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Learning Disabilities

Edited by Wichian Sittiprapaporn

LEARNING DISABILITIES

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Contributors

Bob Algozzine, Manabu Sumida, Ana Grasielle Correa, Irene Ficheman, Marilena Nascimento, Roseli De Deus Lopes, George Mouzakitis, Patricia Robledo-Ramón, Jesús N García, Hideko Sone, Danijela Ilić-Stošović, Snežana Nikolić, Celestino Rodríguez, Rebeca Cerezo, Paloma Gonzalez-Castro, David Alvarez, Mats Niklasson, Paul G. Jacobs, Katsumi Watanabe, Kiyomi Yatabe, Masumi Inagaki, Makiko Kaga, Takaaki Goto, Deilis Ivonne Pacheco, Chi Man Tsui, Cecilia Li, Grace Lung, Jenny Gallagher, Sasha Scambler

Notice

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Meet the editor

Dr Wichian Sittiprapaporn is a Thai Cognitive Neuroscientist who has published in many national and international publications as well as reviewed articles for reputed national and international indexed journals. He was awarded Scholar of the Month for July 2009 for his interdisciplinary research and received educational leadership award by the Guild of Independent Scholars, The Journal of Alternative Perspectives in the Social Sciences. Dr Wichian Sittiprapaporn was born in Udornthani, Thailand in 1970. He received B.A. (Hons.) (English) and M.A. (Linguistics) from Srinakharinwirot University and Mahidol University, Bangkok, Thailand in 1993 and 1997, respectively. He received a Ph.D. degree in Neurosciences from the Institute of Science and Technology for Research and Development, Mahidol University, Bangkok, Thailand, in 2002 and became a postdoctoral fellow at the Clinical Cognitive Neuroscience Center (CCNC), Seoul National University, College of Medicine, Seoul, Korea, in 2006. After working as a lecturer in Neurosciences at the Neuro-Behavioural Biology Center, Institute of Science and Technology for Research and Development, Mahidol University, from 2003 to 2005, he was invited to join the Music Therapy Division, College of Music, Mahidol University, Bangkok, in 2008. In January 2010, he joined the College of Music, Mahasarakham University, Mahasarakham and currently holds a lecturer position in Faculty of Medicine, Mahasarakham University and College of Research Methodology and Cognitive Science, Burapha University, Thailand. His current research interests include Cognitive Neurosciences, Biomedical Image and Signal Processing of Human Brain Function in Music Perception and Cognition.

Contents

Preface

Learning disability, or learning disorder, is an umbrella term for a wide variety of learning problems in which a person has difficulty learning in a typical manner, usually caused by an unknown factor. The unknown factor is the disorder that affects the brain's ability to receive and process information. That is, the brain of people with learning disabilities is wired differently and this difference affects how they receive and process information. This disorder can make it problematic for a person to learn as quickly or in the same way as someone who is not affected by a learning disability. Specific learning disability is defined as a heterogeneous group of disorders that is manifested by significant difficulties in verbal expression-comprehension, reading, writing and mathematical reasoning and ability, and it presumably stems from a dysfunction of the central nervous system. While these conditions are essentially conceptual and define learning disabilities as intrinsic to the individual and with a biological-genetic basis, they can coexist with problems in self-regulatory behaviors, social perception and interaction. They can also exist together with other disabilities, such as sensory impairment, mental retardation, severe emotional disorders or with extrinsic factors such as cultural differences or inadequate schooling. Depending on the type and severity of the disability, interventions may be used to help the individual learn strategies that will foster future success. Some interventions can be quite simplistic, while others are intricate and complex. Teachers and parents will be a part of the intervention in terms of how they aid the individual in successfully completing different tasks. This book is divided into three main parts; myths and fundamental concept, diagnosis and intervention of learning disabilities, and neurodevelopmental disorders, respectively. Thus it deserves a wide audience; it will be beneficial not only for teachers and parents struggling with attachment or behavior issues, but it will also benefit health care professionals and therapists working directly with learning disabled persons or special needs such as sensory integration dysfunction.

Dr. Wichian Sittiprapaporn
Faculty of Medicine, Mahasarakham University,
College of Research Methodology and Cognitive Science, Burapha University,
Thailand

Part 1

Learning Disabilities

1

Language Disabilities: Myths and Misconceptions vs. Reality

George S. Mouzakitis
Educational Organization e-DEKA
Greece

1. Introduction

It is strongly supported that the involvement with the persons who encounter various problems due to certain disabilities in no way can be claimed to be a philanthropic pursuit nor to be limited only to this form of support. It is true that a support based on volunteering work includes organization of social gatherings for disabled persons in order to strengthen their belief in their capacity for work, their ability to behave independently, to be included in the workforce of their country and enjoy the recognition of their environment as concerns the positive traits of their character (Pato,B.,2010)

Evidently, the measures which should be taken by official state services in the line with the expressed support of ordinary people not only will contribute to the relief of persons in need, but, also, will support national efforts to meet the crucial situation as a result of the economic crisis almost worldwide.

The Employment and Social Affairs Directory of EU, in a survey on disability matters (2007) identified that the 74% of the EU27 population thinks that more people with disabilities are needed in the work place. The crucial point of the employment indicators, and the involvement of persons with disabilities in the labour market is the disputable figures of prevalence

A survey has been, also, conducted by my research team almost two years ago,for this study among a randomly selected sample of 138 persons concisted of 70 males and 68 females aged between 25 to 37 years old employeed in small and medium enterprises (SME) .The problem statement was:" *It is claimed that more people with disabilities are required in our today's labour market. Do you agree?"* Please tick one of the following five options .The responses are shown in the following table 1.

Consequently, it is very promising that an increasing interest in recruiting persons with disabilities to the workforse will be an effective treatment of these persons who constitute the "major minority" as it will be proved in the following pages of this paper. Besides, there are plenty of jobs ranging from laborers, gardeners and upholsterers through auxiliary services to unskilled workers. It is clear that to achieve these goals, persons with disabilities are required to attend tailor-made training courses supplied by specific schools with the use of educational tools adapted to meet the learning requirements of these individuals. From

the economic point of view it is more interesting to pay for increasing the productivity of the work force rather than paying unemployment benefits which will provide social benefits to disabled individuals but will not produce any economic output.

SAMPLE	138	100.00%
RESPONSES		
I quite agree	58	42.03%
I agree	50	36.2%
I doubt	05	3.62%
I disagree	20	14.50%
I do not know	5	3.62%

Table 1. People with disabilities accepted in the work place . Sourse: Author's research team

2. Communication problems

Effective communication means that the person, someone communicates with, totally understands the speaker. Verbal and written messages are conveyed by means of **linguistic systems or symbols, or else words,** which represent a thought, a concept, an object or an experience. (Mandy, H (2009) The system requires **a receiver** and **a sender** operating (tuned) in the same wave band. Linguistically, the wave band is the word. In case communication process uses words of confusing or unknown meaning there is no communication and hence understanding. Unfortunately, this negative phenomenon happens in the area of persons with disabilities.

For decades various terms about 'Special Education" are used based on traditional practice rather than a scientific term to describe the situation. The term "special" is used to characterize the educational process of persons with disabilities. Yet, "special " means distinguished, better than normal. Vocational Schools offer many special courses, say for plumbers, electricians or other professionals. All these people are not necessarily disabled Misused terms and terms recommended as appropriate are cited here below (Table 2).

Misused Terms	Recommended	Misused Terms	Recommended
Special Education	Alternative Education	Mental retardation (Low IQ)	Developmental Disabilities
Special Needs	Particular Needs	Physically Handicapped	Physically Challenged
Handicapped (offensive term)	Impaired (accepted term)	Exceptional persons (Extremely good)	Persons with Disabilities

Table 2. Misused and recommended terms for persons with disabilities, Source: Author's proposals

As seen in the above table, the difference between the traditional terms usage and the purely scientific ones is very important in communication. The use of terms not easily understood or creating confusion may have serious impacts on the lives of persons with disabilities. For example, the use of the terms handicapped, exceptional. retarded and other result to confusion. It is, certainly, for this reason that the most authentic world organizations refer to persons with disabilities The United Nations Organization (UNO) in 2006, the World Health Organization (WHO) in 2001, the Council of Europe in 2006, and the Employment and Social Affairs of EU27 in 2010 define persons of any form of impairment as disability .The paradox about the terminology used is that most of the member countries of these world organizations, though signatories of the relative agreements continue to use terminology which was adopted many decades ago.

Presumably, they stick to the traditional terms which have been in use since decades, instead of using the scientific terms which from the communicative point of view are more effective. It is, therefore, important that definitions used to describe persons of any sort of impairments should be universally accepted to ensure clear understanding. **In science,** there is not a matter of **traditional pursuit,** but a **purely scientific discourse. Tradition is a long-established way of defining the various terms related to persons with disabilities. On the other hand, scientific ways of defining terms conform with the principles or methods used in describing specific situations.**

During the early years in the history of "Special Education" various scientists, mainly psychologists, classified people into groups according to their disabilities. As a result of this movement, the following categories have been registered by Heward & Ortansky. (1984)

- Learning Disabilities
- Emotional Disturbance
- Speech and Language Disorders
- Hearing Impairment
- Visual Impairment
- Physical Handicaps
- Mental Retardation
- Behavior Disorders

The lack of linguists in the process of defining the various impairments is obvious and has resulted to the creation of misunderstandings among everybody concerned with special education A typical example of the confusion created by the variety of definitions concerning the various disabilities among the EU27 countries is the dicision of the European Union to assign to the Brunel University (Mablett, D.,2009) to perform a comparative analysis of the definitions of disability used in the social security and employment area across the European Union member states

What is astonishing in the whole defining process is that the predominant term of these persons with disabilities is **exceptional persons.** A simple survey in five on-line dictionaries of English Language randomly selected revealed the confusion the term **exceptional** creates to parents, educators, medical people and others because the form exceptional has contrasting meanings as explained in the dictionaries:

- **Dictionary com**
  - Being unusually excellent, superior. (an exceptional violinist) [+]
  - Being physically ore especially mentally handicapped. Special schooling is required. [-]
- **The free dictionary**
  - Having much more than average intelligence, ability or skills. (an exceptional memory) [+]
  - Deviating widely from the norm as of physical, mental ability. [-]
- **Answers.com**
  - Well above average, extraordinary. (an exceptional talent) [+]
  - Below normal in intelligence [-]
- **Macmillan Dictionary**
  - Extremely good or impressive in a way that is unusual [-]
- **Merrian Webster**
  - Better than average, superior (an exceptional skill) [+]
  - Deviating from the norm, as having above or below average intelligence. [+/-]

Now picture that you receive a letter from your daughter's school informing you that "**your daughter is exceptional".** What will you do? *Will you jump for joy?* or *will you feel bitterness?*

3. Historical review

References related to aid, support and medical treatment of individuals in need are traced even during the dark periods of mankind as cited by Winzer, M., (1993). From 1500 to 1662 four events have been considered the cornerstones in the history of special education.

- Marginal improvements for handicapped persons appear in 1500.
- Pedro Ponce de Leon undertook the education of handicapped persons in Spain in 1578.
- Jean Pablo Bonet wrote the first book on special education in 1620.
- The Royal Society of London supports research into the nature of language and the teaching of deaf and blind individuals in 1662.
- During the 17th century European pioneers were involved in a variety of attempts to educate disabled persons.

Moreover, the first school for blind children is recorded in UK in 1791, whereas the first school for deaf was established in USA in 1817 under the name of American Asylum for the Education of the Deaf and Dumb In the 1800s the education of disabled persons was the responsibility of individuals supported by charities, hospitals, philanthropists etc following a system tending to the isolation of disabled persons.

