production assessments. This chapter highlights the evaluation of auditory-perceptual processing by means of assessments of central auditory processing (CAP), electrophysiology of hearing—given that pure-tone, speech audiometry, and tympanometry are routinely used with children during the diagnostic phase. It also considers speech production, investigated using speech acoustics, electroglottography (EGG), aerodynamic measures, and ultrasound tongue imaging.

1.1. Auditory perception

The auditory perception of speech allows children, through an active process, to organize their internal representations of the language to which they are exposed in order to produce the sounds of this language.

Speech perception can be defined as the process of continuous transformation of an acoustic signal into discrete linguistic units, which occurs through a multistage process permitting the extraction of acoustic information that relies on auditory processing mechanisms. Subsequently, the acoustic representation is transformed into phonetic units, and then a hierarchically organized phonological representation of phones is constructed [24]. Studies into auditory perception of speech have as their central theme the auditory comprehension of speech, but they also describe the organization of sublexical tasks, such as syllable discrimination [25].

Younger children present a need for a larger number of acoustic signals to understand the contrasts between speech sounds. The production performance of motor sequences increases and the variability in production decreases with child development. This regulation of movement and the learning of motor skills occur in a close and continuous connection between action and perception, and this connection is responsible for the development of the auditory and kinesthetic monitoring of articulatory gestures. Auditory perception as a function of language exposure selects some sound categories to be preserved, whereas others are neglected.

Difficulties in auditory perception may occur as a result of hearing loss, a change in central auditory processing or immaturity of the auditory system to process sounds properly. During their development, children gradually acquire the auditory-perceptual and speech sound production domains, as well as an understanding of the linguistic rules that govern their use in a particular language. Assessment of the auditory perception of children with SSD is of great importance insofar as problems in this area are seen by several authors as one of the possible causes of the disorder [19, 26–30]. In these cases, in addition to the standard set of audiological tests, it is possible to perform electrophysiological exams to evaluate the functional and structural integrity of the auditory pathway and the central and peripheral auditory systems [31–34]. Additional testing can also assess central auditory processing via auditory closure, figure-background, temporal ordering, and interhemispheric transfer capacities. It is worth mentioning that electrophysiological tests can be conducted at any age, but the standardization of expected responses is only possible in children aged 2 years and older, whereas evaluation of the CAP can be conducted only in children older than 7 years owing to the maturation of auditory structures, which is completed approximately at this age.

1.2. Speech production

The development of motor speech control is influenced not only by biological factors, but also by intrinsic (cognitive-linguistic and sensorimotor maturation) and extrinsic (auditory and visual stimulation and perception) forces [35]. Recent studies suggest that when children begin to produce their first words, the coordination of the muscular movements involved in speech is distinct from that presented in sucking and chewing [36].

To achieve the adult standard, vocal tract growth occurs not only in geometric proportion, but also in terms of anatomical restructuring, which refers to the physical changes that occur in the vocal tract structures throughout development [37]. It is worth emphasizing that motor speech control does not occur uniformly, that is, some articulators develop toward the adult pattern before others [38]. Studies indicate that control of the mandible occurs before that of the tongue and lips, perhaps because the mandible presents only vertical movements (lower degree of freedom) as opposed to the tongue and lips, which move more complexly (higher degree of freedom) [35, 37].

With respect to velocity of articulatory movements, a study [39] indicated an increase in the velocity of the mandible and lower lip between 9 and 21 months of age, indicating that both the growth and speed of the articulators present a very early increase toward the adult standard. The specific scientific literature also shows that motor speech skills begin to be refined from the age of 8, continuing up to the age of 16 [40]. Therefore, children at the beginning of speech production do not present sufficient neuromuscular control to produce sounds and, consequently, need to adopt strategies to approach the adult speech model [37]. Articulation rate is an interesting measure to assess the pace at which speech segments are produced. Because this measure can be easily obtained (it only requires a stopwatch to mark the time in which a given sentence is produced) and rapidly calculated (division of the number of produced phones by the time), it can be widely used in speech-language pathology practice.

In addition to the articulation rate, speech-language therapists have been using measures that are more objective over the years. To this end, instruments that produce more accurate results, such as acoustic speech analysis, EGG, aerodynamic measures, and ultrasound tongue imaging, have been increasingly used. Through the visualization of a spectrogram, speech acoustics allows verification of the acoustic properties of sounds that cannot be detected auditorily. In the case of children with SSD, this helps with the characterization of the phonological substitutions and mainly with a better understanding of the distortions usually present in the production of anterior sounds.

EGG allows the verification of vocal fold functioning by placing two electrodes on the thyroid cartilage and using specific software that indicates the opening and closing of the vocal folds. Aerodynamic measures also contribute in the verification of the control mechanism of vocal fold vibration, allowing the observation of intraoral airflow pressure. This occurs because the control of voiced sounds requires, among other conditions, appropriate glottal opening and sufficient airflow through the glottis to support vibration, and increased intraoral airflow pressure decreases the pressure ratio through the glottis, reducing vocal fold vibration (a condition for the occurrence of voicing) [41]. Both EGG and aerodynamic measures show quite interesting outcomes for children with SSD who present the phonological process of devoicing of fricatives and plosives, which is very common in Brazilian-Portuguese (BP) [42, 43]. Ultrasound tongue imaging (UTI) is a tool used in articulatory analysis because it allows real time visualization of tongue movement, allowing speech-language therapists to visualize how the lingual sounds are produced, mainly in cases of substitutions of anterior sounds by posterior sounds (or vice versa) [44–48], as well as in cases of distortions [49, 50]. Thinking of ways to address these interrelationships in children with SSD, our research group has conducted different studies seeking to equip speech-language therapists with innovative knowledge regarding the evaluation and treatment of this pathology. Therefore, the purpose of this survey is to present the recent advances observed in studies conducted with speakers of Brazilian-Portuguese aiming to improve the assessment of speech sound disorders and to better understand the relationship between the different processing mechanisms involved in speech.

2. Relationship between auditory and cognitive-linguistic processing

Speech perception is an important stage in the development of speech sounds in children [15, 25, 51, 52], and its role is described as a mediator for learning sound production. With this in mind and because of the difficulties observed in children with SSD, several studies have been conducted to investigate the central auditory processing (CAP) [18, 53] and electrophysiological responses obtained through auditory-evoked potentials in Brazilian-Portuguese speaking children with SSD. These studies seek to identify the auditory-perceptual characteristics of children with this speech disorder as well as the evidence of altered auditory processing and the lack of maturity-integrity of auditory pathways that could compromise auditory feedback, which is extremely important for phonological development.

For the identification of such characteristics, the application of tests involving these three processing mechanisms (auditory-perceptual, cognitive-linguistic, and motor speech) is important for the identification of major impairments and consequent selection of the treatment to be applied to the individual being assessed. The evaluation of CAP provides significant contributions to the diagnostics of SSD, as it helps with the identification of the speech impairments presented by children with this disorder. A CAP disorder could affect the ability to discriminate speech sounds and result in altered and/or less stable neural representations of these sounds, which may interfere with speech perception and production [54]. The CAP evaluation considers the interaction of the auditory information associated with the acquisition and organization of the phonological rules in this population, and it is important to guide speech-language pathology intervention. This contribution comes about because the central auditory processing disorder (CAP disorder)—defined as a difficulty with sound information processing—may result in language and learning disorders [55], as it interferes with the formation of a stable representation of phonemes in the brain and with speech perception, hindering the learning of phonology, syntax, and semantics [56].

There are few studies in the literature correlating SSD with CAP for either English or Brazilian-Portuguese. This can be explained by the fact that the diagnosis of SSD is most frequently performed between the ages of 5 and 7 and the application of CAP is conducted only after 7 years of age because of the maturation of the auditory structures involved, which is expected to be almost complete by this age.

A recent study [18] addressed the analysis of phonological and CAP measures in children with SSD. The study sample was composed of 21 individuals with SSD aged 7:0–9:11 years divided into 2 groups: participants with SSD and participants without CAP disorder. The assessment comprised tests of phonology, speech inconsistency, metalinguistic and motor speech abilities. The abilities assessed in the central auditory processing and the following behavioral phenomena are in **Table 2**.

CAP abilities	Behavioral phenomena
Auditory closure	Acoustic signal recognition when parts of it are omitted
Figure-background	Identifying the speech signal in the presence of other competitive sounds
Temporal ordering and interhemispheric transfer	Recognition of acoustic characteristics of the signal

Table 2. Abilities and behavioral phenomena assessed in the CAP.

The results indicated that children with SSD and CAP disorder showed higher occurrence of the phonological process of consonant cluster reduction and greater difficulty in phonological awareness abilities: rhyme and alliteration. In addition, the group without CAP disorder presented lower values of percentage of consonants correct-revised (PCC-R) and higher values of process density index (PDI), and consequently greater severity of SSD (**Figure 1**).

A cutoff value was established for the PDI [57], indicating that children with an index value >0.54 showed a strong tendency toward presenting a CAP disorder (sensitivity of 0.73 and specificity of 0.90). This measure effectively indicated the need for CAP evaluation in children with SSD aged 7 years and older.

In addition, the authors verified in 2016 that the greater the severity of SSD and the greater the impairment with metaphonological skills of rhyme and alliteration, the larger the number of absent sounds in the child's phonetic inventory, and the larger the number of altered skills found in the CAP exam. Therefore, this reinforces the existing interaction between the three processing mechanisms.

Another recent study [53] was conducted to identify a cutoff value based on the PCC-R [58] metric that could indicate the likelihood of a child with SSD also having a CAPD. Language, audiological, and CAP evaluations were administered. Participants were 27 individuals with

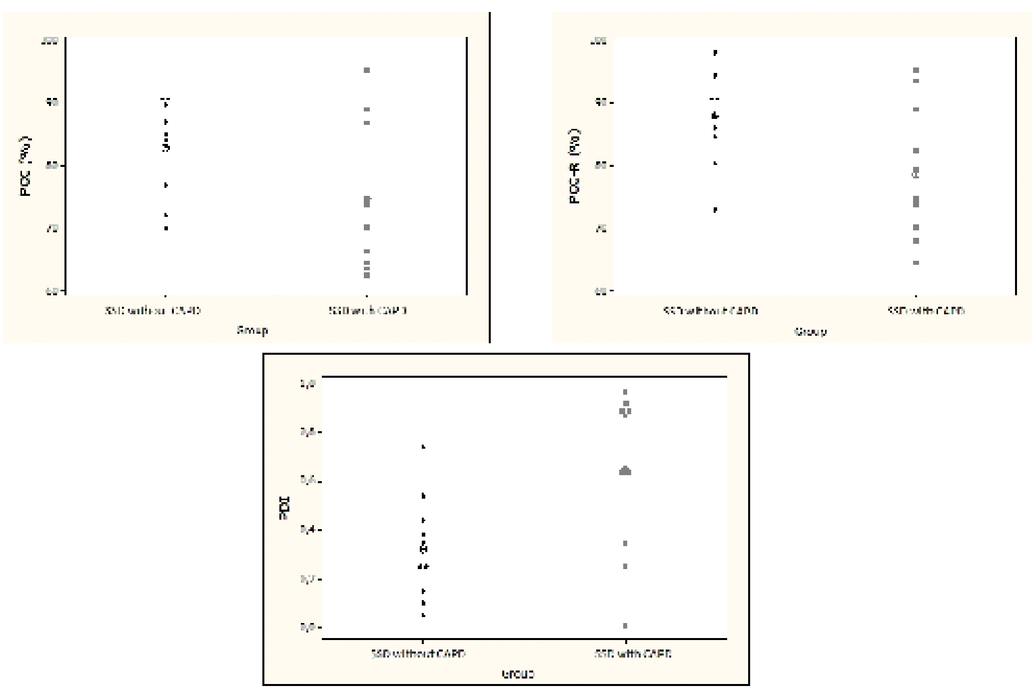


Figure 1. Values of percentage of consonants correct-revised (PCC-R), percentage of consonants correct (PCC), and process density index (PDI) in both group.

SSD aged 7–10:11 years divided into 2 groups according to their CAP evaluation. Three different auditory skills were assessed using the Brazilian versions of four CAP tests [59]. Auditory closure was assessed using the figure identification (with competitive ipsilateral noise) test; binaural integration was evaluated using the dichotic digits test; and temporal ordering was tested using both the pitch pattern sequence test and the duration pattern sequence test. The results indicated that SSD severity varied according to the number of impaired auditory skills. Greater severity of speech disorders in children was associated with a greater probability of presenting a CAP disorder. The cutoff values of 83.4% for the picture naming task (N) and 84.5% for the imitation of words task (I) successfully distinguished children with CAP disorder from those without.

In addition to the conventional audiological assessment composed of tonal audiometry, vocal audiometry, tympanometry measures, and central auditory processing exam, the central and peripheral auditory systems can be evaluated by auditory-evoked potentials (AEPs). As it is possible to assess the AEPs from the age of 2, these tests can be performed at the time of the SSD diagnosis, providing important information for the implementation of treatment in each case. The studies developed for Brazilian-Portuguese relating children with SSD and AEPs have applied both short latency potentials, using the click and speech stimuli, and long-latency potentials, with speech and tone burst stimuli.

The study of the short- and long-latency AEPs in two boys with SSD, speakers of Brazilian-Portuguese, aged 76 and 83 months [18]. The study characterized both the severity of SSD and the auditory responses. SSD severity was described by the PCC-R index calculated based on a specific test for Brazilian [21]. As for the brainstem auditory-evoked potential (BAEP), the click and speech stimuli were used, as well as the long-latency auditory-evoked potential (LLAEP) with speech and tone burst stimuli for analysis of the latency values of components P1, N1, P2, N2, and P300. The results showed PCC-R values of 84% for the younger individual and 71% for the older individual. As for the long-latency potentials with speech stimuli, the results showed alteration in the components N1, P1, N2, and P2 in both individuals, suggesting a delay in the latency of these components. This delay implies a decrease in the velocity of auditory processing of acoustic information in the cortical and subcortical regions. This change can hinder discrimination, integration, and auditory attention to verbal stimuli. In the P300 component, the individual with more severe SSD presented impaired results, suggesting that SSD severity is associated with the P300 cognitive potential.

Other research [60] investigated whether neurophysiologic responses (auditory-evoked potentials) differ between typically developing children and children with SSD, and whether these responses were modified in children with SSD after speech-language pathology intervention. Participants were 24 typically developing children and 23 children with SSD, aged 8–11 years. Of the 23 children with SSD, 12 were undergoing speech-language therapy and 11 were not. These children were re-evaluated after 12 weeks. All participants presented normal hearing thresholds and were submitted to the following procedures: conventional audiological, brainstem auditory-evoked response, auditory middle-latency response, and P300 assessments. Results of the electrophysiological responses indicated different latency between children with typical development and with SSD on both the BAEP and P300 tests. P300 responses improved in the children submitted to speech-language pathology intervention. The authors concluded that the children with SSD presented impaired BAEPs and cortical region pathways that could benefit from intervention.

Aiming to compare the neurophysiological brainstem responses for clicks and repeated speech stimuli of children with and without SSD aged 7–11 years, a group of researchers [61] observed that the early stages of the auditory processing pathway of acoustic stimuli were not similar in children with typical development and those with SSD. This finding suggests that alteration in the coding of speech sounds may be a biological marker of SSD without defining the biological origins of phonological problems (**Table 3**).

	Click evoked—ABR						**Speech evoked—ABR**			
	Wave I	**Wave III**	**Wave V**	**I–III interpeak**	**III–V interpeak**	**I–V interpeak**	**Wave V**	**Wave A**	**Wave C**	**Wave F**
Children without SSD	1.43	3.53	5.41	2.10	1.92	4.02	7.41	9.39	19.42	40.10
Children with SSD	1.50	3.64	5.54	2.14	1.91	4.04	8.58	10.32	18.76	40.00
p-Value	**0.01***	**0.01***	**0.02***	0.43	0.70	0.25	**<0.001***	**0.0003***	0.95	0.58

ABR, auditory brainstem responses; SSD, speech sound disorders.
*statistically significant values (significance level adopted: 0.05).

Table 3. Middle-latency values for both groups in the ABR with click and speech stimuli.

3. Relationship between motor speech and cognitive-linguistic processing

The factors that positively affect child speech production throughout the developmental phase are associated with biological factors and/or learning abilities. Biological factors (modified with age) include anatomical growth and neurological and neuromuscular maturity. Learning skills (acquired with speech and language development) include motor learning (motor planning and motor programming of speech movements) and cognitive-linguistic (semantic, lexical, and phonological access) processing. For a better understanding of SSDs, many studies [62–65] have attempted to define linguistic markers by using specific instruments, such as articulation rate (AR), acoustic analysis of speech (AA), aerodynamic measures, and ultrasound tongue imaging (UTI) that could contribute diverse objective evidence.

3.1. Articulation rate

Despite the fact that AR reflects the maturity of the motor speech system, it is not an isolated motor measure. AR incorporates aspects related to the cognitive-linguistic processing of information [39, 66], including an increased load in phonological and syntactic processing beginning at the age of 5 years [67].

Demands on oral language processing vary according to different speech tasks and depend on factors, such as attention, familiar sentence (word frequency and phonotactic probability), and size and syntactic complexity of the sentence. Previous studies have shown that children speak faster in simple speech tasks (such as repetition of syllables) than in tasks involving higher demand (such as spontaneous speech) [68]. Nip [69] noted that the velocity of articulatory movements was faster for speech tasks of low demand and slower for highly demanding ones.

Other studies have shown that children produce long sentences with higher AR in comparison with short sentences [70–72]. This phenomenon may be associated with AR control strategies, such as reducing effort to increase coarticulation, thus generating an increase in the number of phones per second produced during speech. These motor adjustments also seem to be associated with motor speech control maturity, considering that AR is only greater in longer sentences than in shorter ones for adults, but not for younger individuals [67].

The use of inappropriate AR may also hinder the articulation of sounds and reduce speech intelligibility in children with SSD, resulting in disfluency, articulatory problems, and/or language disorders, indicating difficulties in the formulation of language and/or in the recovery of words [69, 73, 74].

Studies with English [71, 73, 75] and Brazilian-Portuguese speakers [72] that analyzed AR in children with SSD indicated that these children present decreased AR compared with that of their typically developing peers. Decreased AR in children with SSD can occur due to motor speech control immaturity and/or may be caused by some form of compensation provided by these children, such as the occurrence of articulatory adjustments for certain problematic sounds in an attempt to improve speech intelligibility [73]. These studies also found no difference between boys and girls for the AR analysis.

The investigation of how linguistic complexity variables are related to age and phonological measures can provide important insights to understand the influence of biological and cognitive-linguistic factors on the development of speech production velocity, such as those measured by AR.

A recent study [76] aimed to quantify the articulation rate expected between typically developing children and those with SSD to determine whether this measure could be used as a marker to complete SSD diagnosis. The study sample was composed of 157 children, aged 60–119 months, distributed in two groups: a group of 70 participants with typical development (TDG) and a group of 87 participants diagnosed with SSD (SSDG). A phonology test developed for native speakers of Brazilian-Portuguese [21] was applied to verify phonological processes and calculate the PCC-R. AR was measured in a short sentence (ARSS) with 12 phones "The dog ran away"—[ˈu kaˈʃoxu fuˈʒiʷ] and in a long sentence (ARLS) with 22 phones: "Maria has a red ball"—[a maˈɾia ˈt̃e ˈuma ˈbɔla veɾˈmeʎa]. The long and short sentences were repeated three times each, with a total of 942 analyzed repetitions. Productions containing obvious disfluencies or intraphrase pauses (>250 ms) were also excluded. AR analysis was performed using the Praat 5.1 software.

http://dx.doi.org/10.5772/intechopen.70036

The results showed that AR values for children with SSD were lower than those for typically developing children [72, 73] and that the number of phones per second increased according to age in both groups. AR values can be used to distinguish children with SSD from those without, as well as to indicate increased difficulty in speech production in children with SSD [73]. There was a evidence that children with SSD who had PCC-R <65% performed differently to those with PCC-R ≥65% in the AR. Correlation was found between age and AR measured in the short and long sentences (biological factor) in the SSDG [67, 69, 75, 77, 78], but severity was only associated with the long sentence (learning factor) [68–70], demonstrating that the more severe the speech disorder, the lower the PCC-R value, and the slower the production of complex sentences.

AR measurement is important in two contexts in clinical practice. Firstly, it evaluates the speech of a child and verifies if the motor speech and cognitive-linguistic processing mechanisms are those expected for child development and appropriate age range. Second, it can be used as a measure of therapeutic monitoring of children with SSD [67]. Moreover, the study reported that the AR measure can be used to indicate whether modifications caused by speech-language therapy are the result of the intervention strategies selected or only a result of changes already expected during the normal maturation process of children [79, 80].

3.2. Acoustic analysis of speech

Acoustic analysis (AA) reflects the acoustic and articulatory characteristics of speech, thus contributing to a better characterization of the functioning of the motor speech system. In addition to the formant frequencies (with F_1, F_2, and F_3 as the most frequently used in speech analysis), AA allows measurements of speech segment duration, steady-state portion from the target sound, tone burst, silence interval, friction, noise, voice onset time (VOT) of formant transition in word production, and slope analysis [81, 82]. The presence of phonetic and acoustic distinctions provides evidence that children have more knowledge about the sound system than one might imagine based on descriptive phonological analysis alone [82, 83].

Pagan-Neves [81] described the acoustic characteristics of the liquid sounds /l/ and /P/ produced by 20 children with and without SSD. Speech production of the words /se'bola/-onion, /'lãma/-mud, /ʒaka´∡ɛ/-alligator, and /ʒi'∡afa/-giraffe were acoustically analyzed according to the following parameters: F1, F2, and F3, duration and steady-state portion from the target sound, and slope analysis. The results indicated that duration of the sound /l/ was an important measure to differentiate children with SSD from those without SSD. Duration of the sound /∡/ was longer for the children with SSD, who always substituted the target sound /∡/ for the sound /l/, in comparison with the group of children without SSD, who correctly produced the sound /∡/. Slope analysis demonstrated higher values for the children without SSD for the two target sounds /l/ and /∡/, indicating that the articulation velocity from the target sound to the following vowel for the children with SSD is slower for both the sound /l/ correctly produced by these children and for the sound /∡/, which was substituted for the sound /l/. An example of the duration of the transition measurement (between the two thick blak lines) is observed in **Figure 2**.

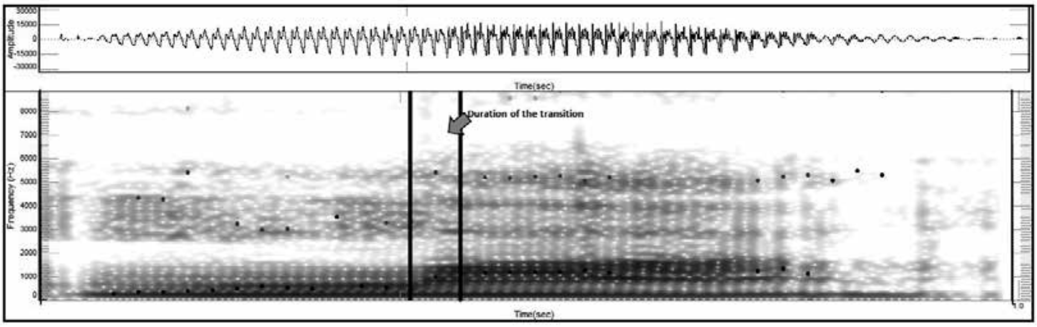


Figure 2. Example of the duration of the transition measurement during the production of the syllable [ʎ].

Results demonstrated that the longer the duration for the production of the target sound, the slower the slope measure. Even though children with SSD used the duration to differentiate the production of the sound /l/ from the same sound produced in substitution for the sound /P/ in the children without SSD, their speech presents slower speeds for transition between sounds, which may interfere with the listener's auditory perception. This study verified that the articulation accuracy of children without SSD was greater even when considering the sound /l/, which was correctly produced by the children with SSD, reinforcing the oral motor difficulties presented by the latter.

3.3. Aerodynamic measures

With the objective of verifying the production and maintenance of voicing of fricatives in Brazilian-Portuguese (BP) speaking children, a group of researchers [43] described the oral airflow characteristics of six BP speaking children aged 82 and 89 months for the voiced fricatives /v, z, Z/, for weak voicing. Comparison between the reference values of the voiced fricatives produced by adult speakers of European Portuguese and the production of BP speaking children showed greater occurrence of weak voicing. This measure is a classification of the voicing category of fricatives, which determines that when there is more than 70% relative reduction in the amplitude of oral airflow oscillations between the fricative and the surrounding vowels, the fricative is classified as having weak voicing. However, children seem to have acquired the phonological rules pertaining to voicing and employ them effectively.

Another study [42] described the properties of the fricative sound /v/ using the aerodynamic measure of weak voicing in 15 children with SSD, also speakers of PB, aged 60–95 months. Of these 15 children, 8 presented devoicing in more than 25% of their productions and 7 did not present devoicing of the fricative [v]. The results showed similarities in the strategies used for the production and maintenance of the voiced fricative sound /v/ in both groups investigated.

In a study [84] that analyzed the speech of 47 children aged 60 and 95 months, 22 with SSD and 27 without, the author recorded aerodynamic and EGG measures for the sounds /v, z, ʒ /.

Overall, the results showed that the children in the age range studied do not make full use of the strategies for the production and maintenance of voicing of fricatives reported for adults. This fact was verified in the group of children without SSD, in which the participants presented no significant difference between the sounds for the aerodynamic and EGG measures. The same was observed for the comparisons between children with and without SSD. Specifically in children with SSD, the aerodynamic and EGG measures suggest greater difficulty in the voicing of the /ʒ/ sound and greater ease in the voicing of the /v/ sound. Furthermore, this finding also shows that children with SSD present difficulty in controlling vocal fold abduction, confirmed by the higher abduction quotient (AQ) found when compared with that of children without SSD.

3.4. Ultrasound tongue imaging

Several studies have revealed that the tongue contour visualized using ultrasound tongue imaging (UTI) during speech production can be used for various purposes. However, the specific use of these images as a complementary analysis for SSD diagnosis is still a recent issue in the literature. Although previous research has shown that ultrasound imaging of tongue shape can be used for various sounds, answering phonological questions, conducting phonetic fieldwork, and for use in speech rehabilitation [45, 85–88], the specific use of this technique as a complementary analysis for SSD diagnosis is recent. Moreover, much discussion about the qualitative and quantitative analysis of data persists, particularly concerning the most appropriate methods for comparing individuals. Few standardized measures enable analysis of tongue contour [86, 88, 89].

A qualitative study [48] of the tongue shape for the /s/ and /ʃ/ sounds in three different groups of children with and without SSD. Six participants aged 5 and 8 years, all speakers of Brazilian-Portuguese, were divided into three groups: Group 1, with two typically developing children; Group 2, with two children with SSD presenting other phonological processes except those involving the production of the /ʃ/ sound; and Group 3, with two children with SSD presenting phonological processes associated with the presence of palatal fronting (these two children produced /ʃ/ as /s/). The words /'ʃavi/ (key) and /'sapu/ (frog) were produced five times and tongue contour was individually traced for each production. **Figure 3** provides an example tongue contour of a child, the front of the tongue is on the right and the tongue root is on the left.

The study presented an initial analysis of the sounds /ʃ/ and /s/ produced by children with typical development and with SSD. The variables focused on were as follows: within-speaker variability, shape contour during the /ʃ/ sound production, shape contour of the /ʃ/ sound produced as /s/, and tongue shape during the /s/ sound production. As demonstrated in other studies conducted with English speaking adults and children [90], significant within-speaker variability was observed in articulatory patterns. General results (**Figure 4**) indicated that the speech variability observed in the groups of children with SSD (2 and 3) was greater than that found in the control group (1). Regardless of gender and the presence or not of the palatal fronting phonological process, the four children with SSD presented greater variability during the production of the target sounds. Analysis of the tongue contour showed that both the /s/ and /ʃ/ sounds were produced using distinct tongue contours for G1 and G2.