By the end of the 18th century, education for disabled children was accepted as a branch of education under the name of *Special Education.*

Following the change of attitude toward people with disabilities during the end of the 18th century in the USA, reformers founded schools to educate children with a variety of disabilities. (Alton, G.,(2001) The compulsory education for normal children (1900) was extended to all children in England in 1913 and in USA in 1918. Beginning in the late 1960 and early in 1970 parents and advocates for students with disabilities began to use the

courts trying to force the states to provide an equal educational opportunity to these students (Yell, M.,(2004).

The compulsory education for normal children (1909) was extended to all children in England in 1913 and in USA in 1918.

Beginning in the late 1960 and early in 1970, parents and advocates for students with disabilities began to use the courts trying to force the states to provide an equal educational opportunity to these students. (Yell, M.,(2006). Among these e cases the following are worth mentioning:

- Established the right of all children to an equal opportunity to education.
- Declared the track system for Special Education placement unconstitutional because of discrimination against black and poor children.
- Supported the right of individuals to have appropriate treatment within state institutions.

In the period of 1958 to 1975, Heward, W. & Orlansky, D., (op.cit,) reported that four important public laws out of the twelve which were passed refer to:

- P.L. 85-926 (1958): Provision of funds for training professionals to train teachers of the intellectually disabled.
- P.L. 87-276 (1961) Funds for training professionals to train teachers of the deaf.
- P.L. 88-164 (1963) Funds for training teachers of other handicapped persons, including retarded.
- P.L. 91-320 (1969) Definition of Learning Disabilities and provision of funds for state-level programmes for learning disabilities.

The emergence of initiatives related to persons with disabilities towards the integration accomplished in the 20th century followed a fascinating pathway from the 16th century in Spain through the Age of Enlightenment in 17th century France and England to 18th –century issues in Europe and North America.(Winzer, M., op.cit)

4. Classification and definition of terms

Following the decisions of all world organizations to refer to all forms of impairments as **disabilities,** a term which is readily accepted by the legal associations of persons with disabilities, it is more than confusing to continue to use this term when referring to all the forms of this learning problem. I would propose that we use instead of the term **learning disabilities** for the whole category the term **learning impairments.**

Then, learning impairments will consist of **slow learners, learners with disorders, learners with difficulties and learners with disabilities**

4.1 Slow learners

It is accepted that all children or adults learn at different rates. Yet, some persons though slow learners do not have a learning deficiency. Slow-learners fail in their studies, regardless of the level of education, because of their low intellectual abilities. They may have a wide range of abilities and a variety of characteristics depending on their background.

4.1.1 Characteristics

According to Haskvitz, A., (2011)

- First, slow learners are frequently immature in their relations with others and do poorly in school.
- Secondly, they cannot do complex problems and work very slowly.
- They lose track of time and cannot transfer what they have learned from one task to another well.
- They do not easily master skills that are academic in nature, such as the times tables or spelling rules.
- Perhaps the most frustrating trait is their inability to have long-term goals.
- In their physical appearance they are not different from normal children.
- Capable of being educated in ordinary schools and achieve a moderate success provided
    - They are allowed to proceed at a slower pace.
    - They are not capable for higher education
    - They have poor memories

4.2 Learning disorders

According to the Encyclopedia of Children's Health Learning Disorders, these disorders are academic difficulties experienced by children and adults of average to above intelligence. People with learning disorders have difficulty with reading, writing, mathematics or combination of the three. These difficulties significantly interfere with academic achievement or daily living.

4.2.1 Characteristics

- Reading disorder: It is a language related disorder coming in four types
    - Some people decode fine but do not comprehend.
    - Some people have a hard time decoding but comprehend well.
    - Some others have both problems.
    - Some people do not recognize or interprete letters and words **(dyslexia)**
- Children have problems recognizing and counting numbers **(dyscalculia**)
- Disorders of written expression typically occur in combination with reading or mathematics. It is characterized by problems with spelling, punctuation, grammar, and organizing their thoughts in writing. **(dysgraphia)**

As it is, learning disorders affect how a person understands, remembers and responds to new information. People with learning disorders may have problems one or more of the following problems (Mediline Plus (2011).

- Listening or paying attention.
- Speaking.
- Reading or writing.
- Doing math.

4.3 Learning difficulties

Within the spectrum of difficulties associated with cognition and learning the Code of Practice the following are identified: (SENCO, 2010)

4.3.1 Characteristics

- Specific learning difficulties. (SpLD)
- Moderate learning difficulties.
- Severe and multiple learning difficulties.
- Sub-groups of SpLD can be considered: Dyslexia, Dyscalculia, Dyspraxia.

4.4 Learning disabilities

Learning disabilities are problems that affect the brain's ability to receive, process, analyze, or store information. These problems can make it difficult for a student to learn as quickly as someone who is not affected by learning disabilities (Mediline Plus (2011).

The following is a list of common characteristics of an LD student. Conditions must be persistent over a long period of time. Presence of these conditions does not necessarily mean a person is learning disabled.

4.4.1 Reading skills

- Poor decoding skills
- Poor reading fluency
- Slow reading rate
- Lack of self-monitoring reading skills
- Poor comprehension and/or retention
- Difficulty identifying important ideas in context
- Extreme difficulty building ideas and images
- Difficulty integrating new ideas to existing knowledge
- Weak vocabulary skills
- Extreme difficulty understanding words or grammar
- Difficulty recognizing high frequency words
- Oral comprehension is noticeably stronger than reading comprehension
- Extreme difficulty focusing attention on the printed marks
- Difficulty controlling eye movements across the page
- Wavy or shimmering pages not attributable to poor vision

4.4.2 Spelling skills

- Phonological awareness is noticeably stronger than spelling ability
- Frequent spelling errors of high frequency words
- Extreme difficulty with homonyms and/or regular spelling patterns
- No understanding of the relationship of phonics to written language
- No understanding of common spelling rules
- Inadequate understanding of phonics even with instruction

4.4.3 Written expression skills

- Poor writing fluency
- Unable to compose complete, grammatical sentences
- Difficulty organizing written information
- Poor handwriting
- Extremely poor alignment
- Inability to take notes or copy information from a book or the board
- Oral expression is noticeably stronger than written expression
- Extremely weak proofreading skills

4.4.4 Oral language skills

- Inability to hear small differences between sounds, not attributable to a hearing loss, particularly vowel sounds
- Difficulty articulating thoughts or ideas orally
- Difficulty pronouncing words
- Inability to blend sounds together to form words
- Difficulty listening and responding to a series of directions
- Disorganized recall of facts or details

4.4.5 Mathematical skills

- Poor mathematical fluency
- Difficulty memorizing multiplication tables
- Difficulty identifying multiples and/or factors
- Poor basic calculation skills
- Difficulty understanding word or application problems
- Poor understanding of mathematical concepts
- Difficulty sorting out irrelevant information
- Lower visual perceptual and visual-spatial ability
- Inability to transfer basic mathematical concepts to solve problems with unpredictable information
- Inability to use basic facts within more complex calculations

4.4.6 Memory skills

- Extremely weak ability to store and retrieve information efficiently
- Extremely weak ability to hold information for immediate use

4.4.7 Reasoning skills

- Extremely weak ability to solve problems, particularly when information or procedure is unfamiliar.
- Extreme difficulty recognizing, transforming, or using specific information to reach general conclusions.

5. Causes of learning impairments

- **Slow Learners**
  Quite often slow learners are confused with reluctant learners. It is claimed that though they are willing to learn, they have problems with the process. This is due to four specific factors (Table 3)

Psychological	School problems	Health Problems	Family Problems
Deprived Culture	Medium Instruction	Defective vision	Illiterate parents
Absenteeism	Untrained Teachers	Poor health	Busy parents
Emotional Growth	Inadequate teaching staff	Physical impairments	Low cultural background
	Violence in School		Hereditary reasons
	Resource problems		Low environment
	Contact with peers		Family size

Table 3. Factors influencing slow-learners Source: Author's research team.

- **Learning Disorders**
  - Neurological abnormalities
  - Brain infections
  - Visual problems
  - Language processing
  - Attention deficit
  - Medical conditions
- **Learning Difficulties**
  - Pre-natal (example Down syndrome)
  - Per-natal (oxygen deprivation, cerebral palsy)
  - Post-natal (example Meningitis)
- **Learning Disabilities**
  - Genetic Influences
  - Brain Development
  - Environmental impacts

6. Prevalence

Prevalence in no way can be considered a reliable indicator. Determining the number of children with disabilities with accuracy is not feasible. Parents are reluctant to have their children identified to having disabilities and tend to consider such classification as a family stigma. Moreover in most cases they are unaware of such situations. At the moment, the

estimated population with disabilities in EU27 is 42.9 million or the 8.56% of the total population. The respective figures of the EuroArea 16 is 24.42 million or 7.41%

People with disabilities often encounter attitudinal and environmental barriers which do not allow their full active and equal participation in society. UNO officials have stated that persons with disabilities are the "World's larger minority". The fact that a fifth of the working age is unemployed due to disabilities is a critical issue in as much as it is accepted that many disabled people are able to work if they are given the proper support Statistical data (Eurostat, 2010) reveal that persons with disabilities in the EU27 are in employment by 42.3% as compared with non-disabled persons who are employed by 64.6% (Table 4).

Category	2000	2003	2006	2009
Employment total 15-64	62.2%	62.6%	64.5%	64.6%
Employment total 55-64	36.9%	40.0%	43.5%	46.0%
Disabled Persons 15-64	38.7%	39.6%	42.0%	42.3%

Table 4. Employment rates jn EU27, 2009, source: Eurostat.

The fact that definitions about persons with the various types of learning disabilities have created confusion has hindered the appropriate implementation of measures and programmes in professional, social and educational sectors. Estimates show that about **10-20% of all persons have learning disorder, about 2-10% of children have a reading disorder and about 1-6% have an arithmetic disorder**. Unfortunately the availability of high quality, internationally comparable data on disability that is important for the planning, implementation, monitoring and evaluation of inclusive policies is often not available. Data vary from under 1% in Kenya and Bangladesh to 20% in New Zealand. Overall, disabled people represent a significant proportion of the world population.[12] The following tables represent the percentage of **disabled persons** in selected countries based on censuses and surveys after the year 2000. European countries not included in this table do not provide data from 2000 onwards.

Source: Surveys		
Country	**year**	**% Population**
Australia	**2000**	**20.0 %**
Zambia	**2006**	**13.1 %**
Ecuador	**2005**	**12.1 %**
Nicaragua	**2003**	**10.3 %**

Table 5. People with disabilities, source Eurostat

Source: Censuses		
Country	**Year**	**% Population**
United States	**2000**	**19.4 %**
Canada	**2001**	**18.5 %**
Brazil	**2000**	**14.5 %**
Uganda	**2001**	**3.5 %**
Mexico	**2000**	**2.3 %**
India	**2001**	**2.1 %**

Table 6. People with disabilities, source Eurostat

Children with learning **difficulties** are estimated to be about 17.6 % with lowest rate 12.6% and children accommodated in hospitals 38.2 % [13]. Whereas these data refer to a single district in USA further surveys confirm that, almost, in all districts the data are the same with a minor deviation. Finally, the situation with **slow learners** is rather complicated since persons characterized as being slow in achievement are not necessarily in the category of disabled persons and statistical data are not quite reliable. However, findings from USA reveal that in typical schools the percentage of slow-learners is something between 12% and 16%. Yet, in a class in areas of poverty and low income urban areas the percentage is between 24% and 32%

7. Measurement of intelligence (I.Q.)

As of a custom, when referring to a disabled person the first criterion is the IQ score. Whether we like it or not, IQ test is a tool which can enable us to draw results based on measurable data. Indeed, it is true to say that the diagnostic practice has been debated, disputed and criticized. [14], in the case of identifying the type and degree of learning impairments. Apart from the fact that a neurological dysfunction has never been proved as being by 100% the cause of learning disorder, yet,it is a message that cannot be entirely neglected. Therefore, an IQ score can indicate to psychologists, educators and teachers the pathway to the category of impairment.The following table presents a descriptive classification of IQ scores (Table 7).