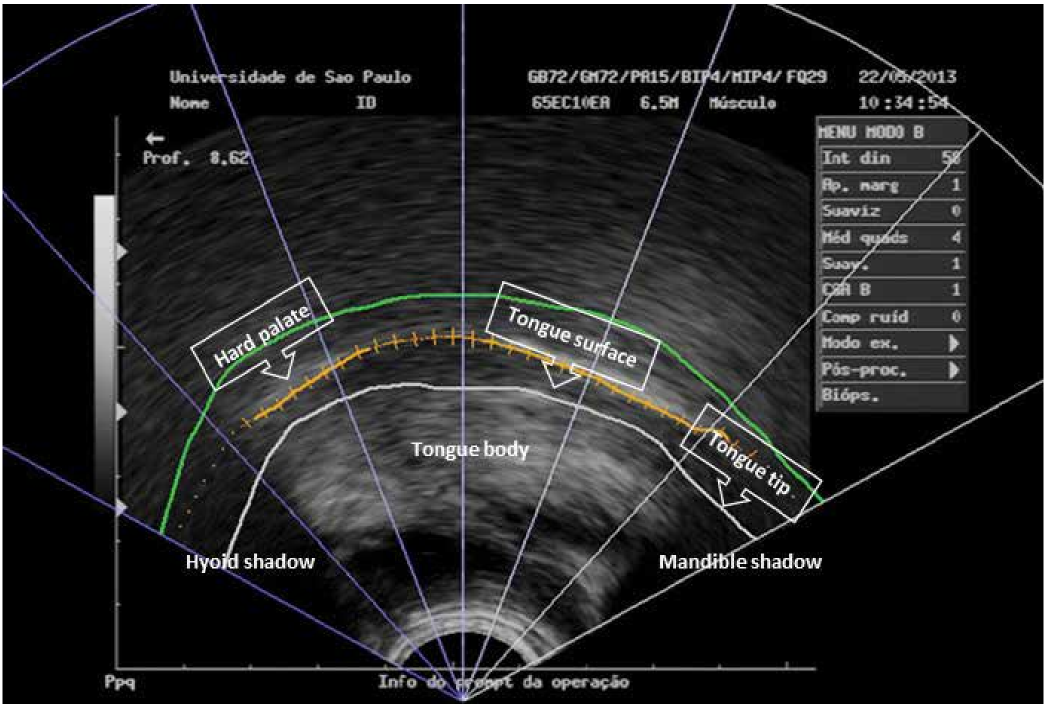


Figure 3. Ultrasound tongue imaging of a child.

The production of these two groups was more stable than that of G3. Tongue contour for the /s/ and /ʃ/ sounds in the children in G3 was similar, indicating that their production was undifferentiated. The authors concluded that the application of UTI to speech analysis was effective to confirm the perceptual analysis of the sound performed by the speech-language pathologist.

Observation of the articulatory pattern in normal adults is also of great importance as it provides information that allows comparative analysis of the variations in speech production expected during child development. It is worth pointing out that children are slower and more variable and that this may be associated with coarticulation [36, 40, 71].

A recent study [46] described ultra sonographic measures for tongue contours during the production of the sounds /s/ and /ʃ/ in adults, typically developing children (TD), and children with SSD with the palatal fronting phonological process. Overlapping images of the tongue contours that resulted from the production of the /s/ and /ʃ/ sounds of 35 individuals were analyzed to select 11 spokes on the radial grid that were spread over the tongue contour (**Figure 5**). The difference between the mean contour of the /s/ and /ʃ/ sounds was calculated for each spoke. The cluster analysis produced groups with some consistency in the articulation pattern between individuals and differentiated adults from children with normal development to some extent, and from children with SSD with a high level of success. Children with SSD were less likely to show differentiation of the tongue contours between articulation of the /s/ and /ʃ/ sounds (**Figure 6**).

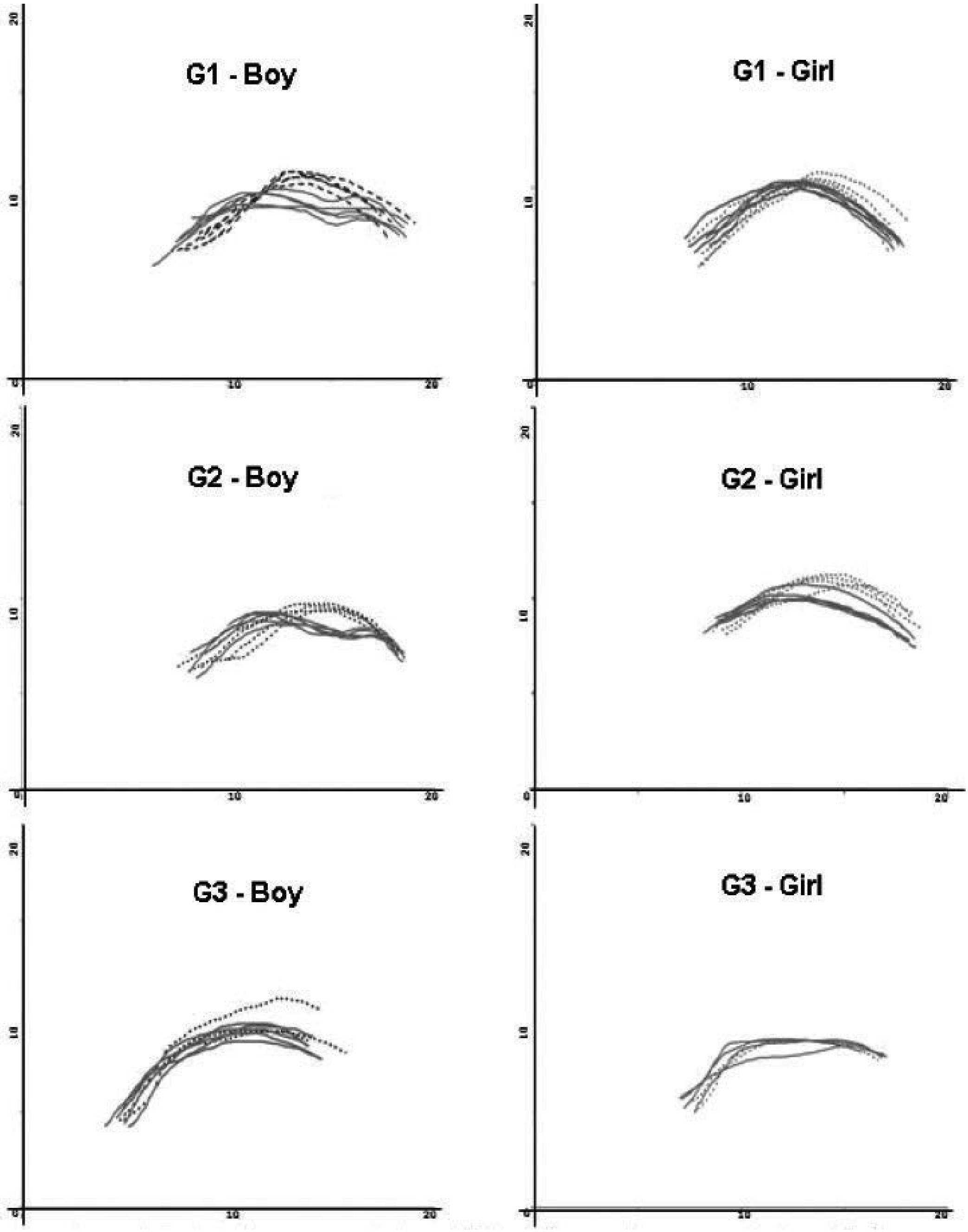


Figure 4. Overlapping images in the production of the sounds /ʃ/ and /s/ for each individual of the study sample.

The results showed that the measures of tongue contour differ in the 11 spokes when articulation of the [s] and [ʃ] sounds was effective to differentiate the full extent of the tongue (tip/blade, dorsum, and root). The values of the differences between the tongue contours allowed

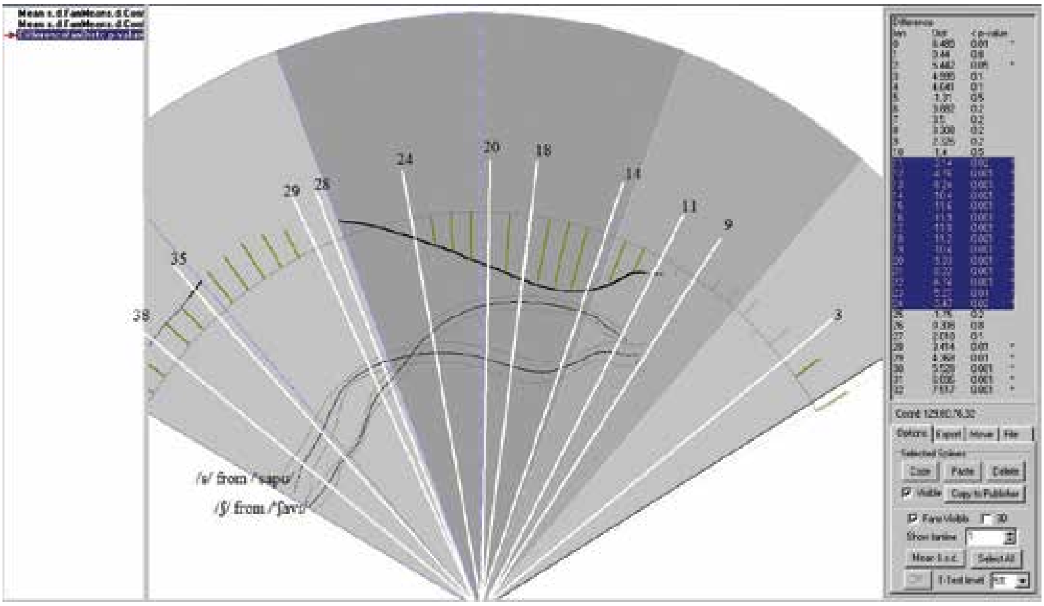


Figure 5. Example of mean tongue contours in the production of the [s] and [ʃ] sounds illustrating the 11 spokes chosen.

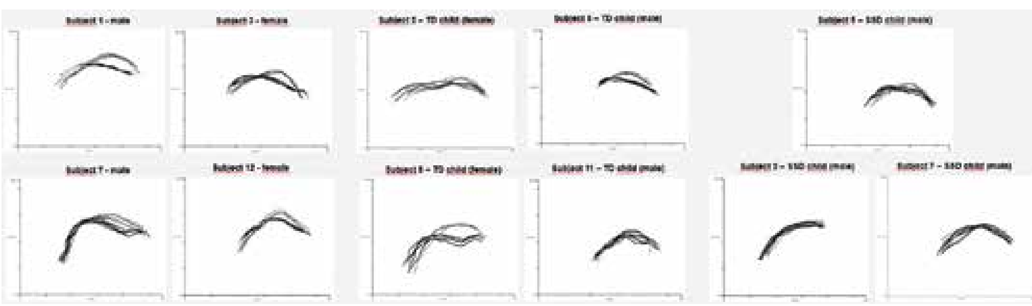


Figure 6. Overlapping of the mean tongue contours in the production of the [s] (solid line) and [ʃ] (dashed line) sounds for some subjects.

differentiation of the articulation patterns in adults, children with normal development, and children with SSD with palatal fronting. Thus, UTI is effective to assist research and in the supplementary diagnosis of children with SSD, therefore, contributing to the planning and prognosis of these children and making speech-language pathology assessments more objective and reliable.

4. Final comments

The presence of SSD in children is confirmed by the application of the imitation of words, picture naming, and spontaneous speech tasks that allow description of both the phonetic inventory and the phonological rules that children have properly mastered and those that they somehow simplify. Due to the intrinsic nature of the disorder, it is necessary to adapt the tests to the language spoken by the child. In the present chapter, we have addressed studies conducted with children who speak Brazilian-Portuguese and present SSD. These studies have contributed to diagnosis refinement and intervention practice for SSD. Identification and description of SSDs became more detailed with the possibility of applying more direct procedures with the use of noninvasive equipment for the evaluation of children with a suspected disorder. Studies that employ these procedures contribute with important information for more effective interventions with better and faster results. We strongly recommend that the methods presented at this chapter should be applied to other languages.

The main contributions of these studies are summarized as follows:

1. Children with speech sound and central auditory processing disorders present lower PCC-R and higher PDI values, indicating greater severity.

2. Studies on auditory-evoked potentials indicate differences between children with and without SSD, with increased latency in the presence of this disorder.

3. There is evidence that the articulation rate in children with SSD is lower than that in children without speech and language alterations, despite its increase with age. Also, children with lower PCC-R values are even slower in producing complex sentences.

4. Acoustic analysis—currently a procedure more easily accessed by speech-language pathologists—is also an interesting intervention strategy. The present study shows evidence that the speech of children with SSD is slower than that of children without SSD, with longer total segment duration and passage to the next sound. The study showed that by replacing the sound [ɾ] with the sound [l], children with SSD tend to produce a longer [l] sound seeking to mark the difference in production.

5. Aerodynamic and EGG measures present great potential to assist speech-language pathologists with understanding the mechanism of production and maintenance of voicing. The studies cited here suggest that children in the age range analyzed still do not have control of this mechanism, even when they are able to produce the voicing.

6. UTI assists with the identification of articulatory language gestures involved in the production of sounds. The study presented a measure of tongue contour that facilitates the identification of gestures used in the production of the [s] and [ʃ] sounds, providing speech-language pathologists with a more accurate description to use during interventions.

Author details

Haydée Fiszbein Wertzner*, Danira T. Francisco, Tatiane F. Barrozo and Luciana O. Pagan-Neves

*Address all correspondence to: hfwertzn@usp.br

University of São Paulo, São Paulo, Brazil

References

[1] Baker E, McLeod S. Evidence-based management of phonological impairment in children. Child Language Teaching and Therapy. 2004;**20**(3):261-285. DOI: 10.1I191/0265659004ct275oa

[2] Dodd B, McIntosh B. Two-year-old phonology: Impact of input, motor and cognitive abilities on development. Journal of Child Language. 2010;**37**(5):1027-1046. DOI: 10.1017/S0305000909990171

[3] Dodd B. Differentiating speech delay from disorder: Does it matter? Topics in Language Disorders. 2011;**31**(2):96-111. DOI: 10.1097/TLD.0b013e318217b66a

[4] McIntosh B, Dodd B. Evaluation of core vocabulary intervention for treatment of inconsistent phonological disorder: Three treatment case studies. Child Language Teaching and Therapy. 2008;**24**(3):307-327. DOI: 10.1177/0265659007096295

[5] Wertzner HF, Amaro L, Teramoto SS. Descritores da classificação da gravidade do distúrbio fonologico. Pró-Fono Revista Atualização Científica. 2004;**16**(2):139-150. ISSN 0104-5687

[6] Wertzner HF, Amaro L, Teramoto SS. Gravidade do distúrbio fonológico: julgamento perceptivo e porcentagem de consoantes corretas. Pró-Fono Revista Atualização Científica. 2005;**17**(2):185-194. DOI: 10.1590/S0104-56872005000200007

[7] Wertzner HF, Papp ACCS, Amaro L, Galea DES. Relação entre os processos fonológicos e classificação perceptiva de inteligibilidade de fala no transtorno fonológico. Rev Soc Bras de Fonoaudiol. 2005;**10**(4):193-200. ISSN 1516-8034

[8] Hodson B. Evaluating and Enhancing Children's Phonological Systems: Research and Theory to Practice. Wichita, KS: Phonocomp Publishers; 2007

[9] American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM-5®). 5th ed. Arlington, VA: American Psychiatric Association; 2013. pp. 44-47

[10] World Health Organization. International Statistical Classification of Diseases and Related Health Problems. 10th. Revision-Icd-10. Geneva: World Health Organization; 2015

[11] Broomfield J, Dood B. The nature of referred subtypes of primary speech disability. Child Language Teaching and Therapy. 2004;**20**(2):135-151. DOI: 10.I191/0265659004ct267oa

[12] Priester GH, Post WJ, Goorhuis-Brouwer SM. Problems in speech sound production in young children. An inventory study of the opinions of speech therapists. International Journal of Pediatric Otorhinolaryngology. 2009;**73**(8):1100-1104. DOI: 10.1016/j.ijporl.2009.04.014

[13] Brumbaugh KM, Smit AB. Treating children ages 3-6 who have speech sound disorder: A Survey. Lang, Speech, and Hearing Services in Schools. 2013;**44**(3):306-319. DOI: 10.1044/0161-1461(2013/12-0029)

[14] Dodd B, McIntosh B. The input processing, cognitive linguistic and oro-motor skills of children with speech difficulty. International Journal of Speech-Language Pathology.2008;**10**(3):169-178. DOI: 10.1080/14417040701682076

[15] Guenther FH. Cortical interactions underlying the production of speech sounds. Journal of Communication Disorders. 2006;**39**(5):350-365. DOI: 10.1016/j.jcomdis.2006.06.013

[16] Bohland JW, Bullock D, Guenther FH. Neural representations and mechanisms for the performance of simple speech sequences. Journal of Cognitive Neuroscience. 2009;**22**(7): 1504-1529. DOI: 10.1162/jocn.2009.21306

[17] Rvachew S, Brosseau-Lapré F. An input-focused intervention for children with developmental phonological disorders. Perspectives on Language Learning Education. 2012;**19**(1):31-35. DOI: 10.1044/lle19.1.31

[18] Barrozo TF, Pagan-Neves LO, Vilela N, Carvallo RMM, Wertzner HF. The influence of (central) auditory processing disorder in speech sound disorders. Brazilian Journal of Otorhinolaryngology. 2016;**82**(1):56-64. DOI: 10.1016/j.bjorl.2015.01.008

[19] Shriberg LD, Fourakis M, Hall SD, Karlsson HB, Lohmeier HL, Mcsweeny JL, Potter LN, Scheer-Coher AR, Strand EA, Tilkens CM, Wilson DL. Extensions to the speech disorders classification system (SDCS). Clinical Linguistics & Phonetics. 2010;**24**(10):795-824. DOI: 10.3109/02699206.2010.503006

[20] Wertzner H, Papp A, Galea D. Provas de nomeação e imitação como Instrumentos de diagnóstico do transtorno fonológico. Pró-Fono. 2006;**18**(3):303-312. DOI: 10.1590/S0104-56872006000300010

[21] Wertzner H. Fonologia. In: Andrade C de, Befi-Lopes D, Fernandes F, Wertzner H. ABFW: teste de linguagem infantil nas áreas de fonologia, vocabulário, fluência e pragmática. 2nd ed. São Paulo: Pró-Fono; 2004. pp. 5-30

[22] Andrade C, Befi-Lopes D, Fernandes F, Wertzner H. ABFW: teste de linguagem infantil nas áreas de fonologia, vocabulário, fluência e pragmática. 2nd ed. Carapicuíba: Pró-Fono; 2004

[23] Wertzner HF. O distúrbio fonológico em crianças falantes do Português: descrição e medidas de severidade [thesis]. São Paulo: University of São Paulo; 2002

[24] Rvachew S, Grawburg M. Correlates of phonological awareness in preschoolers with speech sound disorders. Journal of Speech, Language and Hearing Research. 2006;**49**:74-87. DOI: 10.1044/1092-4388(2006/006)

[25] Hickok G, Poeppel D. The cortical organization of speech processing. Nature Reviews Neuroscience. 2007;**8**(5):393-401. DOI: 10.1038/nrn2113

[26] Shriberg LD, Kwiatkowsky J. Phonological disorders I: A diagnostic classification system. Journal of Speech and Hearing disorders. 1982;**47**(3):226-241. DOI: 10.1044/jshd.4703.226

[27] Gierut JA. Treatment efficacy: Functional phonological disorders in children. Journal of Speech, Language, and Hearing Research. 1998;**41**(1):85-100. DOI: 10.1044/jslhr.4101.s85

[28] Shriberg LD. Epidemiologic and diagnostic profiles for five developmental phonological disorders. Seminar presented at the Annual Convention of the America Speech-Language-Hearing Association. San Francisco; 1999

[29] Shriberg ID. Classification and misclassification of child speech sound disorders. In: Annual Convention of the American Speech-Language-Hearing Association. Atlanta; 2002

[30] Shriberg LD, Kent R, Karlsson HB, McSweeny JL Nadler CJ, Brown Rl. A diagnostic marker for speech delay associated with otitis media with effusion: Backing of obstruents. Clinical Linguistics and Phonetics. 2003;**17**(7):529-547. DOI: 10.1080/0269920031000138132

[31] Hall JW. Handbook of Auditory Evoked Response. Massachustts: Allyn and Bacon; 1990

[32] Kraus N, Koch DB, Nicol TG, Cunningham J. Speech-sound discrimination in school-age children: Psychophysical and neurophysiologic measures. Journal of Speech, Language, and Hearing Research. 1999;**42**(5):1042-1060. DOI: 10.1044/jslhr.4205.1042

[33] Schochat E. Avaliação Eletrofisiológica da Audição. In: Ferreira LP, Befi-Lopes DM, Limonge SCI, editors. Tratado de Fonoaudiologia. São Paulo: Roca; 2004. pp. 657-668

[34] Hall III JW. Overview of auditory neurophysiology past, present and future. In: Hall III JW, editor. New Handbook of Auditory Evoked Responses. Boston: Pearson; 2007. pp. 1-34

[35] Green JR, Moore CA, Higashikawa M, Steeve RW. The physiologic development of speech motor control: Lip and jaw coordination. Journal of Speech, Language and Hearing Research. 2000;**43**(1):239-255. DOI: 10.1044/jslhr.4301.239

[36] Smith A. Development of neural control of orofacial movements for speech. In: Hardcastle WJ, Laver J, Gibbon FE, editors. The Handbook of Phonetic Sciences, 2nd ed. New Jersey: Wiley-Blackwell; 2010. pp. 251-296. ISBN 978-1-4051-4590-9

[37] Green JR, Moore CA, Reilly KJ. The sequential development of jaw and lip control for speech. Journal of Speech, Language, and Hearing Research. 2002;**45**(1):66-79. DOI: 10.1044/1092-4388(2002/005)

[38] Macneilage PF, Davis BL. On the origin of internal structure of word forms. Science. 2000;**288**(5465):527-531. DOI: 10.1126/science.288.5465.527

[39] Nip ISB, Green JR, Marx DB. The co-emergence of cognition, language, and speech motor control in early development: A longitudinal correlation study. Journal of Communication Disorders. 2011;**44**(2):149-160. DOI: 10.1126/science.288.5465.527

[40] Kent RD. Motor control: Neurophysiology and functional development. In: Caruso A, Strand E, editors. Clinical Management of Motor Speech Disorders in Children. New York: Thieme Medical Publishers; 1999

[41] Jesus LMT, Shadle CH. Devoicing measures of European Portuguese Fricatives. In: Mamede N, Baptista J, Trancoso I, Nunes M, editors. Computational Processing of the Portuguese Language. Berlin: Springer-Verlag; 2003. pp. 1-8. DOI: 10.1007/3-540-45011-4_1

[42] Sarmento LS, Pagan-Neves LO, Jesus LMT, Wertzner HF. Análise da medida aerodinâmica de weak voicing na produção do som /v/. Resumo publicado nos Anais do XXIV Congresso Brasileiro de Fonoaudiologia; 2016

[43] Wertzner HF, Pagan-Neves LO, Silva JP, Jesus LMT. Assessment of Children´s Speech Natural Maturation: Voicing of Fricative Consonants. ASHA Annual Convention: Philadelphia; 2016

[44] Bacsfalvi P, Bernhardt BM. Long-term outcomes of speech therapy for seven adolescents with visual feedback technologies: Ultrasound and electropalatography. Clinical Linguistics & Phonetics. 2011;**25**(11-12):1034-1043. DOI: 10.3109/02699206.2011.618236

[45] Bernhardt B, Gick B, Bacsfalvi P, Ashdown J. Speech habilitation of hard of hearing adolescents using electropalatography and ultrasound as evaluated by trained listeners. Clinical Linguistics & Phonetics. 2003;**17**(3):199-216. DOI: 10.1080/0269920031000071451

[46] Francisco DT, Wertzner HF. Differences between the production of [s] and [ʃ] in the speech of adults, typically developing children, and children with speech sound disorders: An ultrasound study. Clinical Linguistics & Phonetics. 2017;**13**:1-16. DOI: 10.1080/02699206.2016.1269204

[47] Gick B, Bernhardt B, Bacsfalvi P, Wilson I. Ultrasound imaging applications in second language acquisition. In: Hansen Edwards JG, Zampini ML, editors. Phonology Second Language Acquisition. Vol. **36**. Amsterdam/Philadephia: John Benjamins Publishing Company; 2008. pp. 309-322. ISSN 0928-1533

[48] Wertzner HF, Francisco DT, Pagan-Neves LO. Tongue contour for /s/ and /ʃ/ in children with speech sound disorder. CoDAS. 2014;**26**(3):248-251. DOI: 10.1590/2317-1782/201420130022

[49] Adler-Bock M, Bernhardt BM, Gick B, Bacsfalvi P. The use of ultrasound in remediation of North American English /r/ in 2 adolescents. American Journal of Speech-Language Pathology. 2007;**16**(2):128-139. DOI: 10.1044/1058-0360(2007/017)

[50] Modha G, Bernhardt BM, Church R, Bacsfalvi P. Case study using ultrasound to treat /ɹ/. International Journal of Language & Communication Disorders. 2008;**43**(3):323-329. DOI: 10.1080/13682820701449943

[51] Hillebrand J. Preceptual organization of speech sound by infants. Journal of Speech and Hearing Research. 1983;**26**(2):268-282. DOI: 0022-4685/83/2602-0268501.00/0

[52] Cabbage KL. The role of speech perception in persistent speech sound disorder. American Speech-Language-Hearing Association. 2015;**16**(2):18-24. DOI: 10.1044/sbi16.2.18

[53] Vilela N, Barrozo TF, Pagan-Neves LO, Sanches SG, Wertzner HF, Carvallo RMM. The influence of (central) auditory processing disorder on the severity of speech-sound disorders in children. Clinics. 2016;**71**(2):62-68. DOI: 10.6061%2Fclinics%2F2016(02)02#pmc_ext

[54] Mcarthur GM, Bishop DV. Speech and non-speech processing in people with specific language impairment: A behavioral and electrophysiological study. Brain and Language. 2005;**94**(3):260-273. DOI: 10.1016/j.bandl.2005.01.002

[55] Jerger J, Musiek FE. Report of consensus conference on the diagnosis of auditory processing disorders in school-aged children. Journal of the American Academy of Audiology. 2000;**11**(9):467-474. DOI: 10.1016/j.ijporl.2008.09.020

[56] McArthur G, Atkinson C, Ellis D. Atypical brain responses to sounds in children with specific language and reading impairments. Developmental Science. 2009;**12**(5):768-783. DOI: 10.1111/j.1467-7687.2008.00804

[57] Edwards ML. Clinical forum: Phonological assessment and treatment in support of phonological processes. Language, Speech and Hearing Services in Schools. 1992;**23**:233-240. DOI: EJ451506

[58] Shriberg LD, Austin D, Lewis BA, Mcsweeny JL. The percentage of consonants correct (PCC) metric: Extensions and reliability data. Journal of Speech, Language, and Hearing Research. 1997;**40**(4):708-722. DOI: 10.1044/jslhr.4004.708

[59] Pereira LD, Schochat E. Testes Auditivos Comportamentais para Avaliação do Processamento Auditivo Central. 1ª. ed. Barueri: Pró-Fono; 2011. 82 p. ISBN: 9788585491970

[60] Leite RA, Wertzner HF, Matas CG. Potenciais evocados auditivos de longa latência em crianças com transtorno fonológico. Pró-Fono Revista Atualização Científica. 2010;**22**(4):561-566. DOI: 10.1590/S0104-56872010000400034

[61] Gonçalves IC, Wertzner HF, Samelli AG, Matas CG. Speech and non-speech processing in children with phonological disorders: An electrophysiological study. Clinics. 2011;**66**(2):293-298. DOI: 10.1590/S1807-59322011000200019

[62] Flipsen P, Hammer JB, Yost KM. Measuring severity of involvement in speech delay segmental and whole-word measures. American Journal of Speech-Language Pathology. 2005;**14**(4):298-312. DOI: 10.1044/1058-0360(2005/029)

[63] Shriberg LD, Lewis BA, Tomblin JB, McSweeny JL, Karlsson HB, Scheer AR. Toward diagnostic and phenotype markers for genetically transmitted speech delay. Journal of Speech, Language, and Hearing Research. 2005;**48**(4):834-852. DOI: 10.1044/1092-4388(2005/058)

[64] Lewis BA, Freebairn LA, Hansen AJ, Stein CM, Shriberg LD, Iyengar SK, et al. Dimensions of early speech sound disorders: A factor analytic study. Journal of Communication Disorders. 2006;**39**(2):139-157. DOI: 10.1016/j.jcomdis.2005.11.003

[65] Vick JC, Campbell TF, Shriberg LD, Green JR, Abdi H, Rusiewicz HL, et al. Distinct developmental profiles in typical speech acquisition. Journal of Neurophysiology. 2012;**107**(10):2885-2900. DOI: 10.1152/jn.00337.2010

[66] Peter B, Stoel-Gammon C. Timing errors in two children with suspected childhood apraxia of speech (sCAS) during speech and music-related tasks. Clinical Linguistics & Phonetics. 2005;**19**(2):67-87. DOI: 10.1080/02699200410001669843

[67] Walker JF, Archibald LMD. Articulation rate in preschool children: A 3-year longitudinal study. International Journal of Language & Communication Disorders. 2006;**41**(5):541-565. DOI: 10.1080/10428190500343043

[68] Haselager G, Slis I, Rietveld A. An alternative method of studying the development of speech rate. Clinical Linguistics & Phonetics. 1991;**5**(1):53-63. DOI: 10.3109/02699209108985502

[69] Nip ISB, Green JR. Increases in cognitive and linguistic processing primarily account for increases in speaking rate with age. Child Development. 2013;**84**(4):1324-1337. DOI: 10.1111/cdev.12052

[70] Van Lieshout PH, Starkweather CW, Hulstijn W, Peters HF. Effects of linguistic correlates of stuttering on EMG activity in nonstuttering speakers. Journal of Speech, Language, and Hearing Research. 1995;**38**(2):360-372. DOI: 10.1044/jshr.3802.360

[71] Smith A. Speech motor development: Integrating muscles, movements, and linguistic units. Journal of Communication Disorders. 2006;**39**(5):331-349. DOI: 10.1016/j.jcomdis.2006.06.017

[72] Wertzner HF, Silva LM. Speech rate in children with and without phonological disorder. Pró-Fono Revista Atualização Científica. 2009;**21**(1):19-24. DOI: 10.1590/S0104-56872009000100004

[73] Flipsen P. Articulation rate and speech-sound normalization failure. Journal of Speech, Language, and Hearing Research. 2003;**46**(3):724-737. DOI: 10.1590/S0104-56872009000100004

[74] Sturm JA, Seery CH. Speech and articulatory rates of school-age children in conversation and narrative contexts. Language, Speech, and Hearing Services in Schools. 2007;**38**(1):47-59. DOI: 10.1044/0161-1461(2007/005)

[75] Flipsen P. Longitudinal changes in articulation rate and phonetic phrase length in children with speech delay. Journal of Speech, Language, and Hearing Research. 2002;**45**(1):100-110. DOI: 10.1044/1092-4388(2002/008)

[76] Wertzner HF, Francisco DT, Pagan-Neves LO. Articulation Rate: Parameters for Analysis in Children. Submitted to International Journal of Speech-Language Pathology.

[77] Tsao Y-C, Weismer G. Interspeaker variation in habitual speaking rate evidence for a neuromuscular component. Journal of Speech, Language, and Hearing Research. 1997;**40**(4):858-866. DOI: 10.1044/jslhr.4004.858

[78] Hall KD, Amir O, Yairi E. A longitudinal investigation of speaking rate in preschool children who stutter. Journal of Speech, Language, and Hearing Research. 1999;**42**(6):1367-1377. DOI: 10.1044/jslhr.4206.1367

[79] Sadagopan N, Smith A. Developmental changes in the effects of utterance length and complexity on speech movement variability. Journal of Speech, Language, and Hearing Research. 2008;**51**(5):1138-1151. DOI: 10.1044/1092-4388(2008/06-0222)

[80] Logan KJ, Byrd CT, Mazzocchi EM, Gillam RB. Speaking rate characteristics of elementary-school-aged children who do and do not stutter. Journal of Communication Disorders. 2011;**44**(1):130-147. DOI: 10.1016/j.jcomdis.2010.08.001

[81] Pagan-Neves LO, Wertzner HF. Parâmetros acústicos das líquidas do Português Brasileiro no transtorno fonológico. Pró-Fono. 2010;**22**(4):491-496. DOI: 10.1590/S0104-56872010000400022

[82] Pagan-Neves LO, Wertzner HF. O processamento do sistema motor da fala em crianças com transtorno fonológico. In: Gonçalves GF, Brum MRP, Soares MK, editors. Estudos em Aquisição Fonológica.ed. Pelotas: Gráfica e Editora Universitária-UFPell; 2011;**4**:125-140

[83] Kent RD, Pagan LO, Hustad KC, Wertzner HF. Childrens speech sound disorders: An acoustic perspective. In: Paul R, Flipsenr Jr P. Child Speech Sound Disorders in Children—In Honor of Lawrence D. Shriberg. San Diego: Plural Publishing; 2010. pp. 93-114. DOI: 10.1597/05-113

[84] Wertzner HF. Produção E Manutenção Do Vozeamento De Sons Consonantais No Transtorno Fonológico. FAPESP-São Paulo Research Foundation. SãoPaulo; 2016

[85] Bressmann T, Thind P, Uy C, Bollig C, Gilbert RW, Irish JC. Quantitative three-dimensional ultrasound analysis of tongue protrusion, grooving and symmetry: Data from 12 normal speakers and a partial glossectomy. Clinical Linguistics & Phonetics. 2005;**19**(6-7): 573-588. DOI: 10.1080/02699200500113947

[86] Davidson L. Comparing tongue shapes from ultrasound imaging using smoothing spline analysis of variance. The Journal of the Acoustical Society of America. 2006;**120**(1):407. DOI: 10.1121/1.2205133

[87] Gick B. The use of ultrasound for linguistic phonetic fieldwork. Journal of the International Phonetic Association. 2002;**32**(2):113-121. DOI: 10.1017/S0025100302001007

[88] Stone M. A guide to analysing tongue motion from ultrasound images. Clinical Linguistics & Phonetics. 2005;**19**(6-7):455-501. DOI: 10.1080/02699200500113558

[89] Davidson L, Stone M. Epenthesis Versus Gestural Mistiming in Consonant Cluster Production: An Ultrasound Study. Somerville: Cascadilla Press; 2003. pp. 165-178. DOI: 10.1.1.583.111

[90] Nijland L, Maassen B, Meulen SV, Gabreels F, Floris KW, Schreuder R. Coarticulation patterns in children with developmental apraxia of speech. Clinical Linguistics & Phonetics.2002;**16**(6):461-483. DOI: 10.1080/02699200210159103

Section 4

New Ideas About Speech and Language Intervention

Superhero Costumes as a Method for Treating Children with Selective Mutism: A Case Study

Nada Yousef Alrabiah

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69613

Abstract

This chapter describes a creative method for treating children with selective mutism. It is a case study of a 5 year, 8 month old child who has been silent since the first day of school for 2.5 years. No one, for 2.5 years, has ever heard him speak. He used to stare at his classmates as they played but did not participate. His mother described his language as normal and behavior as quiet. When the researcher first saw him he was wearing a "Superman" costume. The researcher used the child's ambition to be superman as a platform to think creatively to treat his deficiency. He spoke in 1 hour and 30 minutes. The single session treatment successfully treated the child and he was observed afterwards for 2 months, no relapses, and he continued speaking. To maintain the success, the teacher and the student-teacher were advised to use the "descriptive language approach." He was observed regularly.

Keywords: selective, anxiety disorder, early intervention, treating using superheroes' costumes, descriptive language approach

1. Introduction

Selective mutism (SM) is a condition of anxiety disorder most often diagnosed in children. According to the American Psychiatric Association (APA) [1], this condition occurs when a child persistently fails to speak in certain social situations where speaking is required, such as school, sport fields, church, restaurants, parks, or stores. It is a rare disorder affecting preschool- and school-aged children [2]. Children with selective mutism are generally quiet in nature. The SM child chooses silence rather than a deal with the anxiety of the inability to speak in public, despite the child's ability to speak normally at home. When the child encounters guests, relatives, or school populations, he or she turns to silence. The selective mute children have no problem in language formation; they speak fine in their homes and around people they are comfortable with but their silence accelerates their language developmental delay. Some children who are shy or who have social phobia also have selective mutism. About 1% of children referred to mental health professionals are diagnosed with this disorder. This percentage equals between 0.03% and 0.02% of the general population of children. Selective mutism is a serious disorder which requires qualified professionals in mental illness [3, 4].

2. Symptoms of selective mutism

Despite the long history of deducting SM, the disorder is still not clearly understood, and much debate among mental health specialists continues regarding its appropriate classification and causes. Some of the major symptoms of selective mutism besides refusal to speak in specific situations are excessive shyness and anxiety, clinging behaviors to parents and safe significant others, fear of social embarrassment and social isolation, oppositional attitude, and negativity in evaluation. Children with SM often have delays in social skills as the result of limited experiences' exposure and limited opportunities to interact with peers socially and verbally [5, 6].

3. Etiology and elements of perpetuation of SM

Typically, this condition starts at the time of entering school for the first time. The onset of selective mutism is associated with the first separation of the anxious child from the primary caregiver. Early intervention, which constitutes early deduction and diagnosis, is mandatory in these cases [5]. According to the APA [1], before taking any treatment measures, symptoms must last for a month, excluding the first month of school enrollment, during which most children are shy. Although SM was originally thought to be a disorder of oppositional defiance, recent evidence has classified SM as a condition for both anxiety and avoidance disorder [7, 8]. This avoidance hinders new language learning and experiences. It was also possible that if anxiety is primary, speech and language deficits develop as selective mutism and it persists over time [9].

Some people are more apt than others to develop an anxiety disorder due to their "psychological vulnerability" which may interpret this condition [8, 10].

Selective mutism was referred to as "elective mutism." The negative connotation of this term, which implied the defiance and stubbornness that many teachers interpreted in the child's behavior, caused the APA to rename it selective mutism during the nineties.

Peers at school and social gatherings may make the selectively mute child self-conscious when he or she attempts to talk. The child becomes anxious upon initiating any attempt to vocalize because of the attention he/she attracts. Thus, the child may be dissuaded from repeating vocal attempts [5]. Naturally, the child feels uncomfortable being put on the spot; therefore, he or she will continue to prefer silence to dealing with anxiety. Another significant element of SM causes is the acceptance, and sometimes favoring, of shy children in some cultures like some of the Middle East countries and Far East, which can make it difficult to identify the symptoms before the problem worsens.

Some studies suggest that a family history of shyness or anxiety may interfere with the social and emotional development of the child, but the theory of genetics as a cause of the syndrome remains unclear [11]. Traumatic events, poor reinforcement strategies, unresolved internal conflicts, and social and emotional family dysfunction are likely some of the causes of SM. These factors may inhibit the development of emotion regulation skills in children [6, 12, 13]. Oon [12] added that exposure to trauma and dysfunctional family relationships might trigger an existing disposition for SM. Researchers generally agree that anxiety disorder is a common cause of SM.

SM might be caused by a teacher reprimanding the child or seeing one of his or her peers reprimanded for a toilet accident or another reason [14]. Children of mobile families, such as immigrant families, are also at risk of developing SM greater than non-immigrant children.

4. Treatment choices

Behavioral therapy is among successful treatment with the options of behavioral techniques, such as contingency management, stimuli fading, systematic desensitization, and negative reinforcement shaping [12, 15]. One of the mostly used therapies for selective mutism is Cognitive Behavioral Therapy (CBT). CBT is an approach to problem solving. It is a tool for helping people to become aware of their irrational beliefs about themselves. This new awareness is a key to the client overcoming his or her problem. It works to modify the irrational beliefs and thoughts that cause maladaptive behavior by replacing them with more accurate, rational interpretations. Generally thoughts lead to our emotions and subsequent behavior. This approach is considered “behavioral” because it involves helpful behavioral techniques. CBT may be inadequate for small children in most of the situations [15].

Other method that may be convenient for younger children is Emotive Imagery, which was developed by Lazarus and Abramovitz [16]. They developed emotive imagery as a variant of systematic desensitization, which is an approach to the treatment of fear and anxiety problems in children [17–19]. Lazarus and Abramovitz [16] described emotive imagery as “imagery which is assumed to arouse feelings of self-assertion, pride, affection, mirth, and similar anxiety inhibiting responses” (p. 191). Through conversation, the therapist helps the child establish his or her imagination some superheroes or imaginary characters. Then the child is asked to close his or her eyes and imagine a sequence of events built around his or her “wish fulfillment” [16].

Using this therapy, Lazarus helped an 8-year-old girl who had nocturnal enuresis and a fear of going to school. Over four sessions, the therapist employed emotive imagery to assist the child in creating scenes and situations involving heroes she liked. By using this approach, the child managed to reduce her fear of going to school. She succeeded in overcoming her nocturnal enuresis in 2 months.

Roleplay as a technique in emotive imagery has an inherent healing power, which can help a child with SM to overcome the anxiety of speaking. Through roleplay, the child has the chance of experiencing a different side of him or herself. Through projecting aspects of him or herself, a selectively mute child can externalize inner conflicts in a metaphoric manner to obtain a new perspective. These roles can provide "the stepping stone from which the child may gain the confidence to speak as others before speaking directly as herself" ([12], p. 219).

Play therapy as a treatment approach is well established and widely favored. The popularity of play as a therapy increased with the work of Virginia Axline (1950). It is a self-guided process where clients express their feelings and challenge their irrational believes in the play room communicating through toys. Generally play therapy employed with children aged 3 through 11. Nowadays it is used with adults too.

5. Current case study

5.1. History and referral

A student teacher (Tahani) invited the researcher as a researcher/therapist to the kindergarten where she had practicum in order to help her with a male child. The subsequent information and characteristics she provided the researcher with were usually manifested on the selective mutism child. The boy, Fahd (a pseudonym), had not spoken for 2.5 years since he was enrolled at age three in preschool. At the time of therapy, he was 5 year, 8 months. He was the youngest of the three siblings. According to Tahani, teachers and kindergarten staff, Fahd was shy and quiet. His mother told his teachers that Fahd was quiet in the house too. School special education specialist reported that his hearing ability was tested, with positive results. She had seen Fahd and tried to help him speak. At school his teachers considered him "stubborn, never cooperated with teachers." He was a big boy in stature compared to his peers. His previous teachers described to Tahani his difficulty in separating from his mother when he first enrolled in preschool 2 years previously. He avoided social situations, and he was silent in the classroom and in performance situations.

The family of this child had limited resources. They were unable to take him to a specialist; therefore, the child continued showing symptoms of selective mutism for more than 2 years. I was the researcher and the therapist she felt helpless and she approached the researcher at her university, asking for help. The researcher had experience working with maladaptive behaviors like SM, and in using CBT and play therapy (PT). The researcher/therapist visited the school site school in the fall of 2011.

5.2. Treatment trajectory

That morning, the researcher/therapist entered the kindergarten with a tentative plan to meet the child, start a relationship, and prepare him for play therapy, which she thought appropriate for his age. PT was an approach that she believed in. Nevertheless, each case dynamics and elements constitutes the appropriate therapy to start with. In this case, Fahd "initiated his treatment" when he decided in the first day of therapy to wear a Superman costume to kindergarten.

To the researcher/therapist's surprise, when Tahani pointed at the child, she saw a quiet, lonely child wearing a Superman costume. Based on previous experiences with superheroes costumes, she assumed that the child might be silently calling for help, after living for 2.5 years in silence. The researcher/therapist changed her plan to accommodate the child's passion for superman costume which might help the child in the desensitization process of his anxiety of public speaking. There was no Internet access at the school; therefore, the researcher/therapist drew a picture of superman. She decided to start the therapy by using fiction around the superhero. The researcher/therapist's goal was to help Fahd speak while he was under desensitization created by unspoken ownership of the costume he was wearing. Being in a superman costume, the child felt responsible about it. If a scenario created and required someone to speak for superman, the unspoken ownership might desensitize him and lead him to vocalize or speak in best case scenario (**Figure 1**).

Figure 1. Picture drawn by the researcher.

5.3. The sequence of the session

- Superman picture: Drawn by the researcher/therapist to be used for the fictional story, and as an acknowledgment of Fahd's passion for the superhero. It was an image he might inadvertently relate to.
- The script: The researcher/therapist wrote a script for a fictional story tailored for Fahd, related his fantasy of wearing superman costume. The story started with a "pleasant setting which evoke[d] positive emotions" [17] and was about a girl driving a beautiful car over a bridge, and then suddenly driving over a fence and hanging suspended from the bridge: a "sudden negative event" [17]. In the story, a TV reporter was driving by and announced the news of the accident from his car. Police called her parents and people gathered. Her parents arrived but could not help her. At that moment, Superman flew in and saved her and her car. This scene was accompanied with positive initiatives as superheroes. The purpose of evoking emotions is to inhibit the anxiety [17].
- Setting the stage: The setting for the story and role play was in the library which was equipped with the story probes from school materials, blocks for the bridge, a microphone for the TV reporter and a big toy car.
- Story time: The Tahani shared with her class (12 children that day, including Fahd) that they were going to the library to enjoy listening to a new story.
- Drama time: After the story, the Tahani gave the children the choice to play the roles they liked. To minimize stress on Fahd for public expectancy of him to play the role of Superman.
- No strangers: The researcher/therapist decided not to join the class. She was listening to the chain of events through the library door, which was left ajar.

The procedure went better than planned. The Tahani told the story dramatically and vigorously. When she asked the children if someone is interested to play the roles of the driving girl, the TV reporter, and the parents, some children showed interest and took the roles. The minute the student teacher Tahani said, "Who will play the role of Superman?", a loud shriek, "I will play Superman, see I am wearing Superman, look at me I am wearing Superman, I am Superman." The researcher/therapist's visit lasted for less than 2 hours, she arrived at the school at 8:00, and Fahd spoke his first words at 9:30. She left the school without even having made eye contact with the Fahd. The main class teacher was absent that day, so the researcher/therapist explained the maintenance measures to the Tahani. The maintenance measures, listed below, were crucial components of the treatment.

5.4. Maintenance measures

Observation: Tahani was instructed to write daily observations about the behavior and progress for a week.

Reinforcement technique: Later class teacher and Tahani were instructed to use the descriptive language approach (DLA) [20] with Fahd throughout the day, every day. This is a powerful reinforcement technique upon which early childhood teachers depend on to encourage children. This technique applies to all typical children and adults not just children with disorders. It involves describing to the child in details what he/she does without any judgment, in order to help him/her pay attention to his accomplishments, rather than concentrate on pleasing adults, parents, or teachers. For example with little children, "I see you drew three circles on the left side of the paper and a red box underneath," instead of "Oh beautiful drawing, I loved it." Another example with older kids "you knew the bike's tires needed air, you checked the valve type, bought a pump and inflated them) instead of "Great you did it, you are smart, I am proud of you." Gradually, besides acquiring more vocabulary and improving language, the child develops pride in his or her work, and self-worth increases accordingly. This approach is appropriate for use with a targeted child among siblings and peers, because no one will feel jealous if an adult uses it as a form of encouragement, as opposed to conventional praise ("Oh that is a great picture"). This approach is realistic and not faked. It focuses on confidence-building. Teachers reported less relapses with this reinforcement approach when the researcher/therapist advised utilizing DLA as a maintenance tool with the cases she had treated. When the targeted children are feeling confident and content, relapses in therapy are minimized. DLA has additional advantages, which will not be discussed in another future research.

Student teacher observation notes: On the day of the successful therapy, she wrote, "During outside playtime Fahd was shouting, 'I am the courageous Superman. Call me if anyone needs my help'" (repeatedly). Next day he was talking normally to his peers. He started making relationships and requesting to play with peers ('Ahmed, I want to play with the block with you'). Fahd did not wear the Superman costume the next day, and he never did later. Tahani and the class teachers continued to monitor him for the next 8 weeks, and the intervention gains were sustained.

6. Discussion

6.1. Why the superhero costume?

In the above case, the Superman costume may help the child develop positive skills. The costume was "the response induction aid." In the case study of Jackson and King [18], a 5.5-year-old child who was referred to him for fear of dark, noises and shadow. He described how the treatment of emotive Imagery and the use of the "torch" enhanced the child's positive coping skills too. He named the use of the torch "the response induction aid." To the researcher humble knowledge, there is hardly any references any references about using superhero's costumes. Many resources studied Superheroes but not Superheroes' costumes. Therefore, the researcher/therapist recalls two unsearched cases when she was working in a kindergarten prior to her recent work at the university. The first one was a very shy boy 6 years of age. The only variant that took place in relation to his shyness condition was a costume of a Power Ranger which his mother bought. Whenever he wore it in the kindergarten he acted happily and confidently. According to his mother and teachers, few weeks later and with no professional help he showed confident behaviors without even wearing the costume.

When wearing a costume, children tried out different roles and lived them later in real life. Children identify superheroes in accordance with their own needs. A girl who was small in built and was always abandoned by her friends identified with Tasmanian devil (Taz). According to her teachers and mother, she mostly drew the pictures of Taz at home and school. For her Taz might be huge, voracious but kind. Through watching Taz videos, she managed to win over her peers with her kindness and support, as she saw these traits in Taz, despite his ugly appearance.

In the current case the shriek of the child was not a protest against someone else trying to take the role; rather, it was a protest against the fears and silence that hindered him from being what he wanted to be throughout the last 2.5 years. Fahd might have wanted to be courageous self-confident and heard. It was a dramatic moment, over which Tahani and the researcher/therapist both wept. The approach was a convenience treatment evolved from the fallout of the case long term and its dynamics. The researcher/therapist had planned to meet the child and talked to him, but the superhero costume invited a creative way to address his condition.

6.2. Suggested procedures for utilizing superhero costume therapy

Superhero introduction: The therapist, teacher, and parents should work together to casually introduce a few superheroes with characteristics that may speak to, or complement, the child's limitation.

Superhero connection: The best ways to connect to a character are through reading stories and watching movies.

Superhero costume: When the child dresses in the superhero's costume, he or she may act out the character's role at home or school.

Treatment selection: The treatment will depend on the child, the problem or disorder, the researcher/therapist's experience.

This case study suggests that the therapist can get the lead of the trajectory of their treatment form the children's cues. Fahd had reached a state of inhibition caused by this anxiety. The superhero costume might be an opportunity to save him from despair. As a therapist, I assume Fahd seemed to master his fear and anxiety through the costume which provided him a mask of his sense of vulnerability. Tahani reported that the day he spoke was the third time he'd worn it since she had been his student-teacher.

The Superman story was the metaphorical ladder that Fahd climbed, to cry out loud "'I am the courageous Superman." All that was needed was a script. The costume created a systemic desensitization. The researcher/therapist had always believed in superheroes' power in influencing the souls of children. She used to encourage the mothers of shy children to purchase superhero costumes. Costumes are not favored in all societies, as they do not represent all cultures and are considered unsafe when the child imitates the character's behavior. Many people find it difficult to believe that they can have a strong influence on a child's psychological state.

The approach used in this case study can be described as a psychodynamic. It assumes that a maladaptive behavior is due to an internal conflict, and that clients can gain insight through art, play, or drama [5]. Exposure principles are established through the indulgence to drama events. In this case study, Fahd was ready, and tired of living in silence; his first words may support this argument. The treatment components for this approach are the child's emotional state, the costume, the story, and the tailored script.

This novel intervention is the first of its kind, and it is not well established or studied. I encourage researchers to study its potential, as well as its limitations, more methodically. Superhero costumes can be considered a variant of systematic desensitization for the treatment of selective mutism. This suggested therapy might be a type of emotive imagery [16] with a twist. Lazarus and Abramovitz [16] developed emotive imagery as a variant of systematic desensitization. It is an approach for treating fear and anxiety problems in children. The difference between emotive imagery and superhero costume therapy is presented in **Figure 2**. They are assumptions and need to be studied thoroughly.

Emotive imagery	Superhero costume therapy
• The therapist leads the imagining of a hero and imagining of the child as the hero's "agent "as used by Lazarus and Abramovitz	•The child imagines himself or herself the hero while wearing the costume
•	
• Directive	•Less directive
• Session occurs mostly in therapy room	•Intervention possible *in vivo*
•	
• The child might be more self-conscious	•The child is less self-conscious
• Safe therapy	•The child might hurt himself or herself imitating superheroes
• Requires skillful therapist	•Teachers in remote areas might be able to help children with SM
• Some children might resist	•Less chance of intervention resistance
• The therapist must be prepared with a repertoire of questions	•No direct questions during the session

Figure 2. Comparison between emotive imagery and superhero costume therapy.

7. Recommendations

Sometimes the child will declare his treatment, like Fahd did. Therefore, therapists must pay attention to cues and study them from different perspectives and use all the available resources of information such as teachers, family, and peers. Family involvement is usually crucial, but in this case the family played small role before starting the treatment. As a therapist, she should have worked from a "family-system perspective and focused on changing any unhelpful family dynamics" that may have perpetuated the mute behavior [12]. Initially, the researcher is saying that as a disclaimer because she visited the kindergarten to help a SM child with no plan to publish the experience.

Generally, the therapist can utilize more than one approach for treatment for children with SM. The child's moods and surroundings differ from one day to another. Family dynamics and school events will help determine the model a therapist must adopt.

A maintenance technique like DLA is highly recommended. Tahani's successful application of the steps of treatment created by the researcher/therapist, as well as the maintenance techniques she mastered and practiced daily with the child (which prevented relapses), was appreciated by the researcher/therapist.

This case emphasizes the exceptional potential of utilizing superheroes costumes as a medium for therapy. Children can hide their fear and vulnerability behind these costumes. Superheroes facilitate the exploration of qualities, values, limitations, self, and family [21]. Rubin [21] published a book about Superheroes. Hopefully in the near future we can have a book devoted solely to Superheroes' costumes.

To the author's knowledge, there are no records in the literature of utilizing superhero costumes for SM therapy. Some books spoke about using superhero toys and figures in therapy.

8. Limitations

This procedure might be limited to children who have a fascination with superheroes. Extra effort from parents and teachers may help children build interest in superheroes. Different superheroes characters are associated with different traits. Another limitation is that superhero costumes may jeopardize the child's safety depending on the character's representation and the child. The costumes should be utilized with caution.

Regardless of its limitations, superhero costume therapy has potential as a type of emotive imagery, and offers a zone of social and emotional development that might be helpful in the therapeutic treatment of selective mutism and other maladaptive behaviors.

The researcher/therapist is an early childhood majored with a counseling background in Master. Play therapy was her favorite course in graduate program. This was the second case in which metaphor and roleplay were used. Both cases were treated in a short period of time—less than 3 days—and relapses did not occur.