IQ score	**Description**	**% of population**
130 +	Very superior	**2.2 %**
120-129	Superior	6.7 %
110-119	High average	16.1 %
90-109	Average	50.0 %
80- 89	Low average	16.1 %
70- 79	Borderline	6.7 %
Below 70	Extremely low	2.2 %

Table 7. Classification of IQ scores,, source Wechsler's scale

Apparently, the IQ scores give a global indication of the occupations a person can follow for a life long career. (Wilson,G., & Gylls,D.(2004).

IQ SCORES	OCUUPATION ACCORDING TO IQ	IQ SCORES	OCCUPATION ACCORDING TO IQ
160	Professors, Researchers	100 +	Machine Operators, Shopkeepers
140	Senior Civil Servants	100 -	Warehousemen, Bakers, Drivers
130	Scientists, Lawyers	90	Laborers, Gardeners, Miners
120	School Teachers, Managers, Nurses	70	Auxiliary Services
110	Clerks, Telephone Operators	Below 70	Unskilled workers

Table 8. Classification of occupations according to IQ, source OECD

The above classification has been slightly adopted according to IQ normal curve based on Wechster IQ scale and Stanford Binet IQ scale .

The IQ score is one part of the factors which are taken into consideration for defining the various disabilities. Though much interest .is attached to the intelligence factor, Siegel , L.,(2009) supported that intelligence tests and IQ scores are not necessary for defining learning disability She further examined four assumptions of the use of IQ scores in the definition of learning disabilities. These assumptions were:

- IQ tests measure intelligence.
- Intelligence and achievement are independent.
- IQ scores predict reading, and children with low IQ scores should be poor readers.
- Children who have reading problems with different IQ scores have different cognitive processes and information skills.

Though the reliability of the IQ Normal Curve (fig.1) is disputed by certain scientists, it is still regarded a useful tool for measuring the IQ score of individuals for academic, professional or psychological reasons

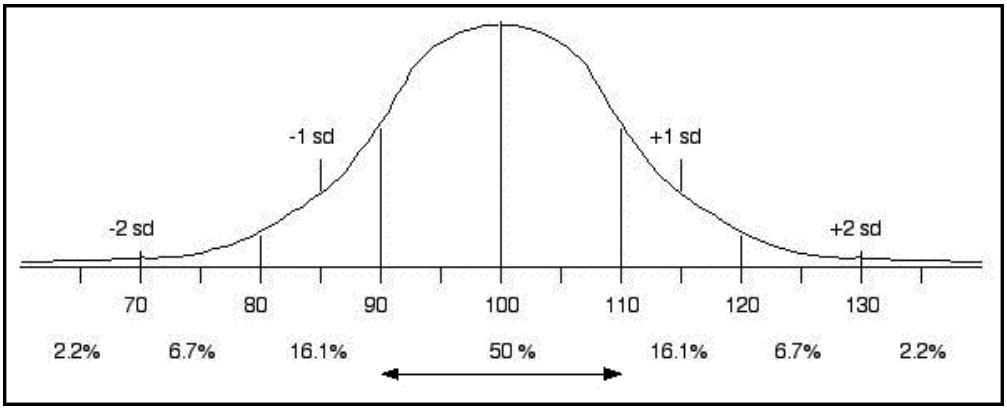

Fig. 1. Measurements of Intelligence

In the process of her surveys Siegel noticed that some children with low IQ scores can be good readers. Then, on logical and empirical grounds it was concluded that **IQ test scores are not necessary for the definition of** learning **disabilities.**Back to the table 9 to consider the differences of IQ scores related to the various types of learning impairments.

IQ scores for various learning impairments	
RANGE	**Type of impairment**
71-85	**SLOW LEARNERS**
70 or less	**LEARNING DISABILITIES**
50-70	**Mild Learning Disabilities**
35-49	**Moderate Learning Disabilities**
20-34	**Severe Learning Disabilities**
Less than 20	**Profound**
Various	**LEARNING DISORDERS DIFFICULTIES**
70 -65	**Moderate Learning Difficulties**
64-40	**Severe Learning Difficulties**
Below 40	**Profound, multiple Learning Difficulties**

Table 9. Classification of learning impaired people according to IQ, source Hallahan, D., & Kauffman .J.

8. Employability of people with disabilities

People with disabilities often encounter attitudinal and environmental barriers which do not allow their full active and equal participation in society. The fact that a fifth of the working age is unemployed due to disabilities is a critical Issue. In as much as it is accepted that many disabled people are able to work if they are given the proper support. Statistical data (Eurostat, 2010) reveal that persons with disabilities in the EU27 are employed by 42.30% as compared with non-disabled persons who are employed by 64.60% (Table 10). Evidently, the unemployment rates between disabled and non-disabled persons are dramatically unbalanced. (Table 11)

Category	2000	2003	2006	2009
Employment total 15-64	62.2%	62.6%	64.5%	64.6%
Employment total 55-64	36.9%	40.0%	43.5%	46.0%
Disabled Persons 15-64	38.7%	39.6%	42.0%	42.3%

Table 10. Employment rates between 2000-2009, source Eurostat, 2010.

Status	EU27 million 2009	EU27 million 2010
Total population	502.8	501.00
Unemployed non-disabled	8.9%	9.7%
Youth non-disabled	19.5%	20.5%
Unemployed Youth disabled	49.2%	53.2%

Table 11. Non-disabled VS disabled unemployed youth, source Eurostat.

Apart from the public assistance and the Active Labour Market Policies (ALMP) which are provided by EU27 to support employed persons with disabilities, at a percentage of 16.3% (Euro 7.233 million) in 2006 (Eurostat database, 2010) a basic factor which reduces the unemployment rates of persons with disabilities is the level of education.The lower the level of education the higher the rate of unemployment (Table 12).

Work status	Lower Level	Medium Level	Higher Level
Activities	31.6%	56.3%	69.7%
Employment	25.3%	48.5%	61.7%
Unemployed	19.9%	13.3%	11.4%

Table 12. Educational level and unemployment, source Eurostat, 2010)

9. Conclusion

The increased economic crisis in our era has dramatic influence in all sectors. Indicators reveal that whereas the world population will increase in the next 20 to 40 years by 2.593 million the increase of population in the EU27 countries is minimal. In parallel, the rates of unemployment are considerably disproportionate between disabled and non-disabled persons. There is, also, a quite unbalanced relationship between unemployed persons graduates of lower and upper secondary education and tertiary education. The rate of unemployed persons of lower secondary level raised from 2007 to 2009 by 47%, of upper secondary level by 25% and of tertiary level by 32%

The problems identified are related to an unbalanced relationship between unemployed disabled and non-disabled persons, educational attendance and social security expenditure.

Yet, the most important problem is the terminology used to describe persons with disabilities which is linguistically, psychologically and socially inappropriate. As a result, prevalence data are highly disputed preventing the implementation of the required measures and the effective communication between professionals, parents and disabled persons. In the sector of learning disabilities, which should be changed to learning impairments to avoid confusion between the general term and one of the types of learning impairments, the use of terms which are not clearly expressed should be given adequate

consideration. Since, every type of disability is linked to the IQ score of disabled persons, attention to the use and usage of terms is both important and necessary.

10. Recommendations

The situation requires immediate consideration and measurements in a multi-dimensional setting. The unemployment rates of persons with disabilities must decrease. It is necessary that these persons are included in the normal social setting as much as possible in order to contribute to the efforts of economic recovery which, also, will result to the reduction of public expenditure on supporting projects..

The problem of the use of disputable terms in describing and/or classifying persons with disabilities is extremely important, mainly in the sector of learning impairments, since situations like **slow learners, learners with difficulties, learners with disorders and learners with disabilities,** though seemingly identical they are characterized by substantial differences among them, which necessitate appropriate measures for dealing with them..

The terms of classification should be substituted by the appropriate ones. The provisions established by UNO (2006) and other organizations should be followed

Though a number of disabled persons are employed, barriers to employment should be prevented.

The social model of disability, implemented in UK should be considered. Under this model, persons with intellectual or psychological variations are not always considered to be disabled.

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2

Achievement Gaps: Learning Disabilities, Community Capital, and School Composition*

Bob Algozzine[1], Erik Porfeli[2],
Chuang Wang[3], Ann McColl[4] and Robert Audette[5]
[1]*Behavior and Reading Improvement Center,*
University of North Carolina, Charlotte,
[2]*Northeastern Ohio Universities College of Medicine,*
[3]*Department of Educational Leadership, University of North Carolina, Charlotte,*
[4]*University of North Carolina, Chapel Hill,*
[5]*Department of Reading and Elementary Education,*
University of North Carolina, Charlotte
USA

1. Introduction

A fundamental defining characteristic of students with learning disabilities (LD) is a difference between expected and actual achievement in one or more academic areas (Cortiella, 2009). In identifying these students, professionals document that disabilities related to vision, hearing, or physical impairments, mental retardation, emotional disturbance, and environmental, cultural, and economic disadvantage are not the primary cause of the underachievement (Interagency Committee on Learning Disabilities, 1987; U. S. Office of Education, 1977). While this distinguishing feature has been widely accepted, it has not been easily implemented. For example, after 5 years of research on decision making in schools, Ysseldyke et al. (1983) concluded that "there currently is no defensible system for declaring students eligible for LD services;" and, among the problem facing professionals when identifying students in need of special education services was the consistent finding of "no reliable psychometric differences between students labeled (with LD) and those simply considered low achievers" (p. 79, 80). Of course, addressing differences and gaps in achievement across groups of students is not new in America education.

Racial diversity has been a concern in America's schools for many years. Dunn (1968) focused attention on what has become known as the disproportionality problem evident in the over-representation of children from diverse ethnic, linguistic, and cultural backgrounds in special education. Once the alarm was sounded, disparities of placement and performance were widely and continuously documented (cf. Blanchett, Mumford, & Beachum, 2005; Donovan & Cross, 2002; *Educational Researcher*, 2006; Harry & Klingner,

* Portions of this chapter are from the authors' previously published or to be published work.

2006; Krezmien, Leone, Achilles, 2006; Lewis, 2005; National Center for Education Statistics, 2010; Vincent, Swain-Bradway, Tobin & May, 2011) and issues and corrective instructional activities related to diversity and schooling were widely discussed (Algozzine, Campbell, & Wang, 2009a,b; Algozzine, Daunic, & Smith, 2010; Algozzine, Marr, McClanahan, & Barnes, 2008; Algozzine, O'Shea, & Obiakor, 2009; Campbell, Wang, & Algozzine, 2010; Castro-Olivo, Preciado, Sanford, & Perry, 2011; Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld, & York, 1966; Coleman, 1969; Coleman, 1988; Henley, Ramsay, & Algozzine, 2009; Lo, Mustian, Brophy, & White, 2011; Skiba, Poloni-Staudinger, Simmons, Feggins-Azziz, & Chung, 2005).

Historically, concern related to differences in achievement across groups of students arose when the U. S. Supreme Court made it clear in the decision of *Brown v. Board of Education* that equal educational opportunity for all was expected when states, in providing education, must make it "available to all on equal terms."[1] The reasoning was that "educating all children together would increase the availability of high quality schools to all students" (Southworth, 2010, p. 3) but educators have struggled to achieve this goal (Aud, Hussar, Kena, Bianco, Frohlich, Kemp, & Tahan, 2011; Coleman, 1969; Evans, 2005; Frankenberg, Siegel-Hawley, & Wang, 2011; Goldsmith, 2011; Leithwood, 2010; Rumberger & Palardy, 2005). Rather than a systematic and productive effort resulting in reduced inequities associated with racially-segregated schools, "equal educational opportunity" has been a cobbled together plan that continues to fail in achieving promised and desired benefits (Ball, 2006; Boger & Orfield, 2005; Lyons & Chelsey, 2004; Mickelson & Bottia, 2010; Smith & Kozleski, 2005; Southworth, 2010).

Interest in equal opportunities is given renewed life by continuing analyses and documentation of academic performance and efforts to bring about change in intractable schools (Aud et al., 2011; Leithwood, Patten, & Jantzi, 2010). Once again, despite some changes in policy and approaches, there have been persistent and pervasive gaps in educational achievement across and within America's schools and communities (Anderson, Leithwood, & Strauss, 2010; Aud et al., 2011; Ball, 2006; Borman et al., 2004; Cartledge, 2011; Evans, 2005; Ferguson & Mehta, 2004; Frankenberg, Siegel-Hawley, & Wang, 2011; Hess, 2005; Leithwood, Patten, & Jantzi, 2010; Mathis, 2005; Morris & Monroe, 2009; Smith & Kozleski, 2005; Wraga, 2006). The modern-day *Brown* issues are in play when schools can choose to consider race in efforts to achieve equity for important purposes, including improved academic outcomes for all (Bourdieu, 1986; Hong & Youngs, 2008; Olneck, 2000).

2. Factors affecting student achievement

Conventional wisdom holds that differences in achievement across groups of students are a school problem, often defined as "disabilities" requiring special education, and the belief has fueled historical and current efforts to bring about reform in the American educational system (Evans, 2005; Southworth, 2010). Placing the blame by blaming the place has at its core the logic of equity and equality of opportunity:

[1] 374 U.S. 483, 493 (1954); Brown v. Board of Education of Topeka, Kansas (1954).

> "All children are created equal, but all children are not performing equally in school; the gap typically worsens as children advance through the grades; *the fault must therefore be the schools,'*so the solution must lie in the school; the necessary *knowledge and tools* are available, and schools must be pressed to apply them." (Evans, 2005, p. 583, emphasis added)

Guidance from this view suggests that if achievement gaps spring from the *structure of and practice within* schools then changing aspects of schooling (e.g., new curriculum, reducing class size, increasing student motivation, implementing response-to-intervention practices) will provide a way to reduce disparities in educational attainment. In this context, laws and legislative mandates are seen as ways to bring about change viewed as necessary and possible but, for projected and/or undefined reasons, unrealized. For example, America's No Child Left Behind (NCLB: 2002) Act is based on the belief that setting high standards and establishing measurable goals can improve outcomes in education and it sanctions states for schools that fail to document adequate yearly progress for their students. In contemporary special education practice, driven in large part by reauthorizations of Public Law 94-142 now codified as the Individuals with Disabilities Education Act (IDEA), identification of learning disabilities is now embodied in response-to-intervention (RtI) methods that have emerged as the preferred practices for improving education for the "most vulnerable, *academically* [emphasis added] unresponsive children" in schools and school districts (Fuchs & Deshler, 2007, p. 131). We take a different view of the base for differences in achievement and direct attention to community capital and school composition as powerful predictors of performance and the intractable gaps among student groups. Our view does not see children as the source of problem but more their problems are a result of where they go to school and what happens or does not happen there.

The resources contributed by the institutions (e.g., family, school, and labor) within a community and the interactions that emerge from them reflect the context in which children learn rather than defining the potential of individual students (Bourdieu, 1986; Furstenberg & Hughes, 1995). From this view, we believe that community capital and composition of the student body interact to explain academic achievement differences *at the school level*; that is, the academic potential of the student body not only serves to improve raw educational advancement, but it also shapes other aspects of the learning climate like classroom behaviors and values that bear on their educational advancement. A student body that has the capacity to successfully perform academically is more likely to engender a set of values, beliefs, self concepts, and behaviors (Bear, Minke, & Manning, 2002; Hoge & Renzulli, 1993) that promote the learning environment because on a core level humans prefer to engage in activities that are aligned with their capacities (Ford, 1994; Harker & Nash, 1996; Harker & Tymms, 2004). Impoverished schools with a more academically-capable student body should, therefore, be better able to overcome the maladaptive forces associated with diminished community resources much more effectively than schools with less academically-capable students. On the contrary, wealthy schools would exhibit less of a difference on the basis of differences in the academic capacity of their student body because the environmental benefit served by academic potential is likely to be completely diminished by the benefit of a wealthy community.

3. Evidence supporting theory

The importance and value of studying factors in urban schools and school systems in the South that disproportionately disadvantage African American students has been demonstrated (cf. Cartledge, Yurick, Singh, Keyes, & Kourea, 2011; Morris & Monroe, 2009; Lo, Mustian, Brophy, & White, 2011). In recent research, we documented that increases in the academic potential of a school serve as a protective feature decreasing the negative influence or "power rating" of low socio-economic characteristics as reflected in the community capital of a school; we used aggregated composites of community and school characteristics in a large southeastern city to predict school-level (N = 80) achievement (Porfeli, McColl, Wang, Algozzine, & Audette, 2011). We provide a summary of our work in the rest of this chapter.

3.1 Context

We completed our research in one of the top 25 largest public school systems in the United States (cf. Sable & Hoffman, 2005; Sable, Plotts, & Mitchell, 2011) and the largest in the state, with an enrollment of over 125,000 pre-kindergarten through 12th grade students. The ethnic distribution was approximately 43% African-American, 40% White, 10% Hispanic, 4% Asian, and 3% Native American or Multi-Racial. The elementary schools we studied were located in urban, suburban, and rural neighborhoods.

The total number of students enrolled in participating schools was over 55,000, and among them, 18% were kindergarteners, 17% were first graders, 16% were second graders, 16% were third graders, 17% were fourth graders, and 16% were fifth graders. The average student enrollment in the schools was 629 (*Range*=226-1372). Minority enrollments (65%) as well as socioeconomic (53% free or reduced lunch) and second language markers (6% students with limited English proficiency) reflect the overall district demographics and represent similar characteristics to those of the 100 largest public elementary school districts in the United States (cf. Sable & Hoffman, 2005; Sable, Plotts, & Mitchell, 2011). We obtained data from publicly-accessible web-based resources maintained by the school district. This information included many variables (e.g., percentage of student passing the reading and mathematics state-wide standardized tests, percentage of parents with incomes below $25,000, percentage of students within each category of ethnicity groups, percentage of students identified as gifted and as having disabilities) including indicators of the community capital, academic achievement, and the student potential at the school level as well as control factors with potential moderating effects.

We defined community capital using a combination of variables that reflected financial, human, and social conditions of schools in our study. *Financial capital* was the percent of children receiving free or reduced lunch and the percent of parents who earn less than $25,000. *Human capital* was the percent of mothers with some college education. *Social capital* was the percent of parents' attending parent-teacher conferences and volunteering in the school, the percent of children who reside is single parent households, and the percent of parents with limited English proficiency. Our measure of community capital also included elements pertaining to the neighborhoods and surrounding areas in which the school was expected to educate children. School-level academic potential was operationalized as the

percent of children with a "gifted" classification and the percent of children with a recognized disability that could interfere with academic development (e.g., learning and other disabilities). We added the percent of African American children in each school and the total enrollment of each school to the regression models to represent the potential confounding impact of race and school size on the prediction model (see below). Others have used information on these variables similarly in research on predictors of academic achievement (Coladarci, 2006; Ilon & Normore, 2006; Olneck, 2000; Sirin, 2005).

We were interested in the characteristics of schools rather than the characteristics of students in them as predictors of overall achievement. The percent of students at the school who passed state-mandated end-of-grade reading and mathematics tests was available for these analyses. We calculated the difference between current and previous pass rates and used it to estimate the progress that schools made across a single academic year.

The end-of-grade reading test assessed components of the state's Standard Course of Study. The test consisted of eight reading selections with three to nine associated questions for each selection. Each student was asked to read five literary selections (two fiction, one nonfiction, one drama, one poem) and three informational selections (two content and one consumer). The variety of selections on each form allowed for the assessment of reading for various purposes: for literary experience, to gain information, and to perform a task.

The end-of grade mathematics test assessed the goals and objectives in the state's Standard Course of Study. On the test, students demonstrated knowledge of important principles and concepts, and related mathematical information to everyday situations. In order to align with the mathematics curriculum's addressing inquiry instruction and higher-order thinking, the test had an increased focus on processing information and higher-order thinking.

For the purposes of our research, we averaged the math and reading achievement to yield an overall indicator of the academic achievement of each school, because the correlation between reading and math pass rates for the elementary schools was 0.92. Our achievement variable reflected the average passing rate for each school on the mathematics and reading test and was used as an estimate of the "performance" of the school.

We employed a correlation design to test a theoretical model suggesting that community and school characteristics influence academic outcomes. Since we were interested in identifying the magnitude of the relationship between academic outcomes and other characteristics such as the community capital and academic potential, a multiple regression technique was used to investigate these relationships and to identify the relative impact of the characteristics on school-level academic outcomes independent of two control variables believed to influence achievement. Given that we were also interested in assessing the moderating impact of academic potential on the relationship between community capital and academic achievement, an interaction term (community capital by academic potential) was also included in the regression model.

3.2 Findings

Community capital was the strongest independent predictor of school-level academic achievement, with profound predictive power (R^2 = .81) particularly given that the model

did not directly account for aspects of the teaching situation (e.g., qualifications of the teachers or quality of the instruction) that schools aim to change as a way of boosting academic achievement. In other words, predictors that personnel at the school-level are generally unable to influence accounted for about 81% of the variability in achievement across the 80 elementary schools. Our regression results also suggested that the academic potential of the student body moderates the relationship between community capital and overall academic achievement while controlling for the total enrollment and race of the study body of the schools.

The community capital influence was greater in schools with less academic potential and weaker in schools with more potential. Recalling that academic potential is a construct combining the percentage of student with academic gifts and those with academic disabilities, overall academic achievement of schools was *more* influenced by community capital in schools that had a *lesser* fraction of gifted children and *greater* fraction of children with disabilities than schools reflecting the reverse proportions. Although statistically significant, the impact of this moderating influence was relatively weak. Schools with the least amount of community capital and academic potential demonstrated the *greatest gains* in overall academic achievement, *yet* the schools with the least amount of community capital and relatively high academic potential demonstrated the *greatest declines* in overall academic achievement. The schools in the wealthiest communities (e.g., 1 standard deviation above the mean on the community capital variable) generally demonstrated declines, with the greatest decline occurring in those schools with lower academic potential.

4. Discussion

Schools in America are segregated and many are composed "almost entirely of either White, African American, or Latino students" (Goldsmith, 2011, p. 508); and, data indicate that students from schools serving communities with disproportionally more minority students have lower academic profiles than their peers in other schools (Goldsmith, 2009). Almost 60 years after the Supreme Court ruled that "equal educational opportunity" was every person's right, the evidence of persistent and consistent educational inequality refuses to go away. We believe that learning more about the connection between community capital and achievement will help schools and communities to better understand the problem and thereby direct better solutions to it. If community capital is important, then what can communities and schools do to strengthen it? What can school boards do to more evenly distribute it? How should it affect the location of new schools? How should it influence the student assignment plan? These decisions that connect diversity, community capital, and educational achievement could be at the heart of the school district's mission.

The persistent difference between the performances of groups of students (i.e., the "achievement gap") is perhaps the "most stubborn, perplexing issue confronting American schools today" (Evans, 2005, p. 582). Evaluating the impact of community capital on educational achievement is an opportunity to reframe the perspective on blame for this problem and visit and project the benefits of intentional diversity and integration on the educational advancement for all children. Community capital, as operationalized in our research, was significantly related to school-level achievement. This outcome cannot be completely overcome by simply flooding impoverished schools with financial capital or boosting human and social capital by enticing more experienced and proficient teachers.