Author details

Nada Yousef Alrabiah

Address all correspondence to: nalrabiah@ksu.edu.sa

King Saud University, Riyadh, Saudi Arabia

References

[1] American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Washington, DC: American Psychiatric Association; 2013

[2] American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, DC: American Psychiatric Association; 1994

[3] Cunningham CE, McHolm AE, Boyle MH. Social phobia, anxiety, oppositional behavior, social skills, and self-concept in children with specific selective mutism, generalized selective mutism, and community controls. European Child & Adolescent Psychiatry Journal. 2006;**15**:245-255

[4] Kearney CA. Silence Is Not Golden: Strategies for Helping the Shy Child. New York: Oxford University Press; 2011

[5] Hung S, Spencer MS, Dronamraju R. Selective mutism: Practice and intervention strategies for children. Children & Schools. 2012;**34**(4):222-230

[6] Scott S, Beidel DC. Selective mutism: An update and suggestions for future research. Current Psychiatry Reports. 2011;**13**:251-257

[7] Bork PM. Overcoming selective mutism: Play now…talk later! In: Paper Presented at the Designing for Children Conference, Mumbai, India; 2010, February

[8] Reuther E, Davis III T, Moree B, Matson J. Treating selective mutism using modular CBT for child anxiety: A case study. Journal of Clinical Child & Adolescent Psychology. 2011;**40**(1):156-163. Available from: Ipswich, MA: Academic Search Premier [Accessed 23 March 2017]

[9] Tannock R, Martinez Y, Manassis K, Garland E, Clark S, McInnes A. The teachers' role in the assessment of selective mutism and anxiety disorders. Canadian Journal of School Psychology. 2015;**30**(2):83-101

[10] Viana GA, Beidel DC, Rabian B. Selective mutism: A review and integration of the last 15 years. Clinical Psychology Review. 2009;**29**:57-67

[11] Kristensen H, Torgersen S. A case-control study of EAS child and parental temperaments in selectively mute children with and without a co-morbid communication disorder. Nordic Journal of Psychiatry. 2002;**56**(5):347-353

[12] Oon PP. Playing with Gladys: A case study integrating drama therapy with behavioural interventions for the treatment of selective mutism. Clinical Child Psychology and Psychiatry. 2010;**15**:215-230

[13] Therese K, Fernandez G, Sugay CO. Psychodynamic play therapy: A case of selective mutism. International Journal of Play Therapy. 2016;**25**(4):203-209

[14] Shott EF, Warren ME. Selective mutism: Treating the silent child. Zero to Three Journal. 2011;**31**(6):15-19

[15] Bergman RL. Treatment for Children with Selective Mutism: An Integrative Behavioral Approach. New York: Oxford University Press; 2013

[16] Lazarus A, Abramovitz A. The use of "emotive imagery" in the treatment of children's phobias. Journal of Mental Science. 1962;**108**:191-195

[17] Cornwall E, Spence S, Schotte D. The effectiveness of emotive imagery in the treatment of darkness phobia in children. Behavior Change. 1996;13(4):223-229

[18] Jackson H, King NJ. The emotive imagery treatment of a child's trauma-induced phobia. Journal of Behavior Therapy and Experimental Psychiatry. 1981;**12**(4):325-328

[19] King NJ, Heyne D, Gullone E, Molloy GN. Usefulness of emotive imagery in the treatment of childhood phobias: Clinical guidelines, case examples and issues. Counseling Psychology Quarterly. 2001;**14**:95-101

[20] Faber A, Mazlish E. How to Talk so Kids Will Listen & Listen so Kids Will Talk. New York: Scribner; 1980

[21] Rubin LC. Using Superheroes in Counseling and Play Therapy. New York: Springer; 2007

Remote Speech-Language Intervention, with the Participation of Parents of Children with Autism

Milene Rossi Pereira Barbosa and
Fernanda Dreux Miranda Fernandes

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.70106

Abstract

The question about the possibility of identifying the best therapeutic approach for children with autism spectrum disorder (ASD) has also been discussed in the literature. The intervention should be individualized, in order to involve the current level of development of the child and to identify the profile of the facilities and difficulties of each child. The families are constantly involved in complex and changeable context and are aware of the importance of access and participation to the treatment chosen, since that service delays can directly affect efficacy. In general, studies on language acquisition and development in autism focus on the child's communication, and some analyze the mother seeking to understand how the role of parents and caregivers influences the communication of the children with autism. Observing the importance of the active inclusion of parents in the speech and language therapy of children with ASD, a Distance Speech Therapy Intervention project, was developed that would allow language stimulation of a greater number of children and adolescents with autism.

Keywords: autistic disorder, language, parent child relations, social communication, behavior

1. Introduction

Autism is a global disorder of child development that goes on throughout life and evolves with age.

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM) of the American Psychiatric Association [1], the category of Global Developmental Disorders refers to disorders that are characterized by severe and invasive impairment in various areas of development, such as reciprocal social interaction, communication skills, and the presence of stereotyped behaviors, interests, and activities.

The qualitative impairments that define these conditions represent a deviation from the individual's level of development, which affects their social, educational, and communication adaptation [2].

Autism is considered a behavioral syndrome with multiple etiologies, characterized by deficits in social interaction, visualized by the inability to relate to the other, usually combined with language deficits and behavioral changes. However, the table does not involve all areas of behavior in the same proportion and is considered to cause diffuse impairment [3, 4].

In Brazil, since 2012, a law was approved by the federal government that guarantees the rights of persons with autism: I—dignified life, physical and moral integrity, free personality development, security, and leisure; II—protection against all forms of abuse and exploitation; III—access to health services and actions, with a view to the integral attention to their health needs, including the early diagnosis, although not definitive; the multiprofessional service; adequate nutrition and nutritional therapy; medicines; information that aid in diagnosis and treatment; and access to education and vocational education; to the dwelling, including the protected residence; to the labor market; social security and social assistance.

It is significant to note that all descriptions of children with autism mention important language impairments, especially with respect to their functional aspect. The question of the communication of these children is probably their most important disorder, and the studies on the communication of children with autism that refer to questions related to the functional use of language use parameters based on pragmatic theory [5, 6].

The question about the possibility of identifying the best therapeutic approach for these children has also been discussed in the literature [7]. Research has identified the effectiveness of various therapeutic approaches and draws attention to the fact that any comparison should have information about the family and social context [8, 9].

It is suggested that the intervention should be individualized, in order to involve the current level of development of the child and to identify the profile of the facilities and difficulties of each child [10, 11]. The approaches and strategies can be diverse, but the ultimate objectives are the same: to improve the linguistic, social, and cognitive abilities [12].

These families are constantly involved in complex and changeable context and are aware of the importance of access and participation to the treatment chosen, since that service delays can directly affect efficacy [13].

Families of children with autism always find it difficult to obtain appropriate care [14], including obstacles to where and how to obtain these services, how to pay for them [15], and doubts on how to choose the treatment options [16, 17].

In Brazil, there are no epidemiological studies regarding the prevalence of autism spectrum disorder (ASD) cases, with only an estimated number of it. A 2010 survey [18] reported an estimated number of one million cases of ASD in Brazil. In 2012, it was estimated that there would be 100,000 people with autism in the city of São Paulo; most of them would still be without diagnosis and/or treatment [19], and a very large necessity to increase the resources available to take care of the large prevalence of autism that exists.

When the family suspects that the child has some disability, they find difficulty in accessing special services, mainly to obtain the diagnosis [20].

The family is extremely important because it helps to include the child with autism in a world where people connect and where he/she does not see himself/herself, where he/she is not, and where he/she finds it difficult to communicate. The interest of the parents reflects in the children security, motivation, and mitigation of possible difficulties. Inclusion should begin at home, accepting the problem, stimulating improvements, and working daily so that the autism picture has a minimum of stereotypies and compromises [21]. It is important that the child is inserted in a stimulating environment of social interaction.

In general, studies on language acquisition and development in autism focus on the child's communication [22–24], and some analyze the mother (caregiver)—seeking to understand how the role of parents and caregivers influences the communication of the children with autism [25, 26].

Parents of children with autism experience greater challenges than families affected by other disabilities when attempting appropriate services [27]. With the recent increase in the incidence of individuals with autism and limited resources, a potential outcome is that many children will not receive the treatment and services they need and deserve. Thus, as research continues on the possible causes of autism, it is equally critical that better models are developed to ensure that interventions are effective and that the majority of individuals actually receive care.

The introduction and development of advanced technologies, widely available to the population, such as the exchange of digital data through Internet, can provide alternatives and supplements for how services and treatments would be provided to those in need [28]. Telehealth is a mechanism that allows individuals to receive support, service, and professional from a distance. This may involve being able of communicating in real time with a health-care professional or interacting with online platforms to learn new information [29]. Technology can be accessed at any time of the day and at any location with low-cost equipment, basic to customize the information relevant to the individual's learning needs and to be shared between different scenarios and people [30]. Several studies involving telehealth have shown promise in teaching. More recently, researchers have used telehealth to train parents of individuals with autism [31, 32]. For example, Hamad et al. [33] trained 51 professionals and family members to perform applied behavior analysis (ABA) procedures, using an online distance-learning course that included narrated slideshows, video examples, and application exercises. Participants significantly increased their ABA knowledge from pre- to post-training and reported a high level of satisfaction with the online course.

In addition to telehealth training for professionals, researchers began experimenting with online modalities to teach parents to implement specific interventions for autism. Currently, a self-directed DVD [34] and the web-based learning program [35] have been associated with increased parental skills in intervention activities.

Observing the importance of the active inclusion of parents in the speech and language therapy of children with ASD, a Distance Speech Therapy Intervention project was developed that would allow language stimulation of a greater number of children and adolescents with autism.

In addition to study the best proposals for intervention for different manifestations, the research has a responsibility to offer resources that can reach the greatest number of people who require the service and at the most appropriate time for them.

2. Purpose

The purpose is to construct a project of effective speech-language intervention that allows the stimulation of the language of a greater number of children and adolescents with autism.

3. Methods

The project of the Distance Speech Therapy Intervention at home by parents and/or caregivers with remote monitoring was composed by four moments for elaboration and verification of its effectiveness. Each one of these phases is further described in **Table 1**.

At the first moment, the therapist's plans were discussed with the researcher about the activities to be carried out at home with the parents. This should contain the objective of the intervention to be carried out and the proposed activity. Remembering that autism is being part of a broad spectrum with changes in the development of social interaction and language, and such characteristics vary in the typology and severity with which they manifest, the plans made for this research were quite individualized both in the activity to be done such as time and frequency. This moment lasted 2 weeks.

1° moment	2° moment	3° moment	4° moment
• Therapists plan the activities to be carried out at home with the parents	• The proposal of a distance intervention began to be passed on to the parents, starting with the execution of the activities	• The interventions occurred with both face-to-face therapies and at home with the parents	• The patients no longer attended speech therapies weekly with their therapists; they only received the intervention at home
• The patients will still be in weekly care in the service	• The patients will still be in weekly care in the service, and during these visits the therapists questioned the parents some facts	• The feedback given by the parents to the therapists should be done by some means of communication agreed between them	• The feedback given by the parents to the therapists should be done by some means of communication agreed between them
• Lasted 2 weeks	• Lasted 4 weeks	• Lasted 4 weeks	• Lasted 6 weeks

Table 1. Phases of the intervention program.

http://dx.doi.org/10.5772/intechopen.70106

These individual proposals based on an individualized profile of child's characteristics, as well as their needs and family context, will be presented as an example later on.

At the second moment, the proposal of a distance intervention began to be passed on to the parents, starting with the execution of the activities elaborated by the therapists in the first moment of the research. This lasted for 4 weeks.

In these 4 weeks, the patients will still be in weekly care in the service provided by the Laboratory of Speech and Language Pathology Research in Autism Spectrum Disorders, and during these visits, the therapists questioned the parents some facts such as if the activities were performed; If some day was not possible or difficult to perform the activity; what the parent and/or caregiver thought of the proposed activity; how was the activity and if they played together; and if any difficulty was found with the proposed activity.

After these 4 weeks, in the third moment, just as in the second moment the interventions occurred with both face-to-face therapies and at home with the parents but the feedback given by the parents to the therapists should be done by some mean of communication agreed between them. The same questions asked at the second moment should be answered by the parents during this contact. This will also last for 4 weeks.

In the fourth moment of the research, the patients no longer attended speech therapies weekly with their therapists; they only received the intervention at home during the execution of the games with their parents.

During the 6-week period, the therapists made contact with the parents by means of the best or more easily available communication previously determined (email, telephone, Skype, Whatsapp). In these contacts, besides clarifying doubts and discussing the child's performance during the activities, the parents answered the questionnaire described, aiming to improve the next phases of the program.

The evaluation of the functional communication profile was used to verify the effectiveness of the project. The evolution of participants pragmatic performance was evaluated at the beginning and at the end of 2 years, the first one in which the Distance Speech Therapy Intervention project was not applied and the second one in which the participants in the project.

The work was referred to the Ethics Committee for Research Projects Analysis and was approved under the Protocol 1.057.800. Everyone responsible for the individuals involved signed the consent form.

Participants were 40 parents of children with ASD with ages between 6 and 17 years, and in this phase they received just the intervention at home, with the parents as mediators. They were instructed to perform play activities that have been planned and discussed with them before the onset of the program.

Inclusion criteria were the children had to have a diagnosis within the autism spectrum disorders determined by a psychiatrist and/or a neurologist according to the DSM-IVtr (ref) and/or ICD10(ref); parents/caretakers had to have a functional level of literacy and be able to contact the speech-language pathologist (SLP) weekly through Skype, Whatsapp, or telephone.

4. Results

Partial results show that among the five items of evaluation of the Functional Communication Profile analyzed, Communicative Space, Interactivity, Communicative Acts Per Minute, Communicative Functions, and Interactive Communicative Functions, the only item that showed the greatest progress with a statistically significant difference in the year that the distance intervention occurred was the item Interactive Communicative Functions. It authorizes to affirm that the participation of parents in the intervention process and the family environment provide more interactivity of the people with ASD (**Table 2**).

The hypothesis that by participating in a speech at a distance intervention process held at home by parents and/or caregivers of children with ASD, with remote monitoring, would be presented where developments in functional use of language, becoming more interactive, can be confirmed.

The data showed that the participants, despite having shown evolution in the development of the functional profile of communication in 2 years observed, showed greater evolution in Communicative Functions Interactive item in the year received stimulation at home by their parents and with your remote monitoring therapist's speech-language pathologists.

In general, studies on language acquisition and development in autism focus on the communication of the child [19, 22, 26], and some analyze the dyad mother (caregiver)-child, seeking to understand to what extent the role of parents and caregivers influences the child with autism [19, 25].

These results suggest that the participation of parents during the intervention process combined with daily stimulation occurring in the home environment increases the interactivity and sociability of the participants.

This proposal of speech-language intervention with remote follow-up allowed the inclusion of other family members besides the parents. Only 11 children had always had the same adult as play partner during all the activities. However, except for one child, the other adults were close family members. The other adult was a neighbor that had very close contact with the child.

Results indicate that only 40% of the parents/caretakers conducted the activities proposed every day. Among those who skipped the activities a few days, 22.5% did so during the weekends, 12.5% did so due to adult's previous appointments, 10% reported that the child was sick, and another 10% that the child refused to participate.

Number of interactive communicative functions expressed	***T*1 and *T*2**	***T*3 and *T*4**
% subjects that evolved	40	68
p-Value	0.02*	
*≤ 0.05		

Table 2. Proportion of participants with improvement in both periods (ANOVA).

The parents/caretakers of 35% of the participant children reported that the activities were difficult in at least one of the weeks of the program and 5% felt they were repetitive.

Behavioral problems were also reported as reasons for the difficulties in conducting the proposed activities. Attention impairments were described by 30% of the parents/caretakers, as well as anxiety during the activity and tantrums at the end of it.

5. Conclusions

These data highlight the importance of parents to the development of intervention programs that include the families by providing detailed information about the child's development, discussing doubts and exchanging experiences. Speech-language pathologists should encourage and provide guidance to parents and caretakers to take more active roles in providing communication environments that are appropriate to children with ASD and allow successful interactive experiences.

The participation of parents is important for the accomplishment of a Distance Speech Therapy Intervention project, either by providing accurate information about the child's development, accepting doubts, and understanding requests or by inviting them to participate as agents of the language process.

Author details

Milene Rossi Pereira Barbosa and Fernanda Dreux Miranda Fernandes*

*Address all correspondence to: fernandadreux@usp.br

Department of Physical Therapy, Speech-Language Pathology and Audiology and Occupational Therapy, School of Medicine of University of São Paulo, São Paulo, Brazil

References

[1] American Psychiatry Association. DSM-IV-TR. Diagnostic and Statistical Manual of Mental Disorders. 4th ed., Text Revised. Washington DC: American Psychiatry Publishing Inc.: 2001

[2] Silva RA, Lopes-Herrera SA, Vitto LPM. Distúrbio de Linguagem como parte de um transtorno global do desenvolvimento: Descrição de um proceso terapêutico fonoaudiológico. Revista da Sociedade Brasileira de Fonoaudiologia. 2007; **12**(4):322-328

[3] Gillberg C. Autism and pervasive developmental disorders. Journal of Child Psychology and Psychiatry. 1990;**31**(1):99-119. Review. Erratum in: Journal of Child Psychology and Psychiatry. 1991;**32**(1):213

[4] Schwartzman JS. Autismo Infantil. São Paulo: Memnon; 2003

[5] Fernandes FDM. Aspectos funcionais da comunicação de crianças com síndrome autística [tese]. São Paulo: Faculdade de Filosofia, Letras e Ciências Humanas da Universidade de São Paulo; 1995

[6] Fernandes FDM. Terapia de linguagem em crianças com transtornos do espectro autístico. In: Ferreira LP, Befi-Lopes DM, Limongi SCO. Tratado de Fonoaudiologia. São Paulo: Editora Roca; 2004. pp. 941-953

[7] Fernandes FDMF, Cardoso C, Amato CH, Sassi FC, Sousa-Morato PF. Fonoaudiologia e Autismo: Resultados de três diferentes modelos de terapia de linguagem. Pró-Fono Revista de Atualização Científica. Out-dez. 2008;**20**(4):267-272

[8] Fernandes FDM. Sistematização de dados referentes à atuação fonoaudiológica em hospital-dia infantil - o perfil comunicativo como indicador de desempenho. Pró-Fono Revista de Atualização Científica. 1999;**11**(1):1-9

[9] Kamps DM, Dugan EP, Leonard BR, Daoust PM. Enhanced small group instruction using choral response and student interaction for children with autism and developmental disabilities. American Journal of Mental Retardation. 1994;**99**(1):60-73

[10] Koegel LK. Interventions to facilitate communication in autism. Journal of Autism and Developmental Disorder. 2000;**30**(5):383-391

[11] DiLala DL, Rogers SJ. Domains of the Childhood Autism Rating Scale: Relevance for diagnosis and treatment. Journal of Autism and Developmental Disorder. 1994;**24**(1):2-13.

[12] Lopes-Herrera SA. Avaliação de estratégias para desenvolverhabilidades comunicativas verbais em indivíduos com autismo de alto funcionamento e Síndrome de Asperger [tese]. São Carlos: Universidade Federal de São Carlos; 2004

[13] Jeffrey S, Karst AV, Hecke V. Parent and family impact of autism spectrum disorders: A review and proposed model for intervention evaluation. Clinical Child and Family Psychology Review. September 2012;**15**(3):247-277

[14] Mandell D, Novak M. The role culture in families' treatment decisions for children with autism spectrum disorders. Developmental Disabilities Research Reviews. 2005;**1**:110-115

[15] Levy S, Mandell D, Merhar S, Ittenbach R, Pinto-Martin J. Use of complementary and alternative medicine among children recently diagnoses with autistic spectrum disorder. Journal of Developmental and Behavioral Pediatrics. 2003;**24**:418-423

[16] Knapfl K, Ayres L, Gallo A, Zoeller L, Breitmayer B. Learning from stories: Parents accounts of the pathway to diagnosis. Pediatric Nursing. 1995;**21**:411-415

[17] Smith B, Chung MC, Vostanis P. The path to care in autism: Is it better now? Journal of Autism and Developmental Disorders. 1994;**24**:551-563

[18] Junior P, Ribeiro S. Pesquisa do CDC revela número alto de prevalência de autismo nos EUA em crianças de oito anos, além de grande aumento em relação a pesquisa anterior. Revista Autismo: Informação Gerando Ação. 2010;**10**(1):29 [citado em 2012 Out 10]

[19] Petição Pública Brasil. Abaixo-assinado pela aprovação projeto dos cinco Centros de Referência em Autismo em São Paulo. São Paulo: Petição Pública Brasil. 2012. Disponível em: http://www. peticaopublica.com.br/PeticaoVer.aspx?pi=P2012N23097 [citado em 2012 Out 10]

[20] Schereck KA, Mulic JA. Parental report of sleep problems in children with autism. Journal of Autism and Developmental Disorders. 2000;**30**:127-135

[21] Pereira CCV. Autismo e Família: Participação dos pais no tratamento e desenvolvimento dos filhos autistas. Facene/Famene. 2011;**9**(2): 22-28

[22] Fernandes FDM, Barros CHC. Funções comunicativas expressas por crianças autistas: o uso de procedimentos específicos para inseri-las no contexto da terapia de linguagem. Journal Brasileira De Fonoaudiologia, Curitiba. 2001;**2**(6):45-54

[23] Cardoso C, Fernades FDM. Uso de funções comunicativas interpessoais e não interpessoais em crianças do espectro autístico. Pró-Fono Revista de Atualização Científica Barueri. 2003;**15**(3):279-286

[24] Molini DR, Fernandes FDM. Intenção comunicativa e uso de instrumentos em crianças com distúrbios psiquiátricos. Pró-Fono Revista de Atualização Científica Barueri. 2003;**15**(2):149-158

[25] Borges LC, Salomão NMR. Aquisição de linguagem: Considerações da perspectiva da interação social. Psicologia: Reflexão e Crítica Porto Alegre. 2003;**16**(2):327-336

[26] Siller M, Sigman M. The behaviors of parents of children with autism predict the subsequent development of their children's communication. Journal of Autism and Developmental Disorders, New York. 2002;**32**(2):77-89

[27] Kogan MD, Strickland BB, Blumberg SJ, Singh GK, Perrin JM, van Dyck PC. A national profile of the health care experiences and family impact of Autism Spectrum Disorder among children in the United States, 2005-2006. Pediatrics. 2008;**122**:1149-1158

[28] Baggett KM, Davis B, Feil EG, Sheeber LL, Landry SH, Carta JJ, et al. Technologies for expanding the reach of evidence-based interventions: Preliminary results for promoting social-emotional development in early childhood. Topics in Early Childhood Special Education. 2010;**29**:226-238

[29] Dudding CC. Digital videoconferencing applications across the disciplines. Communication Disorders Quarterly. 2009;**30**:178-182

[30] Feil EG, Baggett KM, Davis B, Sheeber L, Landry S, Carta JJ, et al. Expanding the reach of preventive interventions: Development of an internet-based training for parents of infants. Child Maltreatment. 2008;**13**:334-346

[31] Boisvert M, Lang R, Andrianopoulos M, Boscardin ML. Telepractice in the assessment and treatment of individuals with autism spectrum disorders: A systematic review. Developmental Neurorehabilitation. 2010;**13**:424-432

[32] Wainer AL, Ingersoll BR. The use of innovative computer technology for teaching social communication to individuals with autism spectrum disorders. Research in Autism Spectrum Disorders. 2011;**5**:96-107

[33] Hamad CD, Serna RW, Morrison L, Fleming R. Extending the reach of early intervention training for practitioners: A preliminary investigation of an online curriculum for teaching behavioral intervention knowledge in autism to families and service providers. Infants and Young Children. 2010;**23**:195-208

[34] Nefdt N, Koegel RL, Singer G, Gerber M. The use of a self-directed learning program to provide introductory training in pivotal response treatment to parents of children with autism. Journal of Positive Behavior Interventions. 2010;**12**:23-33

[35] Jang J, Dixon DR, Tarbox J, Granpeesheh D, Kornack J, de Nocker Y. Randomized trial of an eLearning program for training family members of children with autism in the principles and procedures of applied behavior analysis. Research in Autism Spectrum Disorders. 2012;**6**:852-856

Recovery from Diffuse Brain Injuries: Two Case Studies

Alejandro E. Brice and Roanne G. Brice

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69624

Abstract

Subarachnoid hemorrhages (SAHs) are grave medical emergencies, whereas 30–50% of all SAHs may ultimately result in death. Subarachnoid hemorrhages share many resemblances with other neurological traumas such as a cerebral vascular accident, meningitis, and/or traumatic brain injury. Autoimmune encephalopathies (AE) occur when human antibodies assault the body's cell surfaces and/or synaptic proteins. Consequently, widespread nervous system and diffuse brain involvement may occur. With subarachnoid hemorrhages and autoimmune encephalopathies, multiple areas of cognition and language can be impaired. Case studies in communication sciences and disorders are underutilized, yet are important in evidenced-based practice. Speech-language pathologists in medical settings have worked with patients and families with similar types of disorders. Therefore, speech-language pathologists should be well equipped to provide therapy with these types of injuries. This chapter presents two case studies and cognitive language rehabilitation strategies following diffuse brain injuries.

Keywords: brain injuries, diffuse injuries, subarachnoid hemorrhage, autoimmune encephalopathy, cognitive language rehabilitation

1. Introduction

1.1. Brain injuries

Brain injuries are a major cause of death and disability worldwide [1–3]. It is well documented that brain injuries exhibit immediate and long-term consequences on language abilities [4]. Language abilities in adolescent individuals with brain injury have been noted to be worse than matched controls (matched for age, gender, general ability, and interests) in syntax comprehension, particularly in the areas of listening and grammar [5]. Inflammation and neuro-degeneration are known to occur after initial traumas as secondary injuries [6].

Brain injuries can be classified according to several dichotomous taxonomies, that is, primary vs. secondary injuries, focal vs. diffuse pathologies, and inflammatory vs. non-inflammatory diseases [7–9]. Traumatic brain injuries (TBIs) s can be classified into two categories of primary and secondary injuries [1]. The primary injury consists of the actual physical trauma, while the secondary injury results from "biomolecular and physiological changes that follow these insults" [1, p. 97]. Secondary injuries are slow to change and may be a major factor in the patient's recovery [1]. Primary damage to the brain and central nervous system occurs with the initial insult (lacerations, fracture, contusions, axonal injury, intracranial hemorrhage), whereas a secondary injury is the resultant of such factors as increased intracranial pressure, interruption in the brain blood barrier flow, brain inflammation, disruptions in cerebral blood flow, ischemia, hypoxia, reperfusion, and/or reoxygenation injury [8, 9]. In addition, a series of events can lead to an accumulation of white blood cells in the injured brain area can lead to inflammation and secondary brain damage.

Graham et al. [9] stated that "Neuroimaging as a means of identifying intracranial pathology after head injury has allowed the clinician adoption of an alternative classification of focal and diffuse damage" (p. 641). Focal damage can be determined with certainty; however, the diffuse damage is much more difficult to ascertain regions of damage and consequently what cognitive and language areas are affected. Diffuse brain injury refers to damage to white and/or gray brain matter and not to a focal or localized injury [9]. However, several categories of diffuse brain injuries share similar pathophysiologies [9]. The diffuse brain injuries range in severity from concussion syndromes to diffuse axonal injury (DAI) to comatose. Currently, the term of traumatic axonal injury (TAI) is used to describe axonal injury after the initial trauma, that is, secondary axotomy (secondary severing or denervation of an axon) [9]. Secondary injuries can occur over a time span of hours, days, or weeks after the initial trauma. Consequently, secondary traumas may exert neurochemical changes in the brain, disrupt cerebral blood flow, disrupt the brain blood barrier function, and/or have neurotoxic effects on glial cells [10].

Central nervous system inflammatory diseases continue to be investigated, defined, and demarcated [7]. However, the pathological processes linking brain injury to neurodegenerative diseases still remain unclear. There is mounting evidence that neuroinflammatory processes may play a significant role in Alzheimer's disease, other dementias, and many neurodegenerative diseases [6, 11]. It is also known that traumatic brain injury also begins long-term neurological degenerative brain processes, for example, microglia activity and inflammation [11]. Brain inflammation is known to be a chronic hallmark of neurodegenerative diseases. Johnson et al. [11] stated that, "thus, persistent neuroinflammation following injury may prove mechanistically important in the link between TBI and Alzheimer's disease" (p. 29). Moderate and severe TBI leads to increased risk of later developing dementia [6, 12, 13]. Tau and amyloid beta pathologies are well-known sequelae in Alzheimer's disease [14]. Tau is proteins abundant in the neurons of the central nervous system and is known to become defective in the brain leading to dementias [15]. Even one traumatic brain injury may lead to tau and amyloid beta brain pathologies [16]. Repeated concussions may also lead to progressive brain abnormalities [6]. Chronic neuroinflammation as seen in chronic traumatic encephalopathies (CTEs) contributes to neurodegeneration. Autopsy studies have demonstrated the presence of reactive microglia even months or years after a single TBI [6].

1.2. Diffuse brain injury

According to Ewing-Cobbs and Barnes [17], "the diffuse injury consists of the cumulative Effects of diffuse axonal injury, hypoperfusion, excitotoxic cascades of neurotransmitters, and chronic alteration in neurotransmitter functions" (p. 210). Diffuse brain damage is likely to affect white matter tracts resulting from diffuse axonal injury affecting memory and executive function [18]. In addition, secondary inflammation resulting from a brain trauma may induce microglial activity which leads to further cognitive decline [2].

Ewing-Cobbs and Barnes [17] found that language outcomes after a traumatic brain injury are dependent upon several factors including age at the time of trauma, focal vs. diffuse brain injuries, and developmental acquisition of language functions at the time of the insult. Furthermore, they state that cognitive and language outcomes are more promising after perinatal and early focal damage. Diffuse brain injuries sustained in early childhood seem to be less promising, thus, indicating lessened behavioral and neural plasticity. Language and cognitive abilities that are in process of being acquired appear to be more vulnerable to disturbance than abilities that are better established [17]. Focal lesions can result in substantial reorganization of function; however, diffuse neuronal lesions do not result in reorganization and consequently poorer outcomes may result.

The sequelae of and pathological mechanisms resulting from a traumatic brain injury and consequent cognitive and language impairments are unclear. The resulting damage may lead to loss of neurons, axonal injuries, microbleeds, and disruptions to the blood-brain barrier (BBB) [3].

Diffuse brain injury has been associated with vascular and axonal impairments [19]. Initial responses include inflammation and disruption in the blood-brain barrier (BBB), and initiation of the body's systemic immune system, for example, glial cells reaction to the inflammation [19]. Changes in the blood-brain barrier at a microvascular level following a brain injury can last for months or years after the trauma. The interruption to the functioning of the BBB has been associated with the negative effects of a brain trauma. Diffuse brain injury occurs in the absence of a cerebral contusion (i.e., bruising of the brain) and does not lead to gross neuronal damage. However, diffuse axonal injury in the cortex, hippocampus, and dorsolateral thalamus may occur in the absence of a contusion and yet lead to cognition, attention, language, and memory impairments [2]. Damage to the hippocampus is associated with memory difficulties [20]. In conclusion, cognitive communication disorders seen in diffuse brain injuries may affect such abilities as memory, word retrieval, attention, an organization of information, and problem-solving [2, 18, 21]. Therapy concerns regarding cognitive communication disorders will be addressed in the following section.

1.3. Subarachnoid hemorrhages and autoimmune encephalopathies

Subarachnoid hemorrhages (SAH) and TBIs are major contributors to neurological cases and demonstrate similar problems in sub-acute care [22]. TBI incidence in industrialized and non-industrialized nations is estimated to be between 150 and 250 cases per 100,000 population, while the incidence of subarachnoid hemorrhages is estimated to be between 10 and 25 cases per 10,000 population [23].

Subarachnoid hemorrhages (SAHs) are grave medical emergencies, whereas 30–50% of all SAHs may ultimately result in death [24]. SAHs occur as a result of ruptured aneurysms or from a TBI. The subarachnoid hemorrhage is when blood accumulates below the arachnoid mater space on the brain's surface between the dura mater on top and the pia mater beneath (all part of the brain's meninges). Individuals who have suffered an SAH experience meningeal inflammation as a result of blood seeping into the cerebral spinal fluid (CSF). Subarachnoid hemorrhages share many resemblances with other neurological traumas such as a cerebral vascular accident, meningitis, and/or traumatic brain injury. Individuals with bacterial or viral meningitis have been reported to have difficulties with short-term memory, working memory, attention, and/or cognitive speed [25–27].

Autoimmune encephalopathies (AE) occur when human antibodies assault the body's cell surfaces and/or synaptic proteins. As a result, AE consist of a larger spectrum of inflammatory nervous system disorders including limbic encephalitis which is noted by subacute onset, memory loss, seizures, possible personality and mood changes, and alteration in one's senses [28]. In essence, encephalopathies can impact all areas of cognition [29]. In summary, subarachnoid hemorrhages and autoimmune encephalopathies both result in meningeal inflammation and diffuse brain injuries [29, 30].

1.4. Clinical history of cases

Two case studies involving patients with a subarachnoid hemorrhage (BA) and autoimmune encephalopathy (SJ) are presented. Both patients were healthy adults with no prior histories of speech, language, cognitive, or serious health conditions when the onset of the traumas occurred. The SAH typically results from a ruptured aneurysm or from a traumatic brain injury and consequential meningeal inflammation occurs. Autoimmune encephalopathies consist of a spectrum of inflammatory central nervous system disorders which may also include brain edema, and limbic encephalitis [29]. Consequentially, cerebral inflammation is a common outcome from both of these disorders.

BA was 52 years old when he suffered a subarachnoid hemorrhage (SAH). Prior to this incident, he was healthy with no history of cognitive or neurological issues. He exhibited slightly above average blood pressure and was taking anti-cholesterol medication prior to the trauma. BA experienced an aneurysm and hemorrhage to his right vertebral artery. This was surgically repaired 2 days after the SAH using two stents and a coil.

Immediately after the SAH, BA was screened by the hospital-based speech-language pathologist. The SLP used the Western Aphasia Battery-Revised [31] picture description task. BA's wife is a licensed and certified speech-language pathologist. The hospital-based SLP and the wife made the determination that BA was functioning "within normal limits" based on these results. The neurosurgeon and primary care physician also concurred with this assessment. However, this screening masked more pronounced difficulties that appeared later such as short-term and working memory difficulties, attention and cognitive speed processing, coping issues, and disruption in daily living skills [25–27, 32–35]. BA also continued to experience difficulties with word anomias, semantic paraphasias, phonemic and phonological paraphasias, and occasional errors in order of syntactical elements up to 2 years post-trauma.

SJ was a healthy 34-year old when she was admitted to the hospital suffering from confusion, disorientation, short-term memory loss, slowed mental processing and an inability to express herself. Over a period of a few months, she was assessed by a clinical psychologist with the Rey Auditory Verbal Learning Test (RAVLT) [36] and the Boston Naming Test [37]. According to the psychology report, SJ presented with low to average verbal immediate memory and low to average verbal delayed memory from the RAVLT. Recognition cues did not improve verbal recall. In addition, the Boston Naming Test indicated confrontation naming to be within normal limits.

SJ was later assessed by a neurologist using the Mini-Mental State Examination (MMSE) [38] and the Montreal Cognitive Assessment (MoCA) [39]. She scored 25/30 on both the MMSE and the MoCA. Specifically, SJ scored poor on attention, low to average on sustained attention, and low to average on delayed memory scores. SJ answered quickly, but incorrectly on tasks of sustained attention. SJ was diagnosed with autoimmune encephalopathy (AE). 4 months afterward, SJ reported that her episodes of confusion and cognitive issues ceased. At this time, she also received a 3-day regime and a dose of Solumedrol (a corticosteroid as SJ also suffered from myasthenia gravis); whereupon, she reported that she sustained attention and recall improved. The anti-inflammatory could have reduced any brain inflammation that could have occurred.

Both BA and SJ received self-administered, clinician-guided therapy. BA is a certified and licensed speech-language pathologist and also a university professor in speech-language pathology; in addition, BA's wife is a certified and licensed speech-language pathologist. SJ's sister is a certified and licensed speech-language pathologist. Consequentially, both BA and SJ did not receive traditional therapy, but self-administered therapy as guided by the SLP family member.

Self-administered, clinician-guided therapy has been noted in treating verbal anomias with individuals with aphasia [40, 41], cued naming therapy in an individual with aphasia [42], and a parent-administered program for teaching gestures to an individual with Angelman syndrome [43]. The objectives were selected by the clinicians; however, all treatments resulted in increased communication abilities in these individuals with severe and varied communication disorders (i.e., aphasia, word anomia, and Angelman syndrome).

2. Research methods

Both BA and SJ experienced diffuse brain injuries as a result from the subarachnoid hemorrhage (SAH) and autoimmune encephalopathy (AE). Encephalopathies affect all, areas of cognition and language with memory loss occurring in half of all patients with this disorder [29]. Consequentially, BA's and SJ's diffuse brain injury symptoms included: disorientation, memory loss, word retrieval difficulties, psychological tiredness, fatigue, concentration difficulties with coping, symptoms of post-traumatic stress disorder, and dependence on others [22, 29, 30, 44–49].

Therapy for diffuse brain injuries addresses issues of memory loss and retrieval difficulties, attention issues, organizational difficulties, problem-solving, and executive functioning [21].

Speech-language and cognitive rehabilitation therapy provided to both patients revolved around functional outcomes (i.e., return to work and life goals). Cognitive remediation was adapted from work with individuals with traumatic brain injury and stroke [50, 51]. Therapy techniques specifically focused on memory deficits, concentration issues, difficulty with daily living skills, irritability, impatience, dependence on others including use of: (a) cueing; (b) fading; (c) use of hierarchical targets; (d) anchoring; (e) repeated practice; and/or, (f) use of strategies [50]. Both patients have returned to work and have not received therapy after a period of 5 years.

2.1. Therapy approaches for subarachnoid hemorrhage and autoimmune encephalopathies

Cognitive and language rehabilitation approaches for both BA (i.e., subarachnoid hemorrhage) and SJ (i.e., autoimmune encephalopathy) were self-administered, clinician-guided since both patients were able to return to work within 4 months after both brain traumas had occurred, and the deficits were not noted to be severe enough to warrant direct speech-language therapy. However, it should be noted that although the deficits may be viewed as minor by others (e.g., family members, therapists, medical professionals), the patient may view the deficits as being major [32].

BA's wife was a certified and licensed speech-language pathologist, while SJ's sister was a certified and licensed speech-language pathologist. Both the wife and sister assisted in providing self-administered, clinician-guided therapy to the patients.

BA began reading and writing on a daily basis after his release from the hospital and return home, approximately one hour per day for both activities. He then began writing one page one hour each day and also reading an additional hour per day for weeks two to three. Afterward, he increased these activities to three hours per day for weeks 4–12. BA returned to work on week 13 post-release from the hospital. BA wrote a brief newsletter article, completed a research article, and peer reviewed refereed one journal articles 3 months following the trauma. Specific self-administered language techniques included semantic cueing, phonemic cuing, semantic feature analysis [52] and practicing strong relationships between noun and verbs; verb and agents (e.g., walk/sidewalk; sleep/bed). As a reminder, BA is also a speech-language pathologist.

BA estimated his attention levels post-trauma as follows: year 1, 85%; year 2, 90%; year 3, 95%; year 4, 96%; year 5, 98–100%.

Also paramount to SJ was her ability to SJ return to work which she accomplished 4 months after onset of symptoms. SJ is currently enrolled in a master's degree program in speech-language pathology, and her sister is a licensed and certified speech-language pathologist. Consequently, SJ like BA was highly motivated to participate in self-administered, clinician-guided therapy. SJ continued her reading activities investigating the cause of her illness, diagnosis, prognosis, and therapeutic outcomes. SJ read approximately one hour per day increasing to two hours per day over the course of 4 months. Use of semantic cueing and semantic feature analysis was also recommended by her sister. In addition, the following approaches were utilized by the SLP family members for both patients.

The therapy approaches were adapted from several sources including non-aphasic traumatic brain injury [53, 54] neurogenic disorders [55], and other cognitive disorders (such as working memory disorders) [56]. Strategies included the following:

1. *Word association and naming tasks* – Give a word and provide other words that are associated with it (this may include nouns, verbs, and/or adjectives). For example, the therapist says "table" and the client may respond with "chairs, eating, work, dining set, coffee table, etc." Implicit and episodic memories may be triggered [54].
2. *Reading* – Provide low and high-level reading materials. For example, reading may vary from the newspaper and pleasure reading books to higher level professional articles.
3. *Writing* – Write informal, formal, low and high-level pieces. For example, the client may write notes and letters and progress to higher-level written pieces as concentration improves.
4. *Word association and memory tasks* – Separate words into categories have the client memorize words in the categories utilize mnemonics. Utilize recognition naming (the target word is given along with two foils) and/or picture description (for more spontaneous naming). For example, the therapist elicits word and category recall. The clinician may keep track of correct information units (CIUs or i.e., words that are accurate and informative to the task) [56].
5. *Auditory attention tasks* – Have the client listen to a paragraph and answer questions; restate what was said; restate the main points; and, restate main items or discussion points.
6. *Divided attention tasks* – The client should focus on specific details while dismissing erroneous detail. For example, have the client press a key when two shapes are the same color and another key when they are different colors.
7. *Working memory and attention tasks* – Divide attention between multiple tasks; the client should attend to key information; and, ignore distractions; and, notice patterns. Examples include driving a car to conducting a presentation at work.
8. *Cognitive speed* – The client should be capable of shortening response times; processing information accurately and quickly. This is similar to spaced-retrieval training [55] where the client is asked to recall information repeatedly and systematically. For example, have the client engage in conversations and increase difficulty levels (i.e., moving from personal information to higher level professional discussions).
9. Compensatory strategies – Compensatory strategies may include note taking, recording events sequentially, and systematically slowing down all tasks for increased comprehension and hence, completion rates, and regular use of calendars for scheduling events.

In addition, speech-language pathologists should target the following goals for the patient and family to facilitate an increased quality of life [57]:

1. Reduce the family burden issues;
2. Reduce the patient dependence levels;

3. Improve the patient's ability to cope to everyday and new situations;

4. Address cognitive-language impairments (e.g., concentration, memory);

5. Address mood disturbances; emotional issues (e.g., anger, irritability);

6. Address fatigue, tiredness issues (directly or indirectly);

7. Address the patient's passivity issues.

In conclusion, subarachnoid hemorrhages and autoimmune encephalopathies share many commonalities with other disorders that speech-language pathologists may have already treated such cerebral vascular accidents, traumatic brain injuries, meningeal inflammation, and memory and attention deficits. While differing etiologies may determine, to some extent, prognoses and outcomes, therapeutic approaches for many cognitive-language disorders may share similarities. Consequentially, issues of disorientation, memory loss, word retrieval difficulties, psychological tiredness, fatigue, and concentration difficulties should be targeted in rehabilitation and in the form of compensatory strategies.

Declaration of interest

The authors report no declaration of interest. The authors have no financial interest, direct or indirect, in the subject matter or materials discussed in the manuscript. This project was a non-funded study.

Author details

Alejandro E. Brice[1*] and Roanne G. Brice[2]

*Address all correspondence to: aebrice@usfsp.edu

1 University of South Florida St. Petersburg, St. Petersburg, Florida, USA

2 University of Central Florida, Orlando, Florida, USA

References

[1] Greve M, Zink B. Pathophysiology of traumatic brain injury. Mount Sinai Journal of Medicine. 2009;**76**:97-104. DOI: 10.1002/msj.20104

[2] Muccigrosso M, Ford J, Benner B, Moussa D, Burnsides C, Fenn A, Eiferman D. Cognitive deficits develop 1 month after diffuse brain injury and are exaggerated by microglia associated reactivity to peripheral immune challenge. Brain, Behavior, and Immunity. 2016;**54**:95-109. DOI: 10.1016/j.bbi.2016/01.009

[3] Wang M, Li W. Cognitive impairment after traumatic brain injury: The role of MRI possible pathological basis. Journal of Neurological Sciences. 2016;**370**:244-250. DOI: 10.1016/j.jns.201609049

[4] Knuepffer C, Murdoch B, Lloyd D, LewisF, Hinchliffe F. Reduced N400 semantic priming effects in adult survivors of paediatric and adolescent traumatic brain injury. Brain and Language. 2012;**123**:52-63. DOI: 10.1016/j.badl.2012.06.009

[5] Tukstra L, Holland A. Assessment of syntax after adolescent brain injury: Effects of memory on test performance. Journal of Speech-Language-Hearing Research. 1998;**41**:137-149

[6] Faden A, Wu J, Stoica B, Loane D. Progressive inflammation-mediated neurodegeneration after traumatic brain injury or spinal cord injury. British Journal of Pharmacology. 2016;**173**:681-691

[7] Bar-Or A, Antel J. Central nervous system inflammation across the age span. Inflammatory Diseases and Infection. 2016;**29**(3):381-387

[8] Dardiotis E, Karanikas V, Paterakis K, Fountas K, Hadjigeorgiou G. Traumatic brain injury and inflammation: Emerging role of innate and adaptive immunity. In: Agrawal A. editor, Brain injury–Pathogenesis, Monitoring, Recovery and Management. InTech. 2012. Available from: http://cdn.intechopen.com/pdfs/33530/InTech-Traumat ic_brain_injury_and_inf lammat ion_emerging_role_of_innate_and_adaptive_immunity.pdf. DOI: 10.5772/27840. Braininjury-and-inflammation-emerging-role-of-innate-and-adaptive-immunity

[9] Graham D, McIntosh T, Maxwell W, Nicoll A. Recent advances in neurotrauma. Journal of Neuropathology and Experimental Neurology. 2000;**59**(8):641-651

[10] McIntosh T, Smith D, MeaneyD, Kotpka M, GennarelliT, Graham D. Neuropathological sequelae of traumatic brain injury: Relationship to neurochemical and biomechanical mechanisms. Laboratory Investigations. 1996;**74**:315-342

[11] Johnson V, Stewart J, Begbie F, Trojanowski D, Stewart W. Inflammation and white degeneration persist for years after a single traumatic brain injury. Brain. 2013;**136**:28-42. DOI: 10.1093/brain/aws322

[12] Gardner R, Burke J, Nettiksimmons J, Kaup A, Barnes D, Yaffe K. Dementia risk after traumatic brain injury vs. non-trauma: The role of age and severity. Neurology. 2014;**71**(12):1490-1497

[13] Lee Y, Hou S, Lee C, Hsu C, Huang Y, Su, Y. Increased risk of dementia in patients with mild traumatic brain injury: A nationwide cohort study. PLoS One. 2013;**8**(5):1-7

[14] Duyckaerts C, Colle MA, Delatour B, Hauw J. Alzheimer's disease: Lesions and their progression. Review of Neurology. 1999;**155**:17-27

[15] Lei P, AytonS, Finkelstein D, Adlard P, Masters C, Bush A. Tau protein: Relevance to Parkinson's disease. International Journal of Biochemistry and Cell Biology. 2010;**42**(11):1775-1778. DOI: 10.1016/j.biocel.2010.07.016.PMID 20678581

[16] Johnson V, Stewart W, Smith D. Widespread tau and amyloid-beta pathology many years after a single TBI in humans. Brain Pathology. 2012;**22**:142-149

[17] Ewing-Cobbs L, Barnes M. Linguistic outcomes following traumatic brain injury in children. Seminars in Pediatric Neurology. 2002;**9**(3):209-217

[18] Kinnunen K, Greenwood R, Powell J, Leech R, Hawkins P, Bonnelle V, Sharp D. White matter damage and cognitive impairment after traumatic brain injury. Brain. 2011;**134**:449-463. DOI: 10.1093/brain/awq347

[19] Mayer C, Huber B, Peskind E. Traumatic brain injury. Neuroinflammation, and posttraumatic headaches. Headache: The Journal of Head and Face Pain. 2013;**53**(9):1523-1530. DOI: 10.1111/head.12173

[20] Dubois B, Feldman H, Jacova C, Dekosky S, Barberger-Gateau, Cummings J, Scheltens P. Research criteria for the diagnosis of Alzheimer's disease. Revising the NINCDSADRDA criteria. Lancet Neurology. 2007;**6**:734-746

[21] American Speech-Language-Hearing Association. Knowledge and skills needed by speechlanguage pathologists providing services to individuals with cognitive-communication disorders [Knowledge and Skills]. 2005. Available from: http://www.asha.org/policy/KS2005-00078/

[22] Hellawell D, Pentland B. Relatives' reports of long term problems following traumatic brain injury or subarachnoid haemorrhage. Disability and Rehabilitation. 2001; **23**(7):300-305

[23] León-Carrión J, Domínguez-Morales M, Martín J, Murillo-Cabezas F. Epidemiology of traumatic brain injury and subarachnoid hemorrhage. Pituitary. 2005;**8**:197-202

[24] Brice A, Brice R, Wallace S. Recovery from a sub-arachnoid hemorrhage: Days one through twenty-two. Communication Disorders Quarterly. 2016;**38**(1):46-51. DOI: 10.1177/1525740116638637

[25] Anderson V, Anderson P, Grimwood K, Nolan T. Cognitive and executive functioning 12 years after childhood bacterial meningitis: Effect of acute neurologic and age of onset. Journal of Pediatric Psychology. 2004;**29**(2):67-81

[26] Hoogman M, van de Beek D, Weisfelt M, de Gans J, Schmand B. Cognitive outcome in adults after bacterial meningitis. Journal of Neurology, Neurosurgery, and Psychiatry. 2007;**78**:1092-1096. DOI: 10.1136/jnnp.2006.110023

[27] Schmand B, de Bruin E, de Gans J, van de Beek D. Cognitive functioning and quality of life nine years after bacterial meningitis. Journal of Infection. 2010;**61**:330-334

[28] McKeon A. Immunotherapies for autoimmune encephalopathies and dementias. Current Treatment Options in Neurology. 2013;**15**:723-737

[29] Flanagan E, Caselli RJ. Autoimmune encephalopathy. Seminars in Neurology. 2011;**31**(2): 144-157

[30] Berggren E, Sidenvall B. Larsson D. Memory ability after subarachnoid haemorrhage: Relatives' and patients' statements in relation to test results. British Journal of Neuroscience Nursing. 2011;**6**(8):383-388

[31] Kertesz A. The Western Aphasia Battery-Revised. San Antonio, TX: Pearson; 2006

[32] Buchanan K, Elias L, Goplen G. Differing perspectives after subarachnoid hemorrhage: The patient, relative, the neurosurgeon. Neurosurgery. 2000;**46**:831-840

[33] Schmidt H, Heimann B, Djukic C, Fels C, Wallesch C-W, Nau R. Neuropsychological sequelae of bacterial and viral meningitis. Brain. 2006;**129**:333-345. DOI: 10.1093/brain/awh711

[34] Sittinger H, Müller M, Schweizer I, Merkelbach S. Mild cognitive impairment after viral meningitis in adults. Journal of Neurology. 2002;**249**:554-560

[35] Weisfelt M, van de Beek D, Hoogman M, Hardeman C, de Gans J, Schmand B. Cognitive outcome in adults with moderate disability after pneumococcal meningitis. Journal of Infection. 2006;**52**:433-439. DOI: 10.1016/j.jinf.2005.08.014

[36] Rey A. L'examen psychologique dans les cas d'encéphalopathie traumatique. Archives de Psychologie. 1941;**28**:21

[37] Kaplan EF, Goodglass H, Weintraub S. The Boston Naming Test. 2nd ed. Philadelphia: Lea & Febiger; 1983

[38] Folstein MF, Folstein SE, McHugh PR. Mini-mental state: A practical method for grading the state of patients for the clinician. Journal of Psychiatric Research. 1975;**12**:189-198

[39] Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, Collin I, Cummings J, Chertkow H. The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. Journal of the American Geriatrics Society. 2005;**53**(4):695-699. DOI: 10.1111/j.1532-5415.2005.53221.x.ISSN0002-8614.PMID15817019

[40] Lavoie M, Routhier S, Légaré A, Macoir J. Treatment of verb anomia in aphasia: Efficacy of self-administered therapy using a smart tablet. Neurocase. 2016;**22**(1):109-118. DOI: 10.1080/13554794.2015.1051055

[41] Routhier S, Bier N, Macoir J. Smart tablet for smart self-administered treatment of verb anomia: Two single-case studies in aphasia, Aphasiology. 2016;**30**(2-3):269-289. DOI: 10.1080/02687038.2014.973361

[42] Ramsberger G, Marie B. Self-administered cued naming therapy: A single participant investigation of a computer-based therapy program replicated in four cases. American Journal of Speech-Language Pathology. 2007;**16**:343-358

[43] Calculator S. Description and evaluation of a home-based parent-administered program for teaching enhanced natural gestures to individuals with Angelman syndrome. American Journal of Speech-Language Pathology. 2016;**25**:1-3

[44] Berggren E, Sidenvall B., & Larsson, D. Subarachnoid haemorrhage has long-term effects on social life. British Journal of Neuroscience Nursing. 2011;**7**(1):429-435

[45] Bethel J. Subarachnoid haemorrhage: Case study and literature review. Emergency Nurse. 2010;**18**(1):22-27

[46] Caselli RJ, Drazkowski JF, Wingerchuk DM. Autoimmune encephalopathy. Mayo Clinic Proceedings. 2010;**85**(10):878-880

[47] Hellawell D, Taylor R, Pentland B. Persisting symptoms and carers' views of outcome after subarachnoid haemorrhage. Clinical Rehabilitation. 1999;**13**:333-340. DOI: 10.1191/026921599695000092

[48] Jarvis A. Recovering from subarachnoid hemorrhage: Patients' perspective. British Journal of Nursing. 2002;**11**(22):1430-1437

[49] Powell J, Kitchen Heslin J, Greenwood R. Psychosocial outcomes at three and nine months after good neurological recovery from aneurysmal subarachnoid haemorrhage: Predictors and prognosis. Journal of Neurological Neurosurgery Psychiatry. 2002;**72**:772-781

[50] Eack S. Cognitive remediation: A new generation of psychosocial interventions for people with schizophrenia. Social Work. 2012;**57**(3):235-246. DOI: 10.1093/sw/sws008

[51] Robertson IH, Murre JMJ. Rehabilitation of brain damage: Brain plasticity and principles of guided recovery. Psychological Bulletin. 1999;**125**:544-575

[52] Boyle M, Coelho CA. Application of semantic feature analysis as a treatment for aphasic dysnomia. American Journal of Speech-Language Pathology. 1995;**4**:94-98. DOI: 10.1044/1058-0360.0404.94

[53] Acerson A. Cognitive therapy for mild traumatic brain injury. 2015. Available from: https://thespeechclinic.wordpress.com/2013/02/28/cognitive-therapy-for-mild-traumatic-brain-injury

[54] Ylvisaker M, Szekeres S, Feeney T. Communication disorders associated with traumatic brain injury. In: Chapey R, editor. Language Intervention Strategies in Aphasia and Related Neurogenic Communication Disorders. Philadelphia, PA: Lippincott, Williams & Wilkins; 2001. pp. 745-808

[55] Hopper T, Bayles K. Management of neurogenic communication disorders associated with dementia. In Chapey R, editor. Language Intervention Strategies in Aphasia and Related Neurogenic Communication Disorders. Philadelphia, PA: Lippincott, Williams & Wilkins; 2001. pp. 829-846

[56] Murray L, Chapey R. Assessment of language disorders in adults. In: Chapey R, editor. Language Intervention Strategies in Aphasia and Related Neurogenic Communication Disorders. Philadelphia, PA: Lippincott, Williams & Wilkins; 2001. pp. 55-126

[57] Hidecker MJC, Jones RS, Imig DR, Villarruel FA. Using family paradigms to improve evidence-based practice. American Journal of Speech-Language Pathology. 2009;**18**(3):212-221

Chapter 20

Intervention Program for Brazilian Children with Language Delay

Camilla Guarnieri and
Simone Aparecida Lopes-Herrera

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.69757

Abstract

The acquisition and development of language are primary in a child's life, especially because language is one of the main means of social interaction. Therefore, it is of great importance that good language development has been assured to children and, when necessary, good intervention at their difficulties. Currently, in the field of children's language in Brazil, different therapeutic approaches are arguable, but the necessity of development of structured therapeutic programs is verified, elaborated with technical and scientific quality so that they may stimulate the different abilities of language, aiming at considering the specificities of each child in order to minimize the difficulties. Such intervention programs would guide speech-language pathologists to plan their therapies and provide more effects in the intervention process. The aim of this study is to elaborate a stimulation program for verbal language for children with language delay. For this reason, the stimulation program was judged by peers (experts) after it was designed. The experts verified if the strategies were coherent about (a) the stimulation target and (b) the complexity level. In conclusion, the program reached the goal, since it could give direction and enhance to speech-language pathologists in cases of difficulties in verbal language.

Keywords: speech-language pathology, children, child language, language delay, speech and language rehabilitation

1. Introduction

The importance of language for child development is a well-known factor in the literature, and disabilities in the process of acquisition and development of language can bring a series of social and academic harms. Therefore, it is of utmost importance that children with these disabilities receive adequate diagnosis and effective treatment as soon as possible, thus improving their quality of life [1, 2].