Using Coleman's (1988) concept of "public good," we believe it is important to consider all capital that is available to the school and the learning environment (i.e., community capital). As Sirin (2005) argues, the capital of a neighborhood should also be considered. This ideally captures the socioeconomic status (SES) of the neighborhood, which reflects the potential of businesses and residents to contribute resources to the school. Families, for example, can share financial capital with the school through support of the parent-teacher organization or through other opportunities to directly donate resources. Parrish, Matsumoto, and Fowler (1995) illustrate this fiscal capacity in their study that found that the higher neighborhood SES, measured by the value of owner-occupied housing and residents' educational attainment, correlated significantly with greater school expenditures per student. Another element of the neighborhood capital is the stability of the neighborhood and its capacity to create societal norms that may have an impact on the school. Coleman also includes safety as an element of social capital. A neighborhood in which parents feel that other adults will keep their children from harm's way has more social capital than one in which parents are fearful for the safety of their children.

Our research supports a hypothesized interactive impact of community capital and academic potential on achievement. The academic potential of the student body reduced the "power rating" of community capital (Coladarci, 2006). Moreover, the overall achievement gap between schools is slightly narrowing, but is being largely offset by the declines in the impoverished, higher potential schools. Academic achievement change at the school level may, therefore, hinge on the issue of consistency when comparing configurations of higher or lower community capital and higher or lower academic potential. If a school with higher potential is situated in a neighborhood with more capital or a school with lower potential is in neighborhood with less capital, then the schools exhibit changes not exceeding ±1.3%. If a school with higher potential is situated in a lower capital neighborhood or a school with lower potential is in a higher capital neighborhood, then the achievement change across time is consistently a negative number (in the range of -1.7 and -4.3%). Where you go to school matters when summative and formative comparisons of performance are used to drive policy and decision making.

The large urban district school examined in our study, therefore, appears to be making good progress in impoverished schools with high concentrations of students with disabilities, but they may be leaving their schools with higher concentrations of gifted students in impoverished neighborhoods behind. On the contrary, the district school is having greater success maintaining their achievement levels in wealthier schools with higher concentrations of gifted students, but the district may be struggling to meet the needs of wealthier schools with higher concentrations of students with disabilities. The interactive influences of community characteristics and school composition represent a clear area for further investigation.

4.1 Implications for the use of community capital

In addition to considerations related to student assignment, concepts of community capital could be incorporated into many kinds of decisions made by local boards such as location of schools, approaches to financing schools, and community and parental involvement approaches to more equitably distribute these resources. By choosing to pay attention to community capital, the board can refine its decision making in these areas.

The location of schools and funding strategies are interconnected. Typically, local boards have control over the selection of sites for schools. There are important exceptions to this. For example, a publicly-passed bond referendum may set criteria for the school location or even specify the location. Or the local government responsible for collecting local property taxes or other funds used for school construction may set conditions on funding. Or if the state has stepped in to take a larger role in funding school construction, it also may exercise some oversight over the school location (Dewees & Hammer, 2000; McColl & Malhoit, 2004; MGT of America, 2001; Parrish, Matsumoto, & Fowler, 1995). Whoever is setting the conditions, the tendency is to focus on population density and travel patterns. Advocates for strong rural schools have urged a broader focus on site location, including the importance of school buildings to the overall vibrancy of a community (Dewees & Hammer, 2000; McColl & Malhoit, 2004). Similarly, local boards, or these other governing entities can consider the type of community capital that would exist for a particular school given the surrounding community and likely student assignment patterns. School boards sometimes consider various funding strategies in order to meet needs. If community capital becomes a priority, it also might help drive the strategies for funding schools based on the options that most likely would best allow consideration of community capital.

"Policymakers need to find ways to desegregate schools" (Goldsmith, 2011, p. 531). By better understanding the impact of community capital and the inequities in school composition potentially created by it, local boards can take steps to change. If it must maintain a school location in a neighborhood that is relatively poor, unstable, and high in crime, then members must recognize the significant challenges that this school will face and must make greater efforts to involve the broader community or nearby business community in the school (e.g., schools located in poor neighborhoods could reap the benefits of localized business leadership and the board could be part of a larger effort to give support to that neighborhood in order to help). In this context, community capital is a tool for helping a board assess its priorities and making its decisions align with them. Or, put another way, it helps a board and its community better understand factors contributing to gaps in achievement across schools to more fully impact policies and outcomes for students.

4.2 Caveats and limitations

We need to underscore that our information was from publicly available datasets. Our aim was to use our conceptual model of community capital and student composition of schools to model extant data. The student potential variable is one variable that could benefit from refinement given that some schools may have higher identification rates not only because more of such students attend the schools but also because their educational practices may lead to over identification. Therefore, one cannot attribute these special education identification rates solely to student characteristics. Fortunately, the statistical model that we used controls for this problem to the extent that these rates correlated with race, school size, and the community capital of the school. This statistical control does not however, completely resolve the measurement limitations of this variable. Future research should, therefore, employ the presented conceptual models to design a measurement protocol that more effectively assesses the conceptual space defined by our conceptions of community capital and potential.

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3

Dyslexia in Hong Kong: Challenges and Opportunities

Chi-man Tsui, Cecilia W. P. Li-Tsang and Pui Yee Grace Lung
Department of Rehabilitation Sciences, The Hong Kong Polytechnic University
China

1. Introduction

This chapter aims to give a full picture of the development of the services for pupils with dyslexia in Hong Kong from the perspectives of the major stakeholders. The successes and challenges of developing dyslexic services in Hong Kong would inspire various stakeholders and in turn shed light on the formulation of the related policies and services elsewhere.

There are four main sections in this chapter which describe the past, current and future development of the services on dyslexia.

2. Awareness of dyslexia in Hong Kong

There has been a growing awareness of the issues of children with dyslexia in Hong Kong since the 1990s.

As dyslexia is often termed as "hidden disability" due to the discrepancy between the intellectual abilities and actual reading and writing performance, under-diagnosis and hence deprivation of early identification and early interventions such as appropriate educational and social support from teachers and parents usually exist (Department of Social Work and Social Administration, 2005).

Currently, there is no reliable prevalence rate of dyslexia. As the knowledge on dyslexia of the major stakeholders is limited, the report rate of dyslexia remains low in Hong Kong. However, over 80% of primary and secondary school teachers come into contact with dyslexic students in their classes. Although primary and secondary school teachers have adequate basic knowledge on dyslexia, the majority desired more in-depth training on its nature and management (Hong Kong Christian Service, 2005). This reflects that there has been a lack of training on dyslexia for personnel working with children which may have made early identification and subsequent interventions of dyslexia less possible.

A study showed that 62.5% of parents suspected that their children were suffering dyslexia, with only 21.6% being identified by their teachers. About 70% and 25% of students were assessed in Child Assessment Centers and in schools (either by Education Bureau, EDB, or school-based educational psychologists) respectively. The long waiting time for assessment services was also an issue. About one-third of students waited for 3 to 6 months; nearly 40%

had to wait for 6 months to one year, and more than 10% even needed more than one year. As a result, parents ought to shoulder a crucial gate-keeping role in early identification so as to initiate the subsequent professional assessment and interventions (Ngan-Keung, 2008).

When parents suspect their children of dyslexia, it is quite common and natural for them to want to know more about its causes, treatment/interventions and prognosis. Accurate and reliable information on dyslexia is best provided by well informed professionals. While various personnel are involved in identification of dyslexia, nurses are usually one of the most readily accessible frontline professionals who provide advices for children's health-related problems. Hence, nurses with knowledge on dyslexia act as a gate keeper for early detection of dyslexia before referring suspected children for further assessment. In Hong Kong, the Student Health Service of the Department of Health (DH) provides comprehensive health programs for primary and secondary school students according to their needs at various developmental stages. Nurses there are responsible for physical examination and health assessment, individual counseling and health education activities as well as referring those with problems to Special Assessment Centre or specialties for further assessment and management. Children suspected of dyslexia can be referred for comprehensive child assessment provided by DH, EDB or private agencies (Hong Kong Department of Health, 2006).

In response to the need to investigate the knowledge on dyslexia among health-care professionals, there was a study (Tsui, 2007) to get a profile of Hong Kong nursing students' knowledge on dyslexia by using ten true/false questions covering basic knowledge on dyslexia. It aimed to find out the implications for nursing education for both nursing students and practicing nurses as well as for current and future nursing practices. Those ten questions which were also adopted in an earlier study on Hong Kong teachers' dyslexia knowledge were designed by Dr. Catherine Lam, a leading advocate for dyslexics in Hong Kong and the consultant of Child Assessment Service of Department of Health. The comparison of the knowledge of the nursing students and the teachers in the two studies respectively was also made. With each correct answer of the ten questions scoring one, the mean was 7.71 in the study on nursing students which was lower than that in the study on teachers. More than 90% of the teachers gave a correct answer in eight out of ten questions whereas of the nursing students scored more than 90% in only three out of ten questions. Performance of the teachers was better than that of the nursing students in three questions. They were "Dyslexia is related to a lack of parents' supervision", "Dyslexia is related to a lack of motivation for learning" and "Dyslexia will usually improve when student grows up". The answers of all these questions were "false". This was expected as teachers were more informed about such situations. They usually had regular contact with parents for discussing students' academic performance. They were probably aware that no strong correlation existed between parents' supervision and the occurrence of dyslexia. In other words, dyslexia did occur irrespective of whether parent supervision was adequate or not. Similarly, teachers could readily notice that dyslexia occurred and did not improve though there were children who were eager to learn. As for Question "Medication is effective for dyslexia", over 90% of the teachers in that study but only 74.4% of the nursing students in the present study answered the question correctly (realising the statement was false). Nursing students were expected to be more familiar than teachers with drug therapy but surprisingly over a quarter of them had the misconceived notion that medication was

effective in the treatment for dyslexia. Considerable lower percentage of respondents in both studies gave correct answers to other two questions, namely, "Hyperactive students will have various degree of dyslexia" and "All dyslexic students suffer problem of inattention". The correct answers for both should be "false". The possible explanation for the misconception is likely to be the common occurrence of attention-deficit/hyperactivity disorder (ADHD) and dyslexia and the relationship between the two disorders being mistakenly perceived to be causal instead of comorbid. The comorbidity of ADHD and dyslexia is well recognised. A meta-analysis study indicates that pharmacological interventions (mainly the use of stimulants) are more effective than non-pharmacological interventions in treating ADHD but still not significant in improving academic performance. As ADHD is wrongly perceived to be the cause of dyslexia and medication is found to be effective for ADHD, one may conclude that medication will thus be effective for dyslexia. The possible reason of better performance of teachers in this question is that they may misunderstand that the medication prescribed is used for the co-existing ADHD problems. Hence, when the teachers notice that dyslexic problems cannot be improved by the medication, they may well believe that the medication is ineffective for dyslexia.

3. Actions taken in the past two decades in Hong Kong

3.1 The Hong Kong Association for Specific Learning Disabilities (HKASLD)

The following parts summarize the report written by the chairperson of a renowned parent group, HKASLD (Ngan-Keung, 2008).

HKASLD is a parent self-help group established in 1998. Before the 1990's, either the government or the general public had very little attention on specific learning disabilities (SLD). Even parents and teachers were not aware that academic underachievement might be due to SLD. Worse still, children with SLD were regarded as lazy and hence ignored and neglected in schools. In view of this, a group of parents organized HKASLD with the following aims:

- creating a better and fairer school environment for their own children;
- improving education policies pertaining the provision of assistance to children with SLD;
- providing both emotional and instrumental support to other parents;
- implementing educational events for the general public.

After more than a decade of development and experiences, the objectives of HKASLD become more structural and precise. They include:

- to facilitate self-help and mutual-help among parents in order to better assist each other in solving problems faced the children with SLD;
- to promote the general public understanding and acceptance towards children with SLD and hence eliminate the discrimination;
- to encourage professional research;
- to advocate for better learning environments for children with SLD.