Language disabilities in childhood have a high prevalence, reaching a frequency of up to 20% [1–3]. In the Brazilian literature, the prevalence for child language disabilities is 3–15% [4, 5]. Overall, the most common are language delay (LD), specific language impairment (SLI), and phonological disorder (PD). Each one of these cases has its respective linguistic manifestations [4, 6].

In view of this, it is of primary importance that professionals in the field of Speech-Language Pathology have good knowledge about the characteristics of the language and its typical development for the identification of children with language disabilities and their differential diagnosis. Such knowledge is not only relevant to the diagnostic area, but also to the intervention one, since a good intervention planning should be based on the patient's linguistic difficulties, and the professional should use strategies that contemplate this planning to provide a correct stimulation of the lagged skills [7, 8].

In the Brazilian literature, there is a lack of interventional studies, especially on language delay [9]. Nevertheless, we have noticed that it is possible to find intervention programs with proven efficacy when the search for the international literature is extended [10–14]. However, as already confirmed by some authors [15], it is not always feasible to adapt or translate such models, firstly because linguistic differences, mainly related to the structure (form) of language, as the interventions are based on these language skills and abilities. Furthermore, adaptations and translations sometimes need a reformulation, because some aspects such as frequency and duration of intervention have different demands depending on the region and target-population where it will be applied, which turn the use of some programs impracticable.

Several studies show that structured programs of speech-language intervention in language bring linguistic gains to those submitted to them [16–18]. Such programs can often help clinical speech pathologists to plan and organize their intervention better and play a key role as a practical guide in developing therapeutic planning.

However, other studies, especially case reports, show that several times these programs are used in an adapted manner, generally including other aspects as an intervention goal, to meet the individual needs of each patient, showing the need for semi-structured intervention programs that could have a previous material structured as well as the flexibility to modify some goals or strategies aiming at considering individualities of each patient [19–21].

Currently in the Child's Language field, there are several Brazilian instruments for the diagnosis of oral language disorders, however, the research and clinical use of models, training, and intervention programs, especially for those in which there is a need to work at different levels of language such as in the cases of SLI and LD are still scarce in the Brazilian literature. There is also great difficulty in finding materials and therapeutic strategies with technical and scientific quality that are available in the literature for speech and language intervention.

Thus, there is a lack of Brazilian models and programs of intervention that encompasses the stimulation of all levels of language, involving theoretical and practical content, including proposing targeted intervention strategies. In addition, the models and programs of therapy currently found are not punctual in the difficulties of each child.

The proposed program in this chapter is based on strategic planning, to emphasize the stimulation of the difficulties of each child, so that it can be effective. The work was developed with the purpose of ensuring that such intervention brings coherent strategies (both to the therapeutic objective and the age range of the child), attractive and executable by such child, in addition to boosting the desired communicative behaviors and to focus the language levels that are out of balance in order to reach a larger linguistic domain.

2. Intervention program (ELO program)

This section aims at describing the elaboration and the content validation (by jury of experts) of an intervention program for children within 3–6 years old with a diagnosis of language delay. The intervention program is called ELO (Estimulação da Linguagem Oral) in Portuguese and meaning "oral language stimulation" in English. Furthermore, the entire intervention program will be described in detail, and the content validation will show results of coherence of strategies in accordance with the intervention targets.

2.1. Methodology

2.1.1. Pilot study

Prior to this study, a pilot study was carried out. In this study, 24 interventional sessions were performed on 10 children with language delay (LD) who were within 3 and 6 years old. The pilot study had its results presented, and for this, the ELO program was reworked in order to solve its deficits [22].

The pilot study had three phases: Pre-intervention assessment—when the children were submitted to Brazilian standardize tests [23–27] to assess information about receptive and expressive language in general, auditory working memory, phonology, expressive vocabulary, and auditory discrimination—; intervention application—where are performed 24 sessions of the proposed intervention program—; and, at last, post-intervention assessment—with the same protocol of the pre-intervention assessment. The comparative results, in percentage, of pre and post-intervention assessment are presented in **Figure 1**.

Based on these results, the Wilcoxon statistical test was applied to verify if the difference in pre and post-intervention performance was statistically significant, for this was adopted $P \leq 0.05$. **Table 1** shows the skills tested and whether there was statistical significance when compared to before and after intervention.

In the pilot study, an improvement was found in all skills tested at the time of intervention, so that most of the results were statistically significant, and the only ability that did not have significance was auditory discrimination.

Another important finding obtained by the pilot study was that, even though the sample was quite specific, there were differences in the language level of these children. Then, two different levels were elaborated for each of the proposed programs: level I with less complex strategies and level II with more complex strategies.

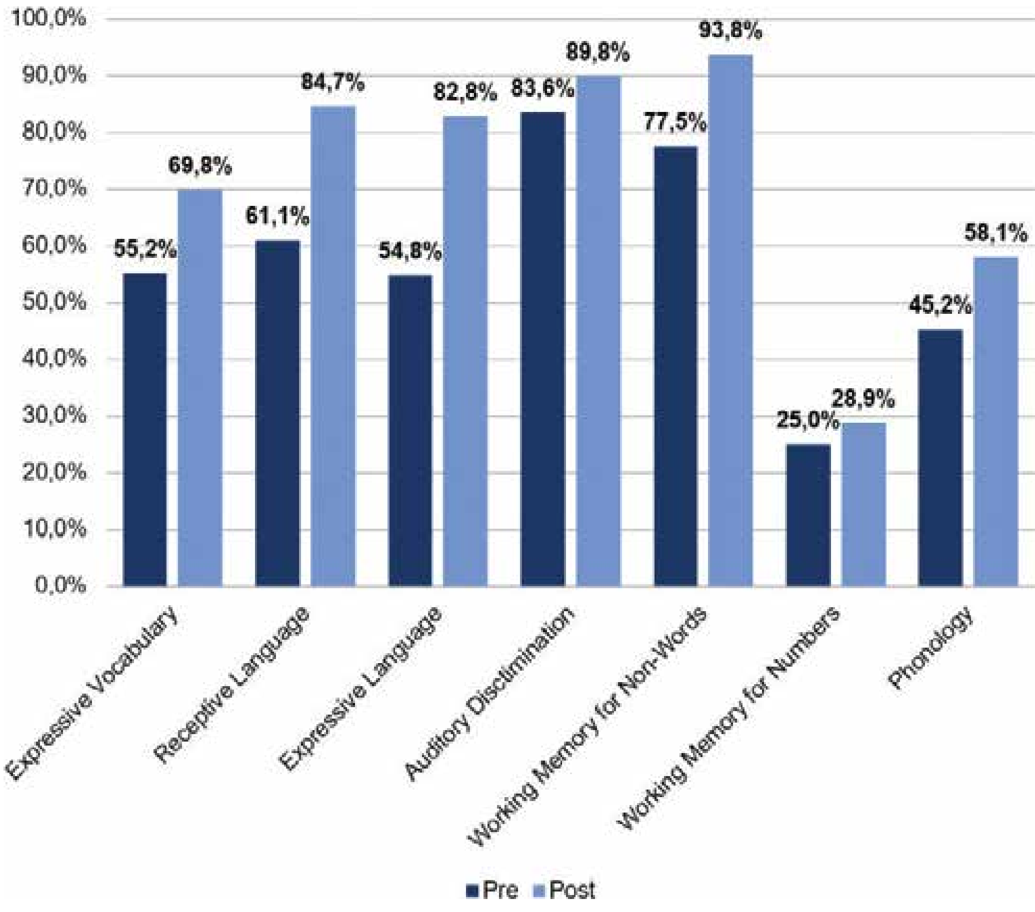


Figure 1. Average results of pre and post assessment of pilot study.

Skills which have statistical significant gain	Skills which do not have statistical significant gain
Expressive vocabulary	Auditory discrimination
Receptive language	
Expressive language	
Working memory for non-words	
Working memory for numbers	
Phonology	

Table 1. Summary of results.

Each child received language therapy with a different therapist—one therapist to each child and all therapists underwent a 6-h training and had 2 h of weekly supervision, one before and one after care. This training and these supervisions were carried out by the authors. All intervention sessions were supervised by them.

http://dx.doi.org/10.5772/intechopen.69757

2.1.2. Elaboration and content validation

According to the identified needs on the pilot study, a review of the literature was undertaken once more aimed at improving the program, which was adjusted based on these studies.

After the revisions, the program was presented to two examiners (who have a master degree in speech-language pathology and experience in Child's Language).

2.2. Results

The ELO program was specifically designed for children with LD, with two levels: Level I and Level II. These levels differ by the levels of complexity of the strategies, as it is known that this should vary accordingly to the general and development level of each child.

It was then elaborated that the Language Level Verification Protocol (LLVP) generally checks items such as receptive vocabulary, expressive vocabulary, phonological organization, narrative-pragmatic skills, and comprehension. This protocol has a global score (GS) and specific scores (comprehensive score (CS), narrative-pragmatic score (NPS), syntactic and semantic-lexical score (SSLS), and phonetic-phonological score (PPS)). All values are represented by absolute numbers and percentages.

Based on LLVP, the child's level of language was classified in I or II, and, for this, the global percentage score was adopted, with scores less than or equal to 50%, corresponding to level I and above this value at level II. This classification ends up reflecting the linguistic level of the child, that is, children of level I are smaller children and/or have more difficulties, and children of level II are older children and/or with fewer difficulties.

The ELO program is also divided into subprograms (Program A, Program B, Program C, and Program D) that vary according to the higher focus skills. Thus, the subprogram was chosen accordingly to the child's greatest difficulties by selecting the specific percentage scores of PVNL. In addition, the program had a greater focus on the ability to obtain a lower percentage score (greater number of errors). Moreover, program A has a greater focus on phonetic-phonological issues, program B on comprehension, program C on syntax and semantics, and program D on pragmatics.

The ELO program is composed of 20 sessions of direct and individual intervention, with a frequency of three times a week with an average duration of 60 min per session.

Each child fits into one of them, regarding language stimulation goals that need to be more focused (more committed) for each case. The types of program are described in **Table 2**.

For the psycholinguistic abilities, the following were addressed: auditory memory, logical-temporal sequence, auditory processing skills, perceptual-auditory abilities (discrimination of verbal sounds), and phonological awareness, distributed accordingly to **Table 3**.

Each of these programs has level I and level II, with each level encompasses 20 individual and direct therapeutic sessions.

Figure 2 briefly summarizes the strategies used, in general, in all subprograms at level I.

Figure 3 briefly summarizes the strategies used, in general, in all subprograms at level II.

Intervention goal	Program A	Program B	Program C	Program D
Morphosyntax and semantics	3 sessions	4 sessions	4 sessions	6 sessions
Narrative and pragmatics	3 sessions	3 sessions	6 sessions	4 sessions
Phonetic and phonology	6 sessions	3 sessions	3 sessions	3 sessions
Psycholinguistic skills	7 sessions	6 sessions	6 sessions	6 sessions
Comprehension	1 session	4 sessions	1 session	1 session

Table 2. Distribution of the number of therapeutic sessions focusing on each of the language stimulation goals.

Psycholinguistic skills	Program A	Program B	Program C	Program D
Memory	1	1	1	1
Logic-temporal sequence	1	1	1	1
Auditory processing	2	2	2	2
Auditory discrimination	2	1	1	1
Phonological awareness	1	1	1	1

Table 3. Distribution of the number of therapeutic sessions focusing on psycholinguistic skills in each of the subprograms.

Target sounds and words used in the auditory perception sessions were the same ones used in the phonology sessions. These were chosen according to the phonological processes performed by the child, prioritizing the work on the sounds to be acquired first in the typical language development.

When vocabulary is targeted, a survey of the familiar vocabulary must be done, using the follow protocol—specifically developed for this purpose, to carry out the lexical expansion, initially by the words that the child is most exposed to. The protocol questions are about properly names such as teachers', family, pets, and classmates; which foods the child prefer or have the habit to eat; which toys, games, or cartoons the child likes; and colors of teeth brush, pajamas, school cloths, tower, pillow, blankets etc. At the end of the protocol, there is space for the family to describe the child routine in detail.

In the next pages are described all the strategies used in the ELO program.

2.2.1. List of detailed strategies

2.2.1.1. Strategies Level 1

The strategies described in **Table 4** were designed for children with the following linguistic profile.

http://dx.doi.org/10.5772/intechopen.69757

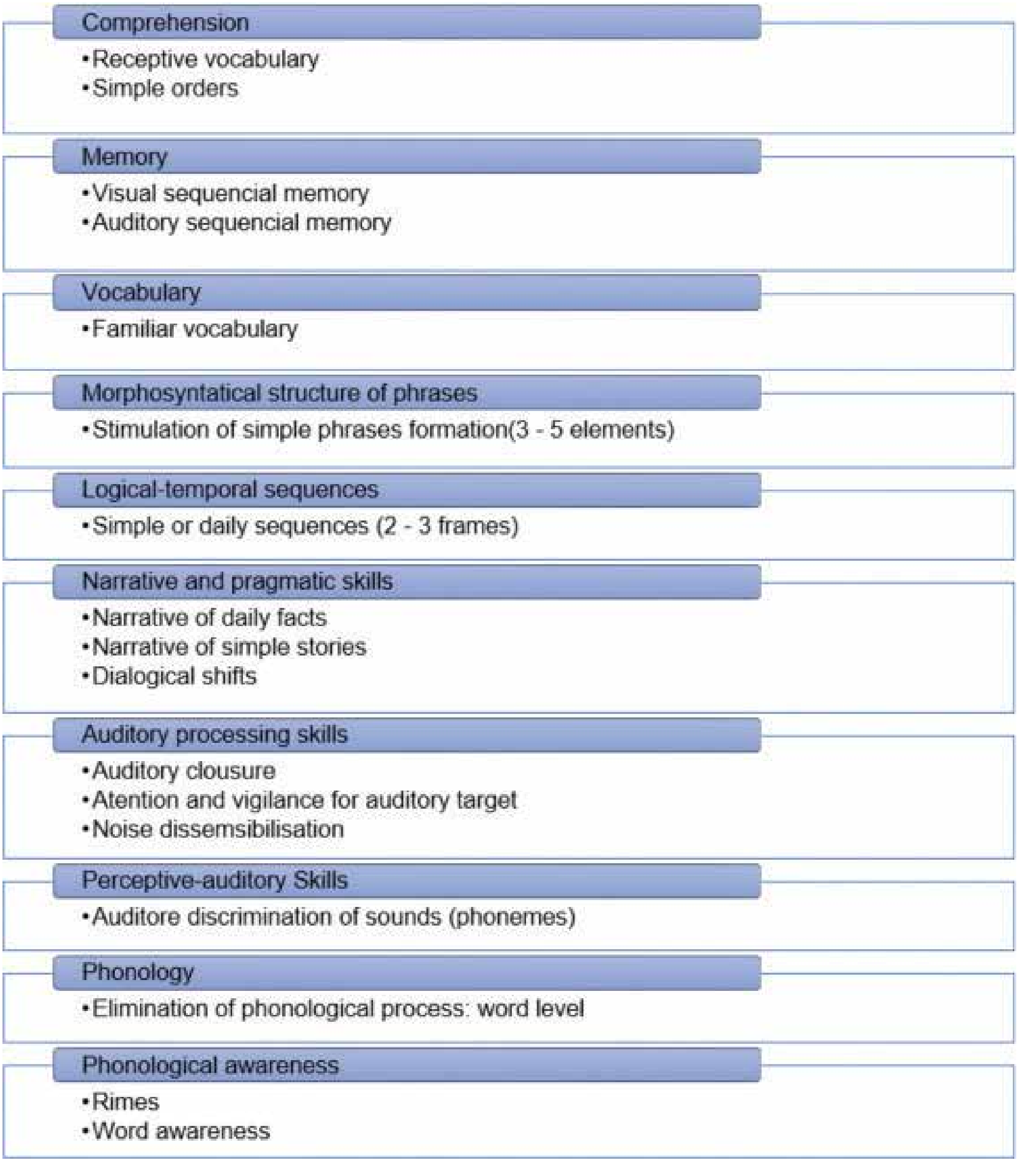


Figure 2. Specific objectives for Level I language stimulation goals of the ELO program.

Children with difficult to understand orders, mainly complex and segmented, presenting lack of oral or speech intelligibility, quite compromised (speech garbled, several phonological processes), presenting deficits in receptive vocabulary, and pragmatic abilities.

2.2.1.2. Strategies Level 2

The strategies described in **Table 5** were designed for children with the following language profile.

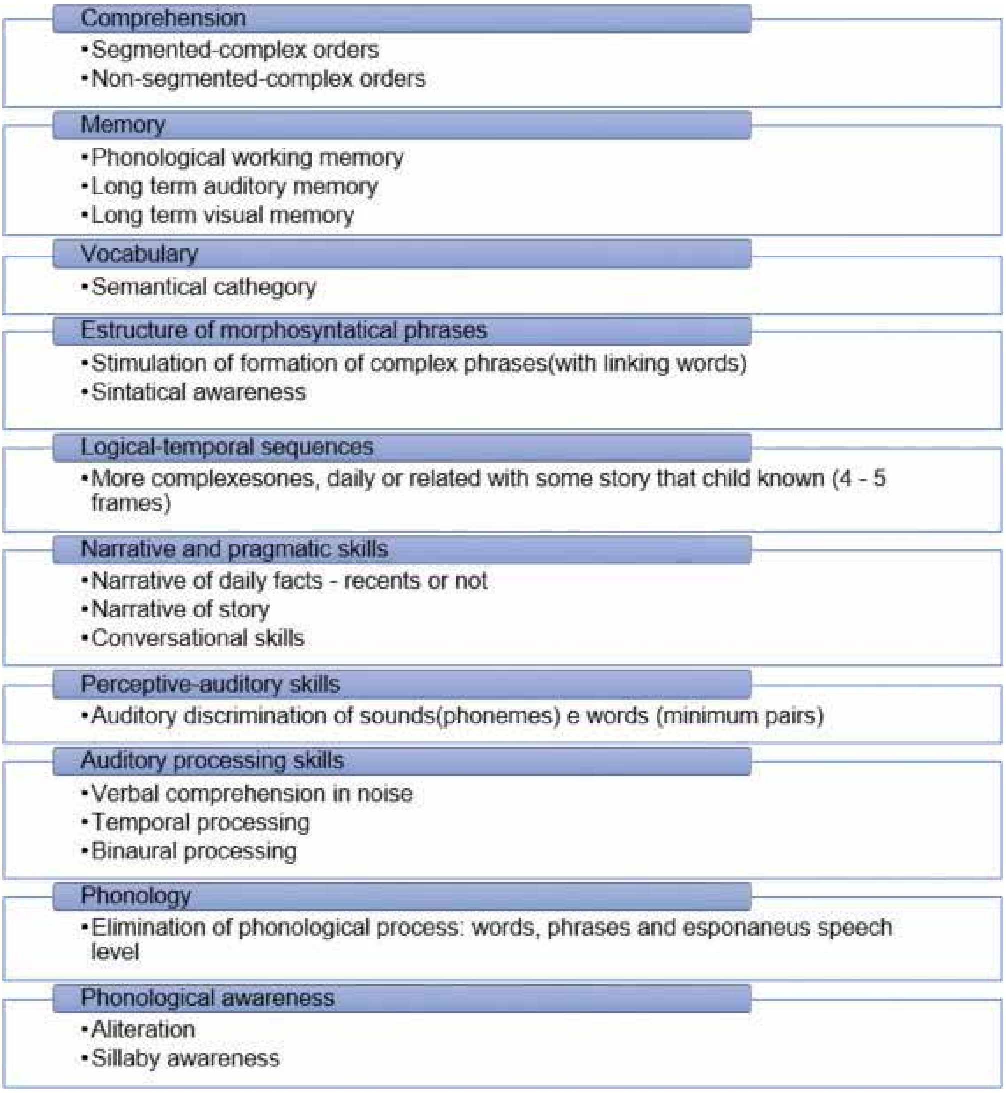


Figure 3. Specific objectives for Level II language stimulation goals of the program.

Children without comprehension difficulties, with deficits in expressive vocabulary, being composed mainly by nouns and verbs (little use of adverbs, adjectives and linking elements), make short sentences (up to 5 elements) and in general do not use binding elements. They are between the periods of proto-narrative and primitive narrative, and they have few phonological exchanges (generally they do not have impaired speech intelligibility).

2.2.2. Examiner analysis

In order to verify the coherence of the ELO Program and its strategies, it was submitted to the analysis of two examiners (speech-language pathologists with experience in language intervention).

Strategy 1: Playing with simple orders

Goal: Understanding and executing simple orders

Description: The child will play a game where he or she will fulfill a series of simple commands ("touch your nose", "clap your hands", "jump on one foot", "pretend to be sleeping", "imitate a dog", "Show how old you are", "show the tongue", "shake your head", "imitate a plane" and "open your mouth wide"). If the child does not execute the proposed instructions, the therapist will, at first, repeat the order, secondly rephrase the order, in a third try, give a gestural clue and if the child still cannot comply, the therapist will show the child what should be done by explaining the order and requesting that the child reproduced the movement.

Strategy 2: Memory game with sounds and figures

Goal: Work on short-term visual and auditory memory

Description: The child and the therapist will play a digital memory game where one of the pairs is an image and its corresponding sound is emitted by such an image. The therapist will be able to avail the game with the theme "Animals," "Means of Transport," "Sounds of Nature," and "Sounds of the City." At first, the therapist will present the sound and the image to the child. As the game begins, if the child shows difficulties, the therapist will reduce the number of pairs (initially four pairs will be presented) and as the child is showing more ease in the task, the therapist will increase the number of pairs contained in the game until reaching 10 pairs).

Strategy 3: Working with memory on the market

Goal: Work on the sequential auditory memory

Description: The therapist will set up a "mini market" to play with the child, they will work in alternating shifts of roles; sometimes, the therapist is the salesperson and the child the consumer and vice versa. Then, the consumer will order, and only after the order is complete, the seller must pick up the requested items. At first, the therapist will request only one item and then gradually increase the number of requested items. If the child shows difficulties, the therapist will repeat the request, and if the child still cannot follow, the therapist will segment the requested sequence and decrease the number of elements for the next time.

Strategy 4: Exploring the familiar vocabulary

Goal: Performing lexical expansion

Description: After raising the family vocabulary, the therapist will organize activities of symbolic play involving such a lexical repertoire. In these activities, the therapist will name such objects (only concrete objects will be used at first) and explore their function. When the child shows mastery over the name and function of the target words, the therapist will begin to match the concrete object to the image.

Strategy 5: Naming game

Goal: Performing lexical expansion

Description: Using target words contained in the child's vocabulary, the therapist and the child will carry out activities where the child should name the corresponding figures (e.g. "bowling", "Don't let the marbles fall", "pop-up pirate" and "don't break the ice"). If the child cannot name the picture, the therapist will give the function and characteristics of the object, even then if the child is not able to do it, the therapist will use prompt articulatory hints.

Strategy 6: Building phrases

Goal: Work on phrase construction

Description: The therapist will use action pictures ("A pig eating corn", "man milking a cow", "children playing on the beach", "A boy crying", "A dog drinking water", "A woman making a cake") as visual stimulus for sentence construction. First, the therapist will work on the elements used in the picture (without showing it) by naming them, giving functions and characteristics of each element and then presenting the action picture for the child to elaborate the sentence. If the child shows difficulties, the therapist will retake the elements in the action picture again.

Strategy 7: Right or wrong?

Goal: Stimulate syntactic awareness

Description: The therapist will present the child with several phrases ("I love bananas," "My house was wet," "Today I went to school," "The cake is overdone," "My toy has broken," "Yesterday I went to the movies," "The water I had was cold") and the child will have a red sign, which he/she will raise when the sentence is wrong, and a green one, for correct sentences.

Strategy 8.: Ordering logical-temporal sequences

Goal: Work with logical-temporal sequence

Description: The therapist will take every day logical-temporal sequences, and the child will put them in order and then narrate what happened.

Strategy 9: Experience Booklet

Goal: Work on narrative-pragmatic skills

Description: The child will draw/make collages in a notebook about the events that happened outside the therapeutic environment, so that in the therapeutic session, the child narrates such events with the support of the notebook. The therapist will always give the correct model if the child shows phonetic-phonological and/or morphosyntax changes, however without correcting the child directly.

Strategy 10: Playing with Puppets

Goal: Work on narrative-pragmatic skills

Description: The child and therapist will stage various situations using puppets, the therapist will allow the child to guide the script with easier subjects, yet always modeling the proper shift, role reversal, and narrative coherence.

Strategy 11: Attention to sounds!

Goal: Work on Auditory attention

Description: A series of syllables will be presented to the child (for example: PA PA PA PA PA PA GA PA PA GA), and every time the child hears the less frequent syllable (which will be indicated by the therapist at the beginning of the session), the child will raise a small sign. It is emphasized that the activity will be carried out with headphones to control the sound intensity and to soften competitive noises.

Strategy 12: Finding the sound

Goal: Work on the auditory localization

Description: The child will be blindfolded, and the therapist will use sound sources of different frequencies (rattle, "Agogo," bell, and drum), and the child should locate, track, and find the object related to the sound source.

Strategy 13: Phoneme pyramid

Goal: increase the auditory perception for the phonemes worked

Description: The therapist will choose a minimal opposing phoneme to the target phoneme (preferably by some phoneme that the patient performs the process to be worked on) and associate the sound with some picture. Then she will use two pyramids and a "reward," each of the pyramids will contain the previously associated picture, and then, the child closes the eyes, and the therapist hides the "reward" in one of the pyramids. When the child opens the eyes, the therapist shows the sounds again and says that he or she will give a clue to the child, then he gives the auditory clue (the "reward" phoneme), and the child using that clue discovers where the prize/reward is.

Strategy 14: Auditory bombarding

Goal: Working on Phonological Aspects

Description: It is read to the child, twice (beginning and end) a list of 20 words (mono and disyllables) that start with the target phoneme. The same list is used at home, and caregivers are asked to read 3 times a day.

Strategy 15: Naming game

Goal: Work on Phonological Aspects

Description: Using the target words (5 of the bombardment words that the child uses the most), the therapist and the child will perform activities where the child should name the corresponding pictures (e.g. bowling, “don’t let the marbles fall”, “don’t let the ice break”). If the child cannot name the pictures correctly, the therapist will give the function and characteristics of the object, even then if the child is not able to do it, the therapist will use prompt articulatory hints.

Strategy 16: Playing with rimes

Goal: Stimulate Phonological Awareness

Description: The therapist will tell stories and songs with rhymes to the child to increase the exposure to that ability.

Table 4. List of strategies on Level 1.

Strategy 1: Playing with segmented and complex instructions

Goal: Work understanding and executing complex and segmented instructions

Description: A game will be done with the child where one must fulfill a series of instructions, at first, segmented (“Take the blue car, now put the blue car in the garage of the orange house,” “Take the blonde girl sitting on the bench,” “pick up the banana, put the banana on the plate,” “pretend you are asleep, now pretend you are sleeping and snoring,” “pick up the cat.” “Put one hand on the blue ball and the other one on the red ball,” “put your foot on the flower and your hand in the sun,” “put your hand on the green square and then on the white square,” “put your foot in the sea and then on the star,” “put both feet in the cloud and then jump on the white square”). If the child does not execute the proposed instruction, the therapist will, at first, repeat the instruction; secondly rephrase it; in a third try, give a gestural clue; and if the child still cannot fulfill the task, the therapist will show the child what is supposed to be done by explaining the drill and requesting that the child reproduce the movement.

Strategy 2: Auditory and visual sequential memory game

Goal: Stimulate both auditory and visual sequential memory.

Description: By means of digital resources, the child will be presented to series of sequences involving colors and sounds (first, color associated to the sound, then only the sound) and the child must repeat the sequence, as the child is showing more ease to the sequence, it will gradually increase.

Strategy 3: Keep a secret

Goal: Short and long-term auditory memory

Description: The therapist will tell a secret to the child at the beginning of the session (e.g. “my father is bald”, “my favorite food is chicken drumstick”, “I’m afraid of frogs” etc.), then the therapist will ask for information at the end of the same session and the next one.