The work of HKASLD is comprehensive which includes parent support and education, advocacy, children and youth development, and public education.

Parent support and education:

- parent sharing, learning skill workshops and family activities in various districts;
- parent hotline, professional counseling services and newsletter publication;
- parent training workshops, seminars for policy development and introduction of new resources;
- SLD Online Discussion Board for parents

Advocacy:

Regular meetings with government bureaux and departments, agencies and other stakeholders to discuss the following issues -

- better monitoring and support systems in primary schools;
- funding and resources support for secondary schools;
- teacher training;
- support for further education such as Vocational Training Council courses;
- pre-employment training and employment support.

Children and youth development:

- gymnastic classes, football programs, hiking, etc. in various districts;
- leadership training for teenagers with SLD;
- English improvement project for teens;
- seminars on studying and learning skills.

Public education:

- media interviews;
- "Wordless Gala" every two years;
- website;
- community and school talks.

3.1.1 Major milestones

In 2000, HKASLD succeeded to advocate for the Equal Opportunities Commission (EOC) to include SLD in the Code of Practice on Education under the Disability Discrimination Ordinance (DDO).

In 2002/2003, the parents there made a request to the Hong Kong Examination and Assessment Authority (HKEAA) to provide public examination accommodations to SLD students. HKEAA then prepared and disseminated a special pamphlet informing schools and parents of the eligibility and procedures for SLD students to apply for accommodations in the Hong Kong Certificate of Education Examination (HKCEE) and the Hong Kong Advanced Level Examination (HKALE).

In the subsequent years, the Education Bureau (EDB) published various teaching, support and assessment guidelines for local primary schools, and started organizing a number of teacher training workshops on SLD.

In 2003/2004, a "New Funding Model" was launched by the EDB. $10,000 or $20,000 financial subsidies (the latter for students requiring individualized education programs) were provided to primary schools.

In short, HKASLD successfully made the turning point which included the inclusion of SLD under DDO and the distribution of leaflets on SLD services by the Hong Kong Examination and Assessment Authority in 2000's. Since then, the schools and society progressively have more understanding of dyslexia.

3.2 EDB

Another crucial stakeholder is EDB. The Deputy Secretary for Education (School and Professional Development Branch) of EDB made a critical review on its development on dyslexic services (Ip, 2010).

The following are the three stages on the development of educational services for students with dyslexia:

Initial stage – 80s' and 90's

The significance of addressing the educational needs of dyslexic students started being acknowledged. Some simple assessment tools and group remediation programs were in trial.

Second stage – Year 2000

The first norm-referenced screening tool for primary school students was published. This checklist helped teachers to screen for pupils with possible dyslexia. The first professional assessment tool for psychologists to diagnose dyslexia in primary school pupils was also published. These made teachers and public more aware of dyslexia which in turn enabled early identification and interventions.

Third stage – from 2000 onwards

Expansion and fine-tuning of the services are in place.

3.2.1 Major developments of the multi-focus model

- Teacher training
  Five-year professional development framework launched in the 2007/2008 school year aims to let 10% of teachers in each ordinary school complete the Basic Course (30-hour), a minimum of three teachers complete the Advanced Course (90-hour) on catering for diverse learning needs, and at least one Chinese Language teacher and one English Language teacher complete the Thematic Courses (60 hours each) on specific learning difficulties respectively.
- Whole-school policies
  Schools should enforce and regularly review the measures including but not limited to enhancement of staff awareness and understanding on dyslexia, establishment of School Support Team, identification and assessment procedures, implementation of interventions, accommodations in classroom learning and examinations, and engagement of parents.
- Funding and professional support for schools
  EDB recommends the adoption of the following 3-tier intervention model as a framework for flexible use of funding to address the varying degrees of needs of the students:

Tier-1 support - preventive in nature; quality language teaching in the classroom for all students; managing early signs of learning difficulties.
Tier-2 support - "add-on" intervention for students with persistent learning difficulties; small group learning, pull-out programs, etc.
Tier-3 support – focusing on a relatively small number of students with the need of intensive support, special accommodations, specialist support, etc. due to higher severity of learning difficulties.

- Development of expertise and specific learning resources
  With a budget of over $150 million, the 5-year READ & WRITE initiated in 2006 has achieved a number of successes including the development of a prevention program at kindergarten level, publication of new assessment tools and evidenced-based learning resources for both primary and secondary students with dyslexia, implementation of the training for a target of 5000 primary school Chinese language teachers, and introduction of a district support model for parents.
- Cross-sector collaboration
  EDB has collaborations with a number of other stakeholders including DH (on assessment); schools, tertiary institutions and non-government organizations (NGOs) (on resource development and service provision); HKEAA (on special public examination arrangements); Vocational Training Centres (on special arrangements for admission); and HKASLD (on provision of parents' advice).
- Promotion of public awareness
  Promotion of understanding and acceptance towards dyslexia is continuously done through mass media, leaflets and web-based information.

3.3 HKEAA

In response to the concerns about the implementation of the special examination arrangements for students with dyslexia, a direct investigation was conducted by The Ombudsman in 2007, under The Ombudsman Ordinance (Office of The Ombudsman, 2008). The following issues about special examination arrangements for students with dyslexia were examined:

- special arrangements for internal examinations and assessments in primary and secondary schools for students with dyslexia;
- the roles of EDB and the former Education and Manpower Bureau in providing these special arrangements;
- special arrangements made by the HKEAA for public examinations for these students;
- coordination regarding the provision of the arrangements among EDB, schools and HKEAA, and between government and NGOs;
- promotion of awareness of the practice of such special arrangements among parents, students, teachers and school authorities.

3.3.1 The necessity to adopt special examination arrangements

The government policy embarked the provision of special examination arrangements for students with dyslexia. The EOC issued DDO Code of Practice on Education. It states that reasonable accommodation in the existing programs, services, facilities and benefits must be

given to satisfy the needs of these students, without unjustifiable hardship. Special examination arrangements are regarded as reasonable accommodation. They aim to remove the disadvantages induced by dyslexia rather than related to the knowledge or skills being examined. The premises include having no unfair advantages over other students and no interferences with the assessment objectives.

3.3.2 Special arrangements in internal examinations

In addition to taking reference from the guidelines such as "Principles and Strategies for Assessment for Students with Special Educational Needs in Ordinary Schools" published by EDB in 2004, special arrangements in internal examinations have to be made by schools according to the difficulties of the individual students, and the advice from educational professionals such as educational psychologists. As schools are supposed to be accountable for such arrangements, EDB can be approached for assistance if parents find any disagreement between them and the school. The examples of the special arrangements include:

- extending examination time;
- enlarging the spaces in answer sheet for writing answers;
- enlarging the font size of examination papers;
- reading out the questions to students for non-language subjects;
- allowing use of a special room under separate invigilation;
- alternative method of answering (e.g. oral response, circling the answers);
- use of computer for word processing; and
- supervised breaks

3.3.3 Special arrangements in public examinations

Students with dyslexia can apply to HKEAA for special arrangements in public examinations (HKCEE for Secondary 5; HKALE for Secondary 7). The "early application" and "second phase application" are open in September/October of the academic year in Secondary 4 and 6, and Secondary 5 and 7, respectively. In addition to completion of an application form, an up-to-date assessment report (with records of special arrangements in his/her school) duly signed by a qualified psychologist and the school head is also necessary. More precise specifications on the requirements of the report are suggested. First, the "qualified psychologist" must be an educational or clinical psychologist with professional practice training. Second, "up-to-date" assessment report refers to the one done within three years prior to the public examination. Third, the psychologist signing the report should be the one who confirms that the applicant has dyslexia and needs special arrangements in the public examination. Last, conclusion has to be drawn on the recommended types of special arrangements. The examples of the special arrangements include:

- providing extra time;
- allowing writing on only one side of an answer book, or on alternate lines or circling multiple-choice answers on a question paper;
- providing special format question papers, e.g. one-side printing or enlarged fonts;
- specially arranged centre (e.g. in a classroom instead of a hall);
- special seating in a centre (e.g. near the front or back of an examination centre);

- supervised breaks in examinations lasting 90 minutes or more; and
- other special arrangements such as use of computer in answering questions

The HKEAA Task Group on Special Examination Arrangements is responsible for deciding to approve or reject the application. Candidates dissatisfied with the decision can appeal by giving reasons and supporting documents to The Appeal Panel for Special Needs. They would be notified of the appeal result prior to the examination.

3.4 Rehab Clinic, The Hong Kong Polytechnic University

In view of the pressing needs to fulfill the demands of the services on dyslexia, the Clinic has launched the occupational therapy interventions for school-age children with dyslexia.

In Hong Kong, children start their Chinese and English handwriting training in the pre-school age. Writing Chinese characters is different from other written language. Chinese handwriting appears to be more critical since Chinese characters are as logographic nature. It is more complex as the skills involve multiple stroke sequence and direction (Lam, Au, Leung, & Li-Tsang, 2011). Chinese characters are composed of many sharp turns of stroke and demand frequent pen lifts (Tseng, 1998). It also involves advanced visual motor and visual sensory processing skills. Hence, children are frequently referred to occupational therapists for handwriting difficulties. The interventions with a combination of approaches based on children individual problems include:

- visual perceptual and visual motor training to improve children abilities to discriminate the fine differences in the form and position of strokes in the Chinese characters
- sensory integration therapy emphasizing tactile and vestibular input to attend and focus
- training on fine motor accuracy to assist children with low muscle tone, postural instabilities, weakness on hand grip strength and hand coordination.
- learning keyboard typing as an alternated way to assist children in managing the written works

3.4.1 Visual perceptual training

Visual perception is an important ability that enables one to make sense out of what is seen (in contrast to visual acuity tests that merely determine something seen by the individual). It is one of the essential components for learning Chinese handwriting, especially for Hong Kong children who are required to have a good legibility on the handwriting in their learning culture. Besides, Chinese characters are logographic nature. Its stroke pattern sequence and direction are more complex. Children should have good visual spatial skills in order to write the characters with good positioning of strokes and proportioning of radicals in a squared-area. The following areas are the main components on our visual perceptual training:

Training on visual memory

Some children have difficulties in memory which preserves some characteristics of senses pertaining to visual experience. They need longer time to capture and memorize new characters and symbols.

Training on visual form-constancy

Some school-age children have weakness to mentally turn and rotate objects or picture. This skill is essential to distinguish differences in size, shape, and orientation of Chinese characters, especially those not printed in a normal horizontal alignment or in different font sizes. Training on visual form- constancy can improve their reading speed and accuracy.

Training on visual sequential-memory

This helps to improve children abilities to conduct visual decoding and encoding. This is an essential component for English spelling.

Training on visual spatial relationship

Some children have difficulties in perceiving the positions of objects in relation to oneself and other objects. Children with visual spatial problems will have poor alignment and spacing in the written outputs.

Training on visual closure

Children with problems in visual closure have weaknesses to identify a whole figure when only fragments are presented.

Training on visual discrimination

Visual discrimination skills involve the ability to perceive words accurately by noting similarities and differences in words. This is an essential ability for the children to differentiate complex figures among different Chinese characters.

Training on figure ground perception

Figure ground perception is the tendency to discriminate between target and background stimuli. The stimulus perceived as the target is regarded as the figure. The other stimuli not perceived as the target make up the background, or ground. It is important for children to capture important content in a reading paragraph.

Training on visual motor skill

Visual motor skills have been defined as "the ability to integrate the visual image of letters or shapes with the appropriate motor response" (Schneck, 1996). These skills have been shown to be highly associated with other functional activities like handwriting. Besides, visual-motor skills can be multifaceted and influenced by number of factors, including pencil grip, fine motor skills, eye-hand coordination, kinesthesia, motor planning, and visual perceptual skills. Activities involving visual scanning and visual tracking like mazes, driving game, throwing, and cycling can improve visual motor skills.

3.4.2 Sensory integration

While traditional handwriting tasks involve paper work and require children to be seated, sensory integration and multisensory modalities become one of the core treatment programs for the school-based occupational therapy. Although the research on the effectiveness of a multisensory approach has been sparse and the results of finding are inconsistent (Harris & Livesey, 1992; Lockhart & Law, 1994; Oliver, 1990), a study in United States found that

approximately 90% of school-based occupational therapists responded used multi-sensory approach when treating students with handwriting problems (Woodward & Swinth, 2002).

In school, occupational therapists design activities which are rich in tactile, vestibular and proprioceptive stimulation can increase body awareness, motor planning and attention. Besides, activities with proprioceptive stimulation can assist children in improving their muscle control which is essential for a good pencil grip and a good posture for handwriting tasks. Here are some activities with multisensory modalities aiming to improve children handwriting abilities:

- "Sky writing" –writing letter in the air
- finger tracing in a bag of hair gel
- black construction paper covered with salt
- block design
- writing with chalk and chalkboard
- colored writing lines representing the sky, grass and dirt
- design copying on paper strips and masking tape on the floor
- writing on a tray of rice or sand with a finger
- parquetry
- shape tracing with vision occluded
- tracing letter over transparency
- verbal cues while writing
- finger writing with shaving cream
- wrist weights

3.4.3 Training on fine motor accuracy

In addition to visual-perceptual problems, fine motor development problems also affect children handwriting. Motor skills are remediable through practice in many cases. If children have weak hand muscles, poor wrist control or in-hand manipulation skills, the skills can be strengthened through various fine motor activities designed by occupational therapists such as playing guitar or threading.

Empirical evidence also shows that pencil grips would affect children's handwriting legibility and speed (Schneck, 1988). The lateral quadrupod and four-finger pencil grips are found to be as functional as the dynamic tripod, lateral tripod, and dynamic quadrupod pencil grips (Koziatek & Powell, 2003). Besides, occupational therapists have to prescribe a pencil grippers or adaptive pencils to those with immature pencil grip. This can faciltiate and improve their hand wirting legibilty as well as their wirting speed.

3.4.4 Mastery of keyboard typing

Children with poor handwriting often score a lower grade on the content of their written work. Relationship between poor handwriting and difficulties has also been shown in many other areas of academic learning (e.g. spelling, writing composition and grammar) (Berninger, Mizokawa & Bragg, 1991; Campbell, 1973). Students with learning disabilities have difficulties in writing which needs to be adequately configured, aligned and spaced in a timely manner. As computers are more available nowadays, word processing is another

option for students who struggle with handwriting problems. Although there is no study proving that children with dyslexia have better performance on keyboard writing, students are able to keyboard faster than handwriting. Among the slowest writers, 75% achieved more text production with keyboard than with handwriting (Rogers, Case-Smith, 2002). These results indicated that keyboarding performance requires distinctly different skills from handwriting. Keyboarding can increase and improve a student's written output in their academic study. Hence, students with learning difficulties are suggested to learn both handwriting and keyboard writing skills. The mastery of handwriting as well as keyboarding is critical for success in school and work.

4. Appraisal of the work done in Hong Kong

The following parts summarize the critique made by Ngan-Keung (2008) on the adequacy and effectiveness of the efforts paid to the dyslexic services.

The actions aiming to satisfy the ever rising parental and professional needs include:

- publication of Hong Kong Test of Specific Learning Difficulties in Reading and Writing for Primary School Students and The Hong Kong Specific Learning Difficulties Behaviour Checklist (for Primary One to Primary Four Students)
- development of support guidelines and teacher training workshops at foundation level by EDB
- launch of new funding system for primary schools to support dyslexic students

These actions were somehow successful which could be reflected by the increase in the awareness among primary school teachers and social workers and hence better acceptance of towards the dyslexia students and provision of some simple accommodations in classes and examinations.

However, most if not all efforts were put on primary education only. This might be due to the misconception that dyslexia is merely a short-term learning difficulty. There is nothing to concern about further education or employment.

In view of this, parents started advocating for tailor-made policies from government and more collaboration among various government departments and concern groups. With many struggles, there have been a number of achievements. SLD has finally been included in the Hong Kong Rehabilitation Programme Plan. The Hong Kong Test of Specific Learning Difficulties in Reading and Writing for Junior Secondary School Students was published in 2007. More awareness has also been attained among secondary schools, Labor and Welfare Department, and community rehabilitation centers on the importance of lifelong support to the individuals with dyslexia.

Nevertheless, there is still much room for improvement.

The school support to students with dyslexia remains very insufficient and ineffective. It could be attributed to the lack of knowledge and teaching methods in teachers and lack of resources and guidance in schools from the government. Both students and parents thus suffer a lot. Students have poor confidence and self-esteem. Some of them had emotional and psychological problems and even committed suicide. Parents' burdens (both psychological and financial) had never been small. A study revealed that about 55% of

parents had negative thoughts during taking care of children with dyslexia, more than 40% had insomnia and depression, and as high as 30% needed to receive professional counseling. Worse still, these psychological issues did not get proper and prompt attention. As for financial aspect, additional expenses are inevitably required for caring children with dyslexia. The same study showed that 80% of families needed to spend extra money for the study skills workshops, tutorial groups, and occupational therapy and/or physiotherapy interventions. The average extra money spent per month ranged from HK $1001 to $2000. Families with children with dyslexia are not entitled to receive any financial subsidies from government or EDB. While the New Funding Model grant launched in primary schools adopts a whole-school approach to create a supportive learning environment for dyslexic students (such as special teaching, and accommodations in classes, school examinations and public examinations), no assurance system is developed for measuring the extent that the students can benefit from it such as improvement in academic performance or personal confidence and motivation. Alarmingly, only 13.7% of parents realized that their children were receiving support under the Model. Worse still, as many as 40% of the parents did not find the support useful or simply knew nothing about such school subsidy. Due to such unclear intervention and insufficient communication between schools and parents, parents have to try to seek other sources of support in which community is a choice. In view of this great demand, NGOs and private centers are offering more and more services such as assessment, learning or studying skills tutorials, emotional management programs, self-confidence development programs, potential development programs, and multi-sensory training etc. The trainers are merely social workers and other non-professionals, and the targets are primary school students only but not including those senior ones.

Unfortunately, the services offered by NGOs are not satisfactory. Despite the fact that only half of the respondents were aware of the services offered by the nearby NGOs, half among those who knew the services refused to use the services due to bad outcomes and poor quality of the trainers.

There are other drawbacks in current services including but not limited to the followings:

- limitations in the identification tools and teaching materials in Chinese
- narrow support to the education system (confining to primary schools)
- immaturity of the service models and broken policies in education, medical and employment
- ineffective and inconsistent support from schools (without good system for monitoring the allocation of the resources to warrant an equal opportunity learning environment for all students with special needs leading to conflicts between schools and parents)

Hence, there is a very urgent need to formulate and strictly enforce good school policy. The continuum of support should be made possible where services have to be ranged from pre-schools, primary schools, secondary schools, vocational training institutes, universities to employment markets. Evidence-based teaching methods and materials for Chinese students with dyslexia would enhance the effectiveness and cost-effectiveness of the interventions. Updated and advanced training has to be provided to the personnel engaged including principals, teachers, educational psychologists, clinical psychologists, occupational

therapists and social workers. Both instrumental (e.g. financial) and emotional needs of parents should be acknowledged and addressed.

5. Ahead

Having gaining the experiences over the past two decades, evidence-based practice is regarded as an important direction for the future development of dyslexic services.

5.1 Writing Chinese and English words

Each written language has its unique characteristics and format according to its origin and development. Alphabetic languages emphasize on smoothness and continuity in their written forms, whereas Chinese characters contain sharp turns of stroke and demand frequent pen lifts (Tseng, 1998). As mentioned earlier, the problem of handwriting would appear to be more critical as Chinese characters are typically characterized by its logographic nature and its complexity with multiple stroke sequence and directions (Lam et al, 2011). The configuration of stroke patterns in Chinese characters do not give any clue in where to start and which stroke to follow while writing a character. Writing in Chinese also involves complex geometric figuration and stroke arrangement within a squared-area. Different composition, proportion and orientation of the parts in Chinese characters can form different characters and carry total different meanings and pronunciation. Therefore, research should focus on evaluation and training of students with dyslexia in writing Chinese characters.

5.2 Objective evaluation of handwriting performance

In the past decade, educators and health professionals often relied on subjective judgment to comment and assess handwriting performance of students. Some researchers and educators tried to evaluate handwriting performance of students using speed and accuracy as the criteria to define good and bad writing (Tseng & Chow, 2000; Tseng & Hsueh, 1997). Most of these handwriting assessments mainly emphasized on the handwriting speed. They could not provide information regarding the process including pen pressure while writing, writing time, pause time (air time) etc. These factors could reflect the underlying problems of handwriting (Rosenblum et al., 2006a; Rosenblum, et al., 2006b). Researchers in recent years also suggested that the process of handwriting is also an important area to explore the underlying problems in handwriting, which can be helpful in identifying specific handwriting difficulties (Rosenblum et al., 2003).

A commercial software system "Optimized Action Sequence Interpreter System (OASIS)" was developed to measure the handwriting speed, pen in air and ground time using the tablet (Smits-Engelsman, et al., 2003). However, this system is rather cumbersome and not user friendly. Another software, the Penmanship Objective Evaluation Tool (POET) was developed by Rosenblum and her team in Israel. The POET can be used to capture the data generated from the WACOM tablet to assess the writing speed, ground time, pen in air time, and pen pressure during the process of writing. Nevertheless, the POET software was not commercially available and only meant for conducting research studies in this area because the system adopted the Mathlab software. There is a strong need to validate an objective and

user friendly handwriting evaluation tool for local students who write Chinese most of the time.

5.3 Validation of Chinese Handwriting Assessment Tool (CHAT)

Recently, the Chinese Handwriting Assessment Tool (CHAT) was developed by a group of researchers from two local universities in Hong Kong led by Li-Tsang (2011). The CHAT was built up to assess the handwriting performance of primary school children in Hong Kong. A total of 322 primary school students were invited to participate in the pilot study of CHAT project. It showed that the CHAT is a reliable and valid tool for assessment of the Chinese handwriting performance of young students.

The research team was further funded by the Quality Education Fund (QEF), Hong Kong Special Administrative Region to support a project to build up the local norm for primary school students in Hong Kong. The objectives of this project were to (1) develop an objective CHAT for assessing handwriting performance and collect the normative data of local Chinese children aged between 6-10 years; (2) screen and assess the handwriting performance and performance components of children with handwriting difficulties using the CHAT system; (3) identify specific deficits of children in the areas of phonological and morphological function, visual motor function, visual perceptual function and sensory-motor function, using standardized assessments; and (4) transfer the training program to teachers and parents if proven effective.

A total of 1136 primary school students were recruited using stratified sampling methods. Six schools were selected from the list of primary schools downloaded from the website of the EDB. In each school, one class (around 30 students in each class) from each grade (Grade 1 to Grade 6) was selected to join the study. Upon the consent of parents/guardians, the students were invited to join the assessment. There were 642 boys (56.5%) and 494 girls (43.5%). The age of the participants varied from 6.06 to 14.20 years. Between Grade 1 and Grade 6, the distribution of subjects was quite even, with a variation of 15.3% to 19.7% of the sample. Handwriting speed, total handwriting time, ground time, air time, mean pen pressure, standard deviation of pen pressure in copying, size of characters and its variation were recorded for each student during the data collection. Results indicated that P6 students wrote faster than P1 students. There was a steady progression of handwriting speed from P1 to P6. No gender difference was found in terms of the handwriting performance. The normative data was subsequently obtained for students studying from P1 to P6 level. The normative data was then published in the CHAT: Process Tool User Manual (Li-Tsang, 2011).