Strategy 4: Exploring vocabulary by categories

Goal: Performing lexical expansion

Description: It will be chosen a vocabulary category that the child has difficulty and the therapist will organize activities, such as stories and games, involving such a lexical repertoire, in these activities the therapist will name such objects and explore their function.

Strategy 5: Building phrases II

Goal: work on phrases construction

Description: The therapist will use pictures to explore children’s prior knowledge and encourage them to organize sentences accordingly to the theme chosen. Every time the child uses a syntactically inappropriate phrase, the therapist will provide the correct model.

Strategy 6: Right or wrong?

Goal: stimulate syntactic awareness

Description: The therapist will present several sentences to the child ("I love bananas," "My house was wet," "Today I went to school," "The cake is overdone," "My toy has broken," "Yesterday I went to the movies," and "The water I had was cold"), and the child will have to repeat the sentence correctly.

Strategy 7: Ordering logical-time sequences

Goal: logical-temporal sequence

Description: The therapist will take logical-temporal sequences about stories previously known to the child ("The Three Little Pigs", "Little Red Riding Hood", "Beauty and the Beast", "Cinderella" and "Pinocchio", etc.), and the child will put them in order and then recount what happened.

Strategy 8: Experiences Booklet

Goal: Work on narrative-pragmatic skills

Description: The child will draw/make collages in a notebook about the events that happened outside the therapeutic environment, so that in the therapeutic session, the child narrates such events with the support of the notebook. The therapist will always give the correct model if the child shows phonetic-phonological and/or morphosyntax changes, though not correcting the child directly.

Strategy 9: Interview

Goal: Work on narrative-pragmatic skills

Description: The child and therapist will be a reporter and interview (sometimes themselves, sometimes some famous character) for turnaround and narrative skills.

Strategy 10: Playing with prosody and supra-segmental speech traits.

Goal: Workout prosody, supra-segmental traits and pragmatic skills

Description: The therapist will record several phrases with different intonations/emotions, then the child should reproduce the speech and intonation of the recording, identify which facial expression (therapist will show printed pictures) corresponds to speech and finally name the emotion expressed in that speech. If the child presents difficulty, the therapist will give another example with the same intonation, first with little facial and body expression, in a second moment with facial expression but without body expression and in a third moment with facial and body expression. If even with all help the child is unable to perform accordingly, the therapist will give the model and explain it.

Strategy 11: Playing with minimal pairs

Goal: Work on auditory discrimination

Description: There will be activities that request the discrimination of minimum pairs (e.g. bingo of the minimum pairs). In the choice of the minimum pairs, it will be prioritized the phonemes that the child presents phonological exchange.

Strategy 12: Completing the information—competitive noise

Goal: Picture-background auditory

Description: The child will be presented with excerpts of dialogs and routine stories with missing information, previously known to the children, this presentation will be performed with a background noise, so the child should verbally complete the omitted information (if the child does not achieve the auditory stimulus, it will be repeated with the same signal-to-noise ratio, if the difficulty persists the signal-to-noise ratio will be increased)

Table 5. List of strategies on Level 2.

The examiners received a survey for the strategy evaluation where they classified the strategy as adequate, partially adequate and inadequate in relation to the intervention goal and also the level of difficulty for children with such profiles, as well as criticizing, comments and suggestions on them. **Table 6** shows the examiners' responses.

The concordance of the examiner was then calculated to check for disagreements and the need to use a third examiner. For this, the formula described by [28] was used where the percentage of agreement between the answers is obtained according to Eq. (1).

$$\text{Concordance} = \frac{\text{Number of agreements}}{(\text{Number of agreements} + \text{Number of disagreements})} \times 100 \qquad (1)$$

Evaluation in relation to the intervention goal	Examiners	
	A	B
Strategy 1—Level 1	2	2
Strategy 2—Level 1	2	2
Strategy 3—Level 1	2	2
Strategy 4—Level 1	2	2
Strategy 5—Level 1	2	2
Strategy 6—Level 1	2	2
Strategy 7—Level 1	2	2
Strategy 8—Level 1	2	2
Strategy 9—Level 1	2	2
Strategy 10—Level 1	2	2
Strategy 11—Level 1	2	2
Strategy 12—Level 1	2	2
Strategy 13—Level 1	1	1
Strategy 14—Level 1	2	2
Strategy 15—Level 1	2	2
Strategy 16—Level 1	2	2
Strategy 1—Level 2	2	2
Strategy 2—Level 2	2	2
Strategy 3—Level 2	2	2
Strategy 4—Level 2	2	2
Strategy 5—Level 2	2	2
Strategy 6—Level 2	2	2

Evaluation in relation to the intervention goal	Examiners	
Strategy 7—Level 2	2	2
Strategy 8—Level 2	2	2
Strategy 9—Level 2	2	2
Strategy 10—Level 2	2	2
Strategy 11—Level 2	2	2
Strategy 12—Level 2	2	2
Strategy 13—Level 2	1	1
Strategy 14—Level 2	1	1
Strategy 15—Level 2	2	2
Strategy 16—Level 2	2	2
Strategy 17—Level 2	2	2
Evaluation in relation to difficulty level		
Strategy 1—Level 1	2	2
Strategy 2—Level 1	1	1
Strategy 3—Level 1	2	2
Strategy 4—Level 1	2	2
Strategy 5—Level 1	2	2
Strategy 6—Level 1	2	2
Strategy 7—Level 1	2	2
Strategy 8—Level 1	1	2
Strategy 9—Level 1	1	1
Strategy 10—Level 1	2	2
Strategy 11—Level 1	2	2
Strategy 12—Level 1	2	2
Strategy 13—Level 1	2	2
Strategy 14—Level 1	2	2
Strategy 15—Level 1	2	2
Strategy 16—Level 1	2	2
Strategy 1—Level 2	2	2
Strategy 2—Level 2	2	2
Strategy 3—Level 2	2	2
Strategy 4—Level 2	2	2
Strategy 5—Level 2	1	1
Strategy 6—Level 2	2	2

Evaluation in relation to the intervention goal	Examiners	
Strategy 7—Level 2	2	2
Strategy 8—Level 2	2	2
Strategy 9—Level 2	2	2
Strategy 10—Level 2	2	2
Strategy 11—Level 2	2	2
Strategy 12—Level 2	2	2
Strategy 13—Level 2	2	2
Strategy 14—Level 2	2	2
Strategy 15—Level 2	2	2
Strategy 16—Level 2	2	2
Strategy 17—Level 2	2	2

0, inadequate; 1, partially adequate; and 2, adequate.

Table 6. ELO program evaluation by examiners.

If the results were considered to be reliable, there was a need for the concordance rate to be greater than or equal to 75%. In the above case, the concordance rate among the examiners was 98.48%, and—when the responses to the objective and the level of difficulty were compared by themselves—the agreement rate was 100% and regarding the level of difficulty of 96.97%, showing consistency in the answers of the examiners.

It was observed that there was no strategy classified as inadequate for both questions. The strategies considered as partially adequate were three (9.09%) in relation to the objective and four (12.12%) in relation to the level of difficulty. Most of these strategies were considered partially adequate due to the lack of some information in their description, so the strategies were rewritten in order to solve the doubts caused by the examiners. There were also two suggestions for the strategies: one regarding the auditory bombardment so that it was carried out in an acoustic booth; however, due to the difficulties in accessing such equipment at the required frequency, the same cannot be done, but all the words of the bombardment were recorded and presented in a speaker with adequate levels (but with material without technical calibration).

The majority of the examiners' answers (90.91% in relation to the objective and 87.88% in relation to the level of difficulty) were that the strategies were adequate, which showed consistency of the ELO program and gave indications that it is adequate to be used in experimental studies.

3. Final considerations

Unfortunately, interventional studies are not always published with sufficient information to be replicated [29] and were found that 72.12% of clinical trials published about child language interventions are randomized. Hence publications showing intervention program effectiveness are not replicable, neither scientifically nor clinically, due to the lack of detail in the methodology, and even seeking such data in complementary sources (literature and questionnaires to speech-language pathologists), such descriptions were not found. This information highlights the need for greater systematic approaches for publications in the mentioned area, which justifies the effort done in this study.

Programs found in the literature usually have a specific focus on only one aspect of language (usually vocabulary, phonology, or narrative), since having more focus on the results which show greater gain in focused ability. However, it is known that several language disabilities, including LD, bring losses in more than one aspect of language [3]; this feature does not disable the programs mentioned above, but [30] states that up to 48 months, the child has greater neuronal plasticity, so it is interesting that they receive the greatest number of adequate stimuli possible. Following this reasoning, programs that stimulate all aspects of language can be a great ally in the intervention process of children with difficulties in different levels of language, such as LD.

The number of ELO sessions as well as their distribution and frequency were selected based on the researcher's empirical knowledge based on the analysis of the pilot project. The pilot project was designed to fulfill a 3-month intervention, following the other intervention programs cited in this chapter.

Psycholinguistic skills were also focused on ELO for two reasons: children with school-aged AL (even after they overcome their difficulties) perform worse than their peers in PA, PWM, and APS tasks [13, 31]; hence, such skills are important for the development of language, if they receive adequate stimulation, it may help working with language levels [32].

In addition to developing an intervention program or model for children with LD, one must propose something coherent and applicable to the population. A literature study was carried out to verify the methodology for the elaboration of interventional programs or models, but only descriptions and efficacy (clinical trials or case studies) were found. In view of the above, the researcher outlined her methodology for verifying the applicability of ELO based on the characteristics of a good intervention described by [33]: choosing appropriate intervention goals, choosing strategies coherent to such goals, and pertinent complexity for each task.

The analysis by the examiners on ELO indicated that it is consistent because the strategies are appropriate according to the objectives of stimulation and also the level of complexity for such children. In addition, the high concordance rate among the examiners further reinforces this consistency. It is important to emphasize that the examiners made observations that contributed to the work, mainly on the question of how to describe the strategies, without doubts.

In conclusion, we observed that the study presented a program of stimulation judged as consistent by pairs, reaching its goal, having a language stimulation program as the main result applicable both clinically and academically.

Author details

Camilla Guarnieri* and Simone Aparecida Lopes-Herrera

*Address all correspondence to: lopesimone@hotmail.com

Bauru School of Dentistry, University of São Paulo, Bauru, Brazil

References

[1] American Speech-Language-Hearing Association. Language [Internet]. 1982. Available from: www.asha.org/policy

[2] McLaughlin MR. Speech and language delay in children. American Family Physician. 2011;**83**(10):1183-1188

[3] Buschmann A, Jooss B, Rupp A, Dockter S, Blaschtikowitz H, Heggen I, et al. Children with developmental language delay at 24 months of age: Results of a diagnostic work-up. Developmental Medicine & Child Neurology. 2008;**50**(1):223-229

[4] Schirmer CR, Fontoura DR, Nunes ML. Distúrbios da aquisição da linguagem e da aprendizagem. Jornal de Pediatria. 2004;**80**(2 Suppl):S95-S103

[5] Indrusiak CS, Rockenbach SP. Prevalence of phonological deviations in children—4 to 6 year old—From a kindergarten school in Canoas-RS. Revista CEFAC. 2011;**30**(11):531-540

[6] Damico JS, Muller N, Ball MJ. The Handbook of Language and Speech Disorders. 1st ed. Chichester: Wiley-Blackwell; 2010

[7] Marcelino FC, Hamer BL. Intervenção fonoaudiológica nos atrasos de linguagem: uma visão integral. In: Lopes-Herrera SA, Maximino LP, editors. Fonoaudiologia: Intervenções e alterações da linguagem oral infantil. 1st ed. Ribeirão Preto: Editora Novo Conceito; 2011. pp. 91-110

[8] Lopes-Herrera SA, Guarnieri C. Planos Terapêuticos Fonoaudiológicos para Intervenção em Crianças com Atraso de Linguagem. In: Pró-Fono, editor. Planos Terapêuticos Fonoaudiológicos (PTFs) Vol. 2. 1st ed. Baureri: Pró-Fono; 2015. pp. 51-56

[9] Capovilla A, Capovilla F. Peabody picture vocabulary test-Revised PPVT-R. Ciência Cognitiva: Teoria, Pesquisa E Aplicação., 1997;**1**(1):353-380

[10] Glrolametto L, Pearce P, Weitzman E. Interactive focused stimulation for toddlers with expressive language delays. Journal of Speech, Language, and Hearing Research. 1996;**39**:1274-1283

[11] Ward S. An investigation into the effectiveness of an early intervention method for delayed language development in young children. International Journal of Language and Communication Disorder. 1999;**34**(3):243-264

[12] Tyler AA, Lewis KE, Haskill A, Tolbert LC. Efficacy and cross-domain effects of a morphosyntax and a phonology intervention. Language, Speech, and Hearing Services in Schools. 2002;**33**:52-66

[13] Wake M, Hudson S, Levicks P, Down K, Nichols R. Maternal responsiveness predicts child language at ages 3 and 4 in a community-based sample of slow-to-talk toddlers. International Journal of Language and Communication Disorders. 2015;**50**(1):136-142

[14] Roberts MY, Kaiser AP. Early Intervention for toddlers with language delays: A randomized controlled trial. Pediatrics. 2015;**135**(4):686-693

[15] Cheng LL. Intervention strategies: A multicultural approach. Topics in Language Disorders. 1989;**9**(3):84-94

[16] Antunes LG, Freire T, Crenitte PAP. Programa de remediação fonológica em escolares com sinais de risco para dificuldades de aprendizagem. Revista Distúrbios da Comunicação. 2015;**27**(2):225-236

[17] Machado AC, Capellini SA. Tutoria em Leitura e Escrita Baseado no Modelo de Rti - Resposta à Intervenção em Crianças com Dislexia do Desenvolvimento. Revista CEFAC. 2014;**16**(4):1161-1167

[18] Ceron MI, Keske-Soares M. Mudanças Fonológicas Obtidas no Tratamento pelo Modelo de Oposições Múltiplas. Revista CEFAC. 2013;**15**(2):314-323

[19] Correa CC, José MR, Fidêncio VLD, Nicolielo AP, Lopes-Herrera SA, Maximino LP. Intervenção Fonoaudiológica em um caso de Toxoplasmose Congênita. Revista Distúrbios da Comunicação. 2014;**26**(2):287-294

[20] Nicolielo AP, Gejão MG, Lopes-Herrera SA, Maximino LP. Evolução do Processo Terapêutico Fonoaudiológico no Distúrbio Específico de Linguagem (DEL): Relato de Caso. Revista CEFAC. 2014;**16**(5):1691-1699

[21] Martins LZ, Fernandes FDM. Intervenção fonoaudiológica em curto prazo para crianças com distúrbios do espectro do autismo. Revista CoDaS. 2013;**25**(6):542-547

[22] Guarnieri C, Abe CM, Gonçalves BRL, Lopes-Herrera SA. Intervention program in oral language for children with language delay. In: Proceedings of the International Association of Logopedics and Phoniatrics Congress (29th IALP); 25-28 August 2013; Turin. Birkirkara: IALP; 2013. pp. 65-66

[23] Andrade CRF, Lopes DB, Fernandes FDM, Wertzner H. ABFW: Teste de linguagem infantil nas áreas de fonologia, vocabulário, fluência e pragmática. 1st ed. Barueri: Pró-Fono; 2004

[24] Capovilla A, Capovilla F. Peabody picture vocabulary test—Revised PPVT-R. Ciência Cognitiva: Teoria, Pesquisa E Aplicação. 1997;**1**(1):353-380

[25] Hage S, Grivol M. Reference values of non-word repetition test for Brazilian Portuguese speaking children. Journal of Applied Oral Science. 2009;**17**(spe):63-68. DOI: 10.1590/s1678-77572009000700011

[26] Lopes-Herrera SA, Fernandes B. Avaliação da Fonologia e Articulação do Português – AFAP para iPad. SmartyEars; 2012. Available from: www.ipadfono.com

[27] Menezes MLN. A construção de um instrumento para avaliação do desenvolvimento da linguagem: Idealização, estudo piloto para padronização e validação [thesis]. Rio de Janeiro: Instituto Fernandes Figueira; 2003

[28] Hersen M, Barlow DH. Single Case Experimental Designs: Strategies for Studying Change. New York: Pergamon Press; 1982

[29] Law J, Roulstone S, Lindsay G. Integrating external evidence of intervention effectiveness with both practice and the parent perspective: Development of 'What Works' for speech, language, and communication needs. Developmental Medicine & Child Neurology. 2015;**57**(3):223-228

[30] Mundkur N. Neuroplasticity in children. Indian Journal of Pediatrics. 2005;**72**(10):855-857

[31] Rescola L. Language and reading outcomes to age 9 in late-talking toddlers. Journal of Speech, Language and Hearing Research. 2002;**45**:360-371

[32] Rothe-Neves R, Lapate LC, Pinto JSS, Loiola LR, Couto EAB. Tarefas para Avaliação Psicolinguística no Português do Brasil: Resultados preliminares. Revista Psicologia e Pesquisa. 2013;**7**(1):70-78

[33] Roth FP, Worthington CK. Treatment Resource. Clifton: Delmar Cengage; 2005

Chapter 21

The Role of Speech and Language Therapist in Autism Spectrum Disorders Intervention – An Inclusive Approach

Kateřina Vitásková and Lucie Kytnarová

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.70235

Abstract

The chapter describes the possibilities of involving a speech-language therapist in the assessment of the pragmatic level of communication in autism spectrum disorders (ASD), where one of the most frequently impaired areas is communication pragmatics. These difficulties lead to a disruption of social interaction, which might be one of the obstacles to speech-language intervention in these children. The text is based on an originally developed testing material aimed at selected pragmatic-oriented communication situations relating to everyday activities and real life. Based on a comparison of domestic and international resources in this area, as well as mediated and own empirical experience, our assessment approach is based on the conclusion that pragmatics can be understood in different contexts and perspectives. The text presents the results of a partial survey comparing the performance of children with ASD and children with typical development. The assessment focused on the children's election of the correct picture of a pair of pictures that represent usual communication and social situations. The results of the research suggest fewer incorrect responses in children with ASD and in different areas compared with children with typical development. However, the results of a qualitative analysis indicate a necessity to expand the assessment of communication pragmatics by adding an individually specific qualitative analysis of children's performance.

Keywords: autism spectrum disorders, pragmatic language level, speech and language therapist, inclusive approach, assessment, evaluation

1. Introduction

The pragmatic level of language is one of the language levels that underpin human communication abilities [1, 2]. This might also be the reason why the pragmatic level of language is a widely discussed topic in modern speech-language therapy (see for example [3–5]). However, it represents a fairly complex issue involving not only the psychological and linguistic area [6], but from an inclusive perspective also educational sciences and special or inclusive education. In many countries, speech-language therapy is classified under special education sciences (see for example [7]), and currently, in the context of the so-called support educational inclusive measures, speech-language therapists represent significant experts who contribute to successful inclusion.

The link between educational and speech-language therapy (albeit clinical) approaches to diagnoses and interventions aimed at variations in the pragmatic level of language in children with autism spectrum disorders (ASD) is considered a significant determinant of the effectiveness of a comprehensive pro-inclusive approach. It is because these disorders involve impaired communication behaviour falling within the area of both communication and social interaction [8, 9].

Autism spectrum disorders (ASD) are lifelong, neurodevelopmental disorders. The symptoms include deficits in reciprocal social interaction and the imagination with presence of behavioural manifestation and impaired communication ability. Symptoms of communication disability, including non-verbal communication abnormalities, are usually the primary indicators of the child's impaired development and significant determinants of his/her socialisation, together with abnormalities in the characteristics of the child´s play and delayed imitation (see for example [10–12]).

Although simulation of the pragmatic level of language is possible in persons with ASD, it must be preceded by targeted diagnostics and assessment of individual components of the pragmatic level of language (for example [13]). For these purposes, it is necessary to verify appropriate materials that focus on specific areas directly affecting the course of speech-language intervention (see for example [11]) but not only from a quantitative perspective. According to our empirical experience, it is necessary to combine the application of performance test materials with an individual qualitative analysis.

Ramberg et al. [14] emphasise the fact that despite a possible absence of difficulties concerning the phonetic-phonological area of language and active vocabulary, communication pragmatics in persons with Asperger syndrome is affected by significant features that adversely influence their social interaction. The authors focused on the presence of differences in vocabulary (lexical-semantic language level), understanding and pragmatics in three heterogeneous groups of participants. The results of the study confirm that the group of individuals with Asperger syndrome has significantly higher values of verbal IQ compared with the group of individuals with high-functioning autism (HFA) and specific language disorder (SLD). This higher verbal intellectual performance may be a reflection of good active vocabulary, verbal memory and engagement of the imitation ability in persons with this disability. On the other hand, however, these features are not homogeneous with deficits detected in social communication aspects, i.e. concerning the pragmatic level of language. Similar conclusions were also formulated by Stefanatos and Joe [15, 16] and others.

http://dx.doi.org/10.5772/intechopen.70235

2. Principles of assessment of the pragmatic level of language in children with autism spectrum disorders by speech-language therapist

Communication pragmatics is affected by mutual interaction of the language and cognitive abilities and the quality of the sensorimotor integration (see for example [3]). We believe that the pragmatic level of language in persons with ASD needs to be considered not only in the context of social behaviour but also motor performance as well as imitation processes and perceptual determinants—sensory skills including orosensory abilities (see for example [17]). Variations in the perception of the pragmatic-oriented communication behaviour can affect the final child assessment in terms of the child's prognosis and functional communication parameters, which are to be stimulated or compensated for in the course of speech-language intervention. The principle of specific speech-language intervention is based on the processes of learning through imitation. Regarding the use of the elements of alternative or augmentative communication (AAC), it is also based on functional communication behaviour, i.e. pragmatic language skills [18].

In terms of inclusive practice, it needs to be emphasised that the symptoms of impaired communication pragmatics are specific not only in children with ASD but also those with specific language impairment or mild intellectual development. Although ultimately they may manifest in an identical or very similar way, in specific individual cases, they may be conditioned by different determinants. In this context, a child may be indicated a different therapeutic or educational procedure, which does not correspond to the child's real abilities and level of pragmatic communication skills, especially in cases of insufficient diagnostic assessment in this area. The cause is misinterpretation of the child's communication behaviour. However, given the importance of communication pragmatics in evaluating the child's school performance (link), its variations represent a high risk of inclusion failure or academic failure of a child with autism spectrum disorders.

Difficult assessment of the pragmatic level of language is also caused by the scarcity of research-based results on communication behaviour in specific groups of children with special educational needs and children with typical development, who may include children with impairment of the socially pragmatic communication ability [9, 19, 20].

2.1. Speech-language therapists' attitude to pragmatic language level assessment and therapy in children with autism spectrum disorders: situation in the Czech Republic

Regarding our previous research studies conducted in the Czech Republic (representing one of the Central Europe countries with very strong and developed special education counselling care and education systems) assume that the main emphasis in speech-language therapists' work with ASD clients is put on the assessment of activities, especially in those working in clinical settings. Although a focus on pragmatic language level is considered as significant by 87% of the addressed respondents, in practice, they still focus primarily on active and passive vocabulary development and pronunciation, i.e. on the phonetic-phonological language level [21]. Nevertheless, only 40% of the respondents apply specific assessment tools for evaluating communication disorders in individuals with ASD; specifically, only 58% of the respondents focus on the diagnosis of pragmatic language level with regard to this. Although we did not find any significant difference between the knowledge of pragmatic language level problematics and the length of their professional practice, the speech-language therapists who perceive PLL as deficient in clients with ASD also focus on the development and improvement of the pragmatics in them. Additionally, a result that we did not expect was that speech-language therapists, working in health institutions (clinical speech-language therapists), in comparison with speech-language therapists working at schools or social institutions, meet clients with ASD in the Czech Republic more often. This fact calls for a deeper reflection of problems in ASD treatment and assessment in speech-language therapy and for a much more intensive and frequent sharing of interdisciplinary knowledge and services (compare for example with [22]).

Finally, we can emphasise, and especially in the context of the situation in the Czech Republic where there is lack of relevant or even standardised diagnostic tools for providing speech and language therapy in general, the importance of working on new, culturally and linguistically adapted materials for assessing pragmatic language level abilities and practical skills from the specific speech and language therapy view. Although working on these materials could be inspired by existing publications and assessment tools, it is reasonable to mention that sometimes the creation of a new, original material bring much plausible effect than the adaption of an existing one. This implication may be concluded from similar attempts to adapt existing diagnostic tools to the regional conditions and speech and language therapists work standards in a specific country (see for example [5]). Nevertheless, the inspiration for assessing the pragmatics in autism spectrum disorders may be found in works of Fernandes et al. [23] or Mohammadi [24].

In our opinion, the new or adapted materials should reflect the new diagnosis of social (pragmatic) communication disorder (or pragmatic language impairment) and focus much more on specifics in oral motor imitation (see also [25]) and on the impact of changes in diagnosis and classification of ASD due to DSM V [26].

2.2. Introduction to the assessment material for evaluating pragmatic language level in children with ASD

For these reasons, the authors of the present study decided to develop an original material for the assessment of selected aspects of communication pragmatics in children with ASD, which would allow a comparison with the performance of children with specific language impairment, mild intellectual disability and children with typical development. The developed diagnostic material with a working title 'Assessment of the pragmatic level of language in persons with ASD: potential barriers to speech-language intervention' focuses on the assessment of children's pragmatic communication behaviour based on individually focused direct observation and performance testing. The basic assumption is that numerous abilities and practical skills related to the pragmatic level of language might be assessed based on the method of observation. Observation is performed without assigning complex tasks, in a natural environment of the child or in the environment of a counselling or therapeutic speech-language centre that the child knows. The objective of formal testing is in a more objective way to detect any difficulties in the respective area, adequacy of task fulfilment, peculiarities of task fulfilment, etc.

http://dx.doi.org/10.5772/intechopen.70235

The diagnostic material is primarily intended for children and adolescents aged 5–18 years with autism spectrum disorders. It is also suitable for individuals with intellectual disorders, individuals with developmental dysphasia, individuals with behavioural and attention disorders and individuals with anxiety and emotional disorders. A precondition for the application of the material is an undisrupted ability to understand instructions. A speech expression disorder is not an exclusion criterion.

The diagnostic material was developed specifically for the purposes of a speech-language therapist. The whole conception of the assessment tool will be published in a separate book as the final result of the grant project of the Czech Science Agency. Therefore, for the purpose of this chapter, we would like to introduce only the main concept of the tool. Each diagnostic area is assessed on the basis of observation (O); the subjective perspective is examined by means of a set of pictures presented to clients with ASD, the purpose of which is to distinguish between visual diagrams (VD). The basic areas of assessment by visual diagrams include problem behaviour, eye contact, social interaction and behaviour (greeting, addressing, paring, changing communication roles and rules of communication). Other part of the assessment material focuses on sensory integration, motor imitation and facial expressions. The purpose of the developed diagnostic material is to perform assessment based on observation (O) and testing (T). The results are recorded into separate record sheets.

Observation (O): many abilities and skills related to the pragmatic level of language can be assessed by means of observation, e.g. observation of a child during a game allows study of establishing interactions with others, asking questions, imitation, etc. This method detects any spontaneous communication and verbal or non-verbal communication. Observation is performed without assigning tasks, in a natural environment of the child or in the environment of a speech-language therapy centre that the child knows. An advantage is the possibility to make a video recording.

Testing (T): the goal of formal testing is to assess in a more objective way whether a child has some problems in the monitored areas.

Description of the basic assessment areas:

- Problem behaviour—the area of social behaviour in persons with autism spectrum disorders is extensively analysed by psychological testing, and the pragmatic level of language is often combined with social behaviour. The assessment of problem behaviour was intentionally included in the diagnostic material because problems in social behaviour lead to problems in communication and might interfere with speech-language intervention. However, this is only a part of the assessment of communication pragmatics, which objectifies the subjective perspective of a speech-language therapist or parent concerning social behaviour of an individual with ASD.
- Eye (visual) contact—in relation to the development of children's linguistic skills, eye (visual) contact determines the acquisition of new vocabulary (through combined and later joint deliberate attention), both in terms of quantity and speed of learning and the quality verifiable by adequate understanding of concepts learned; children with autism spectrum disorders might suffer from disrupted initiation of joint attention (ability higher in terms of quality) but might be capable of a response to joint attention, although it may not be

executed completely as among the typical population because this ability is adversely affected by impaired movement coordination (eye contact level) primarily conditioned by dyscoordination between a gesture and visual contact [27].