5.4 Handwriting performance of primary school students with and without dyslexia

A recent study was conducted to investigate the Chinese handwriting performance of typical children and children with dyslexia in Hong Kong primary school, and to examine whether speed and accuracy of handwriting could reliably discriminate these two groups of children. A total of 137 children with dyslexia and 756 typical children were recruited from main stream primary schools. They were requested to copy 90 Chinese characters using the CHAT. The process of handwriting was recorded and the stroke errors in writing were analyzed using the CHAT system (Lam et.al, 2011)

Results indicated that children with dyslexia wrote significantly slower, with greater character size and variation in size ($p < .05$) than the typical children of same age group. They also wrote with significantly lower accuracy ($p < .05$), i.e. they made more mistakes in writing. Commonly observed writing errors among the dyslexic group were "missing strokes" meaning missing one or more strokes in one word and "concatenated strokes" meaning two strokes were joined together.

From the discriminant analysis, writing speed and accuracy were found to be the satisfactory discriminators that could discriminate students with dyslexic, with reasonably good classification accuracy of over 70% for every grade. Those students with poor handwriting abilities also had problems of fine motor skills, kinesthetic abilities, visual perceptual skills and ocular motor control.

5.5 Training of dyslexic students with specific handwriting difficulties

Another study was conducted to evaluate the effectiveness of an Interactive Computerized Handwriting Training Programme (ICHTP) on the handwriting performance of the students with handwriting difficulties. The ICHTP was first developed in 2004 through the support of the QEF. It consists of 3 parts for training, namely, training of visual perception, training of visual motor integration and training of controlled grip.

A total of 139 students (P1 to P6) with special education need or screened to have handwriting problems by CHAT was recruited to join the ICHTP. They received a series of 8 sessions of training together with the pre-intervention session and the post-intervention assessment under the supervision of a qualified occupational therapist.

Among the measurements for handwriting performance, handwriting speed was significantly improved after the training for the training group. Significant decrease in average pen pressure was also noted in both groups of management. However, no significant improvement was found in the measures of time ratio, accuracy, character size variation and number of characters exceeding grid. This indicated that children displayed a better force modulation so that they could be less prone to fatigue in handwriting. Visual perceptual and ocular motor skills also showed improvement after training and these are some of the important abilities in recognizing and perceiving word structure. In addition, the training program appeared to improve the ocular motor skills, which also helped in reducing chance of skipping the lines and words.

5.6 Provision of special examination arrangements for students with dyslexia

As mentioned earlier, all Secondary Seven students have to get high grades in HKALE in order to enter universities. The competition is huge and only 15% of the candidates can get the university quota for studies. For students with dyslexia, they would be granted with extra time allowance if they have diagnosis of the dyslexia by educational psychologist. However, to them, by adding extra time to complete the test may not solve their problem of reading and writing for the examination. They may make a lot of mistakes while writing, or they may have very slow handwriting speed.

Therefore, a study was conducted to identify factors that might contribute to the handwriting performance of students with dyslexia. Some of the factors which could affect

the handwriting performance, namely gender, grades, types of subjects selected, were also analyzed. Fifty participants (age range: 15–19-years-old) were recruited from one mainstream secondary school and 20 participants (age range: 17–24-years-old) were recruited from two secondary schools for students with dyslexia. They were asked to perform three consecutive handwriting tasks: copying 90 characters using the computerized CHAT, an English passage copying task, and a Chinese passage copying task. The data indicated that students with dyslexia were significantly slower in copying both Chinese and English characters in passages when compared to the typical students.

Significant differences in the measures of writing speed, air/ground time ratio, standard deviation of speed, standard deviation of size per character, and number of stroke errors measured by the CHAT were found between the two groups of students. Further analysis on the data of typical students indicated no significant difference in handwriting speed among students from different classes (i.e. arts or science) on copying Chinese and English passages, and on individual Chinese words (from CHAT). It was interesting to note that no significant correlation was found in their handwriting speed measured by the three writing tasks, i.e. Chinese, English and individual words.

In short, the CHAT is found to be a valid and reliable tool for assessment and documentation. Local normative data has been collected from 1136 students. In addition, the CHAT can be used to identify students who are at risk of handwriting difficulties, particularly for students with dyslexia. With the normative data for comparison, those students with specific handwriting difficulties can be identified and screened at a much earlier stage when they enter the primary education system. Once a student is identified with handwriting challenge, suitable therapeutic and training program can help to enhance their handwriting skills such that they can better cope with the academic work at schools. Through the systematic training on visual perception, visual motor integration and force modulation, students' handwriting abilities can be improved.

The CHAT should further be developed into an objective evaluation tool to explore the handwriting accuracy such that most of the errors can be identified and corrected through professional training or specific intervention by therapists. The results can also help to provide more objective evidence to make recommendations for making special examination arrangements for students with dyslexia or other special needs.

6. Conclusion

To sum up, services on dyslexia in Hong Kong have been getting steady improvement over the past two decades. Nevertheless, there is still a long way to go. Hope the sharing in this chapter would arouse further attention and discussions on this pressing area and in turn synergize efforts to create better lives for students with dyslexia and their parents.

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4

Attention Deficit Hyperactivity Disorder (ADHD) and Writing Learning Disabilities

Celestino Rodríguez, Paloma González-Castro,
Rebeca Cerezo and David Álvarez
University of Oviedo
Spain

1. Introduction

In this chapter, a brief of three studies relating attention deficit and hyperactivity disorder (ADHD) and writing Learning Disabilities (LD) is presented, all of them following a research line. First, we carried out an experimental study on attention and writing with normally developing students, investigating the effects of the use of a graphic organizer and a time interval register processes in writing composition. Second, we selected four samples of students, one group of students with ADHD and LD, one with ADHD without LD. The third group comprised students with LD, and the last group was made up of normally achieving students. Those groups were matched for age and educational level, and we evaluated variables of attention, working memory (first comparative study), and also the processes and the product of writing composition including the orchestration (second comparative study).

We reviewed the previous empirical studies that served as background work. From this review we found that there are only a few published research studies that analyze the overlap of the presence of ADHD and LD in writing, as well as the need to study the relationship between attention and writing in normally achieving students. Besides, it was found a paucity of knowledge regarding the relationship between ADHD and writing LD. It is also pertinent to briefly conceptualize, ADHD and its various presentations; LD in writing; and the existing studies about the overlap of ADHD and LD in writing.

2. ADHD and writing

The problems of the ADHD are very common; between 3 and 6 per cent of all children in school age suffer from it (American Psychiatric Association [APA], 2002) and the problems continue for these children as they grow up in about 40 per cent of the cases, as the revision of Nolan, Volpe, Gadow, & Sprafkin (1999) points out. Other researches even increase this number stating the percentage of children suffering from ADHD in school age to up to 5 to 10 per cent (Scahill & Schwab-Stone, 2000). With these facts and facing the education procedure, we have to keep in mind that in our classrooms there is at least one child that suffers from ADHD (DeShazo, Lyman, & Grofer, 2002). These research studies show us the need of considering this kind of problems, approaching diagnosis and intervention about

ADHD. We also need to provide them strategies that can help in their day-to-day life since there is still no total solution to the problem.

On the other hand, another reason for this chapter is the link this diagnosis presents with other problems or difficulties, as supported by a number of studies (comorbidity with anxiety disorders, bipolar disorder, ODD, etc.). In these studies it is stated that the overlap of the ADHD might be up to 80 per cent with two or three or even more developmental disorders (Kaplan, Dewey, Crawford, & Wilson, 2001). Considering the high prevalence and the large overlap, and that the people suffering from ADHD shows a lack of control of their impulses, it is probable that this will be shown in the written composition.

It is known that writing requires thinking about the aim, the readers, the rhetorical elements, outline, details, complexity, result, coherence, etc. (Alamargot & Chanquoy, 2001; García & de Caso, 2002; Kellogg, 1994; Munro & Howes, 1998; Torrance & Galbraith, 2006; Wong, 2000). Furthermore, the written composition is a complex process that includes having a lot of information in the long term memory and keeps that in mind during the whole process of work, at the same time as one plan, create and revise the ideas. All these activities require a high standard on the attention system and on the working memory, which gives as a result that children suffering from ADHD commit syntactic errors, coherence errors, and that they use a simple structure and a very basic vocabulary (Gregg, Coleman, Stennett, & Davis, 2002).

On the other hand, the short time of planning and supervision of the work produced by students with ADHD, using processes of writing that are very fixed and basic, also influences the final result in a negative way with the creation of short stories in which some of the most fundamental components are omitted and with low coherence. In this point double theory comes, the first one is if the difficulties in writing are secondary problems of the ADHD or are problems related with, and the second one is about the way oneself could interfere and contribute to solve these difficulties.

Considering it in this way, the effective writer chooses, adopts or invents strategies that will improve his aims (Buttler, Elaschuk & Poole, 2000; de la Paz, 1999, 2001), that is, in an auto-settled way (Graham & Harris, 2000), which implies an efficient use of the cognitive ways, such as the reflexive. The intervention focused on improving the strategy of the reflexive process is important and interesting, as well as the cases of overlapping between the ADHD and problems with written composition.

We have to consider the fact that the mental effort and the attention resourses are limited when written assignments are being carried out (Alamargot & Chanquoy, 2001). This implies that several processes have to be considered at the same time (the search for a letter, the theme, the ideas, the readers, or the general plan of the written composition) and in a auto-settled and developing way (García & Fidalgo, 2003); which gives the result that if someone has attention difficulties this would be reflected in the written composition, and also in the complex process of writing (Gregg et al., 2002).

These research studies show us the need and relevancy of going deeper into the research about the overlap between the ADHD and the learning difficulties, since very few researchers have tried to identify the relationship between different frequent subtypes amongst students suffering from ADHD and LD, that is, extending current studies (Gregg et

al., 2002). The research about the overlap seems very relevant if we look at it from the developing and intervention point of view. Concentrating on the context and the various components and considering the main problem the lack of ability of self-regulation and control of impulses (Barkley 1997a, 1997b, 1998, 2001; Miranda & Presentación, 2000) and do that in relation with writing. For example, according to the theory of Barkley (1997a; 1997b), the problem that people suffering from ADHD presents is a lack of behavioural inhibition which affects four important executive functions (working memory; self-regulation of affection/motivation/activation; language internalization; and reconstitution); all of which affect the force/fluency/syntax control of the behaviour. It is predictable that we can achieve some understanding about the problem that these people suffer from by doing a research on written composition, but we also need more specific and in-depth research. Furthermore, there is a lack of research which considers the educational point of view of the overlap between ADHD and the written composition, and here is where this research line is important and relevant.

It is to be stressed, - and it might seem shocking - that with these premises the research about the ADHD and writing have not been done with nearly the depth that these facts imply. In the same way, it is one of the important limitations we have found in the making of this work; the very few previous researches to study, and the lack of previous theory. This fact composes the biggest difficulty in the research that we are going to present on the coming pages, but we have also faced the complexity of carrying out a study which covers a variety of complex structures, such as ADHD and writing.

Finally, and briefly previously mentioned, it seems necessary to know in depth how the problems of ADHD affect written composition. It also seems necessary to answer the question or assumption of a link or/and an overlap, of the learning difficulties in written composition and how ADHD is affecting other LD such as in mathematics or in reading (Miranda, Meliá-de Alba, Marco-Taverner, Roselló, & Mulas, 2006), specifically when it comes to learning disabilities in mathematics LDM. Fletcher (2005) considers that the combination of LDM and ADHD seems to be linked; a child with these problems is affected by the typical learning difficulties in both diagnoses. The outline of the cognitive