- Sensory integration—this section focuses on individual differences and peculiarities of children, which need to be considered during speech-language intervention. The area of sensory integration is believed to be crucial for effective speech-language intervention. For this reason, the following material was developed: 'screening assessment of perceptual-sensory integration' [28], which is recommended in case any difficulties in the child's sensory system are observed. This instrument focuses on the assessment of the sensory system (auditory perception, visual perception, tactile perception, gustatory and olfactory perception, proprioceptive system and vestibular system). 'Screening assessment of perceptual-sensory integration' [28] should inform the speech-language therapist what needs to be strengthened and what needs to be avoided (touching, speaking loudly or quietly, etc.). Every child has a unique sensory-motor profile.
- Social interaction and social skills—subtest aimed at greeting, addressing another person, changing communication roles and rules of communication.
- Motor imitation—this subtest cannot be assessed on the basis of visual diagrams but is of vital importance to speech-language intervention. The subtest assesses the ability of motor imitation of the upper and lower extremities with an object, without an object and oromotor imitation.
- Facial expression—facial expressions, direction of eye movements, movements of the head, body and hands in various situations:
    - Expressing interest in an activity, shared attention
    - Expressing joy, positive excitement
    - Expressing overload by stimuli, need for relaxation

The selection of visual diagrams (VD), which is part of the formal testing procedure, is assessed using the following scale: 0 = correct answer, 1 = incorrect answer. The number of points scored suggests the seriousness of a problem in a particular area.

The observed degree of seriousness of a problem in the observation part of the testing is administered in the following way: 0 = no problem, symptoms, 1 = mild/occasional disorder, differences from other children, 2 = moderate disorder (effects on learning and social interaction), 3 = severe disorder (negative effects on learning and social interaction), 4 = profound disorder (almost impossible learning and social interaction). The number of points scored suggests the seriousness of a problem in a particular area.

This chapter discusses partial outcomes of a research study aimed at children with ASD and children with typical development, specifically the results of assessment performed by means of the newly developed material—specifically the main part including model situations by means of visual diagrams. We believe it is important to use these results to demonstrate the differences in children's performance in the area of communication pragmatics, which also

http://dx.doi.org/10.5772/intechopen.70235

show individual peculiarities and to briefly discuss their confrontation with a qualitative analysis of relevant communication situations including explanation of children's correct answers.

3. Methodology of the research study and description of the assessment tool

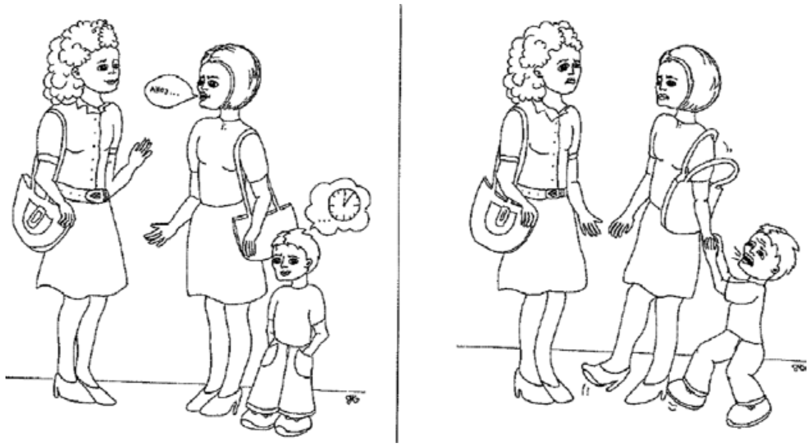
The assessment capacity of the developed diagnostic material is illustrated using the partial results based on a comparison of the performance of 10 children of a typical population and 10 children with ASD of school age and older preschool age. The relative age variance reflects the broad age structure of children in establishments for children with ASD and a degree of heterogeneity of the research sample. Originally, the research was supposed to include only preschool children, which eventually turned out to be impossible due to the development of pragmatic skills and the ability of children to explain their performance. The intention was also to monitor a relatively usual structure of the sample of children that speech-language therapists encounter; these are older preschool children but mainly school-aged children.

In terms of methodology, the research was of a mixed design; children's performance was assessed by means of testing. The test assessment tool was developed using original illustrations demonstrating pragmatic-oriented communication situations based on everyday life and usual social interactions in relation to the narrowest social group.

As it was mentioned above, the visual diagram tasks always include two pictures representing opposite (adequate and inadequate) pragmatic communication situation. The child is instructed to choose one of the two pictures that represent the correct alternative of the communication situation. The task included a total of ten pairs of pictures related to the following assessment categories: 1. eye contact, 2. greeting, 3. parting, 4. want something, 5. proxemics in communication, 6. expressing displeasure, 7. waiting for communication, 8. changing communication roles, 9. behaviour in a shop and 10. response to loss. The test administration was designed to ensure simplification and clarity (see **Picture 1**).

The evaluator use the following scale: 0 = correct answer, the child chose the correct picture and adequately explained the reasons for the choice; 1 = incorrect answer, the child chose the incorrect picture or did not adequately explain the reasons for choosing the correct picture. There are more acceptable answers to the question which picture is correct, e.g. thumbs up, thumbs down, happy or sad smiley. The testing time usually does not exceed 15 min. The testing time depends on the needs of every individual.

Our aim is to highlight the considerable variance of the results and the resulting disproportion, which might result from the absence of subsequent qualitative performance characteristics of a child in the assessment of the child's performance in the pragmatic level of language, in case that speech and language therapist would use only the quantitative assessment form (with dichotomic option related to the visual schemes, for example).



Picture 1. The example of the visual diagram—VD7. 'Waiting for communication'.

4. Partial results of the research study

Table 1 shows the distribution of the assessment results of a pair of visual diagrams. The results suggest that in the group if children with typical development the pair of pictures that was most frequently (four times) incorrectly identified was visual diagram (VD) VD2 'greeting', three times VD3 'parting' and VD1 'eye contact', twice VD5 'proxemics' and once VD7 'waiting for communication'. In the other parts, the communication situations were assessed adequately by choosing the correct answer. An interesting finding is the identical result achieved by boys 7 and 8 (see C7 and C8 in **Table 1**), who gave incorrect answers in eye contact, greeting and parting. The worst result was scored by client C3, who had 4 incorrect answers (C3). An absolutely error-free result was achieved by four children.

The results in **Table 2** relating to the assessment of visual diagrams in children with ASD suggest that, paradoxically, children in this sample made fewer mistakes, specifically in nine cases; their worst result is lower than in the group of children with typical development. Most incorrect answers occurred in the areas represented by VD2 'proxemics', VD7 'waiting for communication' and VD8 'changing communication roles'. On the contrary, error-free areas were 'want something', 'expressing displeasure', 'behaviour in a shop' and 'response to loss'. The worst results were achieved by client K5A; this was a girl with child autism aged 6 years and 6 months. An absolutely error-free result was achieved by half of the children, although their diagnosis involved impaired social interaction and communication, apparently in the pragmatic area.

The research assumption was that children with typical development will achieve better results than children with autism spectrum disorders. The results suggest that the difference between the compared groups of children is negligible. To verify the initial hypotheses, the Mann-Whitney U test was selected for larger groups (group size 9–20):

- H0: there is no statistically significant difference between the two groups.
- HA: there is a statistically significant difference between the two groups.

For comparison the results of both groups are arranged in order (**Table 3**).

Client	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	Total n
Gender	Boy	Girl	Boy	Girl	Boy	Boy	Boy	Girl	Boy	Boy	
Age	6;0	6;6	5;8	6;10	4;9	6;10	5;2	6;4	5;7	5;11	
Area of evaluation											
1. Eye contact	0	0	1	0	0	0	1	1	0	0	3
2. Greeting	0	1	1	0	0	0	1	1	0	0	4
3. Parting	0	0	0	1	0	0	1	1	0	0	3
4. Want something	0	0	0	0	0	0	0	0	0	0	0
5. Proxemics	0	0	1	0	0	0	0	0	0	0	1
6. Expressing displeasure	0	0	0	0	1	0	0	0	0	0	1
7. Waiting for communication	0	0	1	0	0	0	0	0	0	0	1
8. Changing communication roles	0	0	0	0	0	0	0	0	0	0	0
9. Behaviour in a shop	0	0	0	0	0	0	0	0	0	0	0
10. Response to loss	0	0	0	0	0	0	0	0	0	0	0
Wrong responses (n=)	0	1	4	1	1	0	3	3	0	0	13

C_{number} = client´s code; area of evaluation = the name of the item of evaluation material; age = the age of the assessed children with ASD.

Table 1. Assessment using visual diagrams in children with typical development.

Client	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	Total n
Gender	Boy	Boy	Boy	Boy	Girl	Girl	Girl	Boy	Boy	Boy	
Age	9;0	5;0	13;0	14;0	6;6	7;8	4;9	5;6	8;2	6;4	
Area of evaluation											
1. Eye contact	0	0	0	0	1	0	0	0	0	0	1
2. Greeting	0	0	0	0	1	0	0	0	0	0	1
3. Parting	0	0	0	0	0	0	0	0	1	0	0
4. Want something	0	0	0	0	0	0	0	0	0	0	0
5. Proxemics	0	0	0	0	0	1	0	0	1	0	0
6. Expressing displeasure	0	0	0	0	0	0	0	0	0	0	0
7. Waiting for communication	0	0	0	0	1	1	0	0	0	0	2
8. Changing communication roles	0	0	0	0	0	0	1	0		1	2
9. Behaviour in a shop	0	0	0	0	0	0	0	0	0	0	0
10. Response to loss	0	0	0	0	0	0	0	0	0	0	0
Wrong responses (n=)	0	0	0	0	3	2	1		2	1	9

C_{number} = client´s code; area of evaluation = the name of the item of evaluation material; age = the age of the assessed children with ASD.

Table 2. Assessment using visual diagrams in children with autism spectrum disorders.

Intact	Rank order	ASD	Rank order
6	1	7	3
7	3	8	5.5
7	3	8	5.5
9	9	9	9
9	9	9	9
9	9	10	16
10	16	10	16
10	16	10	16
10	16	10	16
10	16	10	16
$n_1 = 10$	$R_1 = 98$	$n_2 = 10$	$R_2 = 112$

$$U = n_1 * n_2 + \frac{n_1 * (n_1 + 1)}{2} - R_1 = 43$$

$$U' = n_1 * n_2 + \frac{n_2 * (n_2 + 1)}{2} - R_2 = 57$$

$$U_{0.05}(10, 10) = 23$$

Table 3. U test calculation.

Regarding the fact that the calculated value U = 43 is greater than the critical value $U_{0.05}$ (10,10) = 23, the null hypothesis is accepted. There is no statistically significant difference between the two groups of children.

5. Discussion of partial results

The diagnostic material entitled 'Assessment of the pragmatic level of language in persons with autism spectrum disorders: potential barriers to speech-language intervention' brings a new perspective of the issue of the pragmatic level of language in persons with ASD, not only in the context of social behaviour. The purpose of the material is not only to react to the absence of a method of diagnosing communication pragmatics in terms of speech-language therapy but also to make speech-language therapy more efficient and to show professionals how speech-language therapy aimed at persons with ASD should be developed, which individual peculiarities should be considered and which potential barriers pose a threat.

We are aware of the possible limitation of the visual schemes (graphic illustrative demonstration) form of the presentation of the social communication pragmatic real-life situation. This graphic version could appear maybe more symbolic than realistic; nevertheless, we were working on the presumption that in ordinary speech and language therapy or special education sessions professionals or parents very often use visual schemes to assess or enhance pragmatic language level, regarding the iconic way of thinking and "inner speech" related to ASD [29, 30]. Moreover, to find out and discuss the possible limits of using such visually symbolic

http://dx.doi.org/10.5772/intechopen.70235

schemes was also one of the primary goals of our research, because finally, we would like to create a material which can bring the speech and language therapist the partial picture of the child ability to work and benefit from such type of material during the intervention. Also we can consider that both, the pro-inclusive, as well as traditional special education systems are full of illustrated textbooks, books and picture didactic materials, so educators or speech and language therapists should know how children with ASD are able to benefit from such graphic demonstrations. Similarly we can mention that intervention in terms of developing communication competence strategies in ASD primarily use AAC, any mostly visually presented picture as pictograms, PECS etc. The research findings proved that such AAC-based strategies using visual picture–based communication during speech therapy have even moderate positive effect on functional and social communication but must be individualised and multimodal [31].

Regarding the limitations mentioned above, we suggest that the combination of assessment using, for example, visual schemes should be accompanied with other ways of evaluating pragmatic communication in natural settings (see for example [23; 27]). On the other hand, the methods of evaluation such observation of children behaviour during play, social communication situation and others may be very demanding in terms of time and personal engage of the speech and language therapist, who must usually deal with a great number of various diagnoses and age variation within the group of his/her clients (and the length of the therapy session per client is limited by the insurance company groups in the Czech Republic).

However, a qualitative analysis of partial results suggests that in each group of children, incorrect responses were indicated in different areas of pragmatic communication skills. The only areas with correct answers in both groups were 'Behaviour in a shop', 'Response to loss' and 'Want something', which we believe require further research. A paradoxical fact is the overall better result of children with ASD. This might however be explained by more frequent training of communication situations shown on pictures. Looking at children's age and performance, surprisingly, some younger children showed better results than older children, although they have the same diagnosis. This finding is similar to previous studies (for example [32]). Nevertheless, this "paradoxical "performance during the pragmatic level of language assessment could be partially related to the form of the evaluation process or tool used [33]. In general, the formal, standardised assessment is problematic as the performance of the child misses the advantage of the natural setting observation analysis. The influence of the examiner´s instruction or contextual cues and the structuring of the environment t may have also a specific effect [34, 35]. The other explanation could be a much more intensive focus on linguistic than nonlinguistic context of the pragmatic situation and the verbal instruction given by the evaluator during testing. Finally, the development and stronger engagement of the cognitive aspect of the pragmatic language information may have some significant effect on the children performance.

In our opinion, these results support the trends aiming at changes in ASD classification in the 11th Revision of the International Classification of Diseases by the World Health Organization. The document better reflects the differences in communication, communication functionality and pragmatics in children with ASD and is therefore better applicable in speech-language therapy for the purposes of planning the communication procedure and development of functional communication or its compensatory function.

This preliminary research suggests that the assessment of communication pragmatics should not be carried out only according to quantitative indicators. It should rather involve a combination of performance testing and a detailed qualitative description with a subsequent analysis or confrontation with the results of process assessment of the course of testing and comments or behaviour of the child during the testing procedure. We believe that the assessment should include or be primarily based on the developed audio-visual recordings that would be used for an analysis of communication behaviour. At the same time, however, it should be mentioned that this procedure has some limitations. The legal guardians' consent must be obtained to make and store recordings, technical and organisational measures are required for recording, and extra time is needed for analyses and special training in analysing pragmatic communication behaviour.

The preliminary research also suggests that the testing procedure is affected by the preparation taken before testing. Some recommendations need to be observed prior to the testing procedure or observation. It is for example advised to take a comprehensive family history, which should include information about the interests of the child, favourite activities, songs, films, food, pets, family members, etc. It is also necessary to establish a positive relationship with the client based on trust. The speech-language therapist should become thoroughly familiar with the testing material, questions and assessment, prepare all required items and check the audio/video equipment. In the course of assessment, adequate facial expressions and verbal praise should be used. The activities should be appropriate to the age of the child; adequate child motivation should be used. Each question should be repeated twice or three times, and time of 3–5 s should be provided for a response.

In the preliminary research, the group of children with ASD included 10 children diagnosed with child autism (according to WHO classification ICD 10 still valid in the Czech Republic). The material is also applicable for children with the Asperger syndrome. With regard to the changes in the assessment criteria of ASD in the context of DSM 5 of APA classification and with regard to the 11th WHO revision, we believe that in future, the diagnoses of some children will be changed at a younger age. Moreover, the diagnoses might be considerably influenced by the diagnostician or the diagnostic department, and the resulting diagnosis might correspond with another level or type of ASD also because this is a developmental disorder whose symptomatology changes with age and as a result of specific interventions. These assumptions are also confirmed in the course of other research studies performed by the authors of the present study in the area of assessment of oral stereognosis, etc., in which children with more severe degrees of disability achieved better values than children with less severe ASD or even combined with intellectual (mental) disability (for example [36]).

6. Conclusion

The assessment of the pragmatic level of communication is a very difficult yet socially significant component of the diagnostic process in the area of both physiology and communication disorders. It is because the process of assessment is dependent on many factors, which result both from the individual personality characteristics of the individual and the examiner and

http://dx.doi.org/10.5772/intechopen.70235

external conditions. Another important aspect is the nature of the communication environment, communication partners and experience of the individual with pragmatically oriented tasks. From a speech-language therapy perspective, in the assessment of the pragmatic level of communication, it is necessary to consider not only the communication performance or nature of non-verbal or co-verbal behaviour, because the components of pragmatic behaviour such as facial expressions and gestures are influenced by motor performance and neuromotor activity, which can be, particularly in persons with health disability, primarily specifically determined by a number of variations and disorders with a secondary effect on the performance in the area of pragmatic communication components.

The preliminary research suggested a paradoxical finding—non-affected areas of communication pragmatics assessed by means of visual diagrams in half of children with ASD and worse performance in the group of children with typical development. Some of the areas were assessed correctly, where the result was not affected by age—on the contrary, younger children diagnosed with severe autism achieved better performance than older children with the same diagnosis. However, the differences between the two groups were not statistically significant.

Another significant finding is that child performance need not necessarily reflect the real mastery of pragmatic communication in a specific situational context, but rather an effort to express a correct response, which according to a qualitative analysis does not match the real response selection by the child or the essence of the communication situation. The pragmatic explanation elicited from children after the testing procedure often suggests that the content of the functional pragmatic behaviour was understood in a completely or partially different way. We believe that this is something like a 'pragmatically oriented analysis' of the child's pragmatic communication behaviour.

Acknowledgements

The research results constitute partial results of the specific research "The research on impairment and deviations of communication ability and orofacial system in a speech and language therapy perspective" IGA_PDF_2017_026 and GAČR GA 14-31457S. 2014–2016 "Pragmatická jazyková rovina u osob s poruchami autistického spektra", principal researcher: Assoc. Prof. Kateřina Vitásková.

Author details

Kateřina Vitásková* and Lucie Kytnarová

*Address all correspondence to: katerina.vitaskova@upol.cz

Faculty of Education, Department of Speech and Language Pathology and Communication Ability Studies, Palacký University, Olomouc, Czech Republic

References

[1] Lechta V, et al. Terapie narušené komunikační schopnosti. 2nd ed. Praha: Portál; 2011. 392 p

[2] Perkins MR. Clinical pragmatics: An emergentist perspective. Clinical Linguistics & Phonetics. 2005;**19**(H.5):363-366

[3] ASHA. American Speech Language Hearing Association. Social Language Use Pragmatics [Internet]. 2016. Available from: http://www.asha.org/public/speech/development/Pragmatics/ [Accessed: 2 May 2016]

[4] Hwa-Froelich DA. Social communication theoretical foundations and introduction. In: Hwa-Froelich DA, editor. Social Communication Development and Disorders. 1st ed. New York and London: Psychology Press. 2015. pp. 3-19

[5] Košťálová M, Poláková B, Ulreichová M, Šmíd P, Janoušová E, Kuhn M, Klenková J, Bednařík J. Dotazník funkcionální komunikace (DFK): Validace originálního českého. Česká a slovenská neurologie. 2015;**78/111**(2):188-195

[6] Zufferey S. Acquiring Pragmatics: Social and Cognitive Perspectives. 1st ed. New York: Routledge; 2015. 202 p

[7] Georgieva D, Woźniak T, Topbaş S, Vitaskova K, Vukovic M, Zemva N, Duranovic M. Education of speech and language therapists/logopedists in selected central and southeastern European countries: Challenges and new horizons. Folia Phoniatrica et Logopedica. 2014;**66**(4-5):183-196

[8] Thorová K. Poruchy autistického spektra. 1st ed. Praha: Portál; 2012. 465 p

[9] Vitásková K, Říhová A. Speech and language therapy in the context of autism spectrum disorders assessment and intervention: Professional undergraduate and graduate approach. In: Gómez Chova L, López Martínez A, Candel Torres I, editors. ICERI2015 Proceedings; 18-20 November, 2015; Sevilla. IATED. 2015. pp. 4484-4491

[10] Toth K, Munson J, Meltzoff AN, Dawson G. Early predictors of communication development in young children with autism spectrum disorder: Joint attention, imitation, and toy play. Journal of Autism and Developmental Disorders. 2016;**36**(8):993-1005

[11] Říhová A, Vitásková K. Logopedická intervence u osob s poruchami autistického spektra: odborná publikace pro logopedy. 1st ed. Olomouc: Univerzita Palackého v Olomouci; 2012. 126 p

[12] Yoder P, Watson LR, Lambert W. Value-added predictors of expressive and receptive language growth in initially nonverbal preschoolers with autism spectrum disorders. Journal of Autism and Developmental Disorders. 2015;**45**(5):1254-1270. DOI: 10.1007/s10803-014-2286-4

[13] Boyd B. Výchova dítěte s Aspergerovým syndromem. 1st ed. Praha: Portál; 2011. 128 p.

[14] Ramberg C, Ehlers S, Nydén A, Johansson M, Gillberg, C. Language and pragmatic functions in school-age children on the autism spectrum. International Journal of Language and Communication Disorders. 1996;**31**(4):387-413. DOI: 10.3109/13682829609031329

[15] Stefanatos GA, Joe WQ. Autistic disorder. In: Morgan JE, Ricker JE, Morgan JE, Ricker H, editors. Textbook of Clinical Neuropsychology. New York, NY, US: Psychology Press; 2008. pp. 185-260

[16] Reboul A, Manificat S, Foudon N. Autism from a cognitive-pragmatic perspective. In: Foudon N, Manificat S, Reboul A, editors. Cognitive Pragmatic. Berlin: Mouton de Gruyter; 2012. pp. 317-344

[17] Miller M, Chukoskie L, Zinni M, Townsend J, Trauner D. Dyspraxia, motor function and visual-motor integration in autism. Behavioural Brain Research. 2014;**269**:95-102. DOI: 10.1016/j.bbr.2014.04.011

[18] Vitásková K, Říhová A. Komparativní studie aplikace Výměnného obrázkového komunikačního systému u osob s poruchami autistického spektra. In: Vitásková K, et al, editors. Vybrané typy narušené komunikační schopnosti v interdisciplinárním přístupu. 1st ed. Olomouc: Univerzita Palackého; 2013. pp. 13-38

[19] Buntová D, Mikulajová M. Sémanticko-pragmatický deficit u detí s narušeným vývinom reči. Československá psychologie. 2012;**56**(4):343-352

[20] Norbury CF, Sparks, A. Difference of disorder? Cultural issues in understanding neurodevelopmental disorders. Developmental Psychology. 2013;**49**:45-58

[21] Vitásková K, Říhová A. Trans-disciplinary cooperation in children with autism spectrum disorder intervention with emphasis on the speech and language therapist's important role. Procedia—Social and Behavioral Sciences. Vol. 132 (6th International Conference on Intercultural Education ČEducation and Health: From a transcultural perspectiveč). 2014. pp. 310-317. DOI: 10.1016/j.sbspro.2014.04.315

[22] Defense-Netrval DA, Fernandes FM. The provision of speech-language therapy in services destined to individuals with Autism Spectrum Disorder (ASD). CoDAS. 2016;**28**(4):459-462. DOI: 10.1590/2317-1782/20162015094

[23] Fernandes FDM, Barbosa MRP, Santos THF, Amato CAH. Speech-language pathology in the assessment and diagnosis within the autism spectrum. In: Fitzgerald M, editor. Autism Spectrum Disorder—Recent Advances. Rjeka: InTech. 2015. Available from: https://www.intechopen. com/books/autism-spectrum-disorder-recent-advances/speech-language-pathology-in-the-assessment-and-diagnosis-within-the-autism-spectrum. DOI: 10.5772/5940

[24] Mohammadi M-R, editor. A Comprehensive Book on Autism Spectrum Disorders, New York: InTech, 2011. 488 p. Available from: https://www.intechopen.com/books/a-comprehensive-book-on-autism-spectrum-disorders. DOI: 10.5772/975

[25] Miller M, Young GS, Hutman T, Johnson S, Schwichtenberg AJ, Ozonof, S. Early pragmatic language difficulties in siblings of children with autism: Implications for

DSM-5 social communication disorder? Journal of Child Psychology and Psychiatry. 2015;**56**(7):774-781

[26] Tsai LKY. Review: Impact of DSM-5 on epidemiology of Autism Spectrum Disorder. Research in Autism Spectrum Disorders. 2014;**8**(11):1454-1470

[27] Bernier R. Assessment of core features of ASD. In: Tarbox J, Dixon DR, Sturmey P, Matson JL, editors. Handbook of Early Intervention for Autism Spectrum Disorders. 1st ed. New York: Springer Science + Business Media, 2014. pp. 83-110

[28] Biel L, Peske N. Raising A Sensory Smart Child. New Times Naturally! New York: Penguin Books; 2007. pp. 27-28

[29] Whitehouse AO, Maybery MT, Durkin K. Inner speech impairments in autism. Journal of Child Psychology and Psychiatry, and Allied Disciplines. 2006;**47**(8):857-865

[30] Kunda M, Goel A. Thinking in pictures as a cognitive account of autism. Journal of Autism and Developmental Disorders. 2011;**41**(9):1157-1177

[31] Tierney CD, Kurtz M, Panchik A, Pitterle K. 'Look at me when I am talking to you': Evidence and assessment of social pragmatics interventions for children with autism and social communication disorders. Current Opinion in Pediatrics. 2014;**26**(2):259-264. DOI: 10.1097/MOP.0000000000000075

[32] Schulze C, Tomasello M. 18-month-olds comprehend indirect communicative acts. Cognition. 2015;**136**:91-98. DOI: 10.1016/j.cognition.2014.11.036

[33] Barbosa MP, Fernandes FM. Comparing the results of DAADD and ABC of children included in autism spectrum disorders. CoDAS. 2014;**26**(3):208-212

[34] Kissine M, Cano-Chervel J, Carlier S, De Brabanter P, Ducenne L, Pairon MC, Deconinck N, Delvenne V, Leybaert J. Children with autism understand indirect speech acts: Evidence from a semistructured act-out task. PLoS ONE.

[35] Miilher LP, Fernandes FDM. Considering responsivity: a proposal for pragmatic analysis in autism spectrum. CoDAS. 2013;**25**(1):70-75. DOI: https://dx.doi.org/10.1590/S2317-17822013000100013

[36] Vitásková K, Málková M, Hlavinková A. Ověřování výzkumných možností diagnostiky orální stereognozie v oblasti symptomatických poruch řeči u dětí – význam pro interdisciplinární praxi. In: Maierová E, Viktorová L, Dolejš M, editors. PhD existence6. výzkum + /vs/− praxe. Česko-slovenská psychologická konference (nejen) pro doktorandy a o doktorandech. Sborník odborných příspěvků; 8.-9.12. 2016; Olomouc. Olomouc: Univerzita Palackého v Olomouci; 2016. pp. 124-131

Edited by Fernanda Dreux M. Fernandes

Speech-language pathology has different practice and research histories, standards, methods, and challenges in different countries and regions. Awareness of these different realities may contribute to the scientific development of the field and improve the services delivered to different populations. Sharing solutions to similar problems in different contexts can increase evidence-based practice that is relevant in specific situations. The aim of this book was to build a panel of contributions from different countries and several areas of research. Authors were invited to contribute with their newest conclusions and results about the themes they considered most relevant. The result includes discussions about new theoretical trends, research results, and new proposals for assessment and intervention.

Photo by Kolidzei / iStock

IntechOpen

ISBN 978-953-51-4657-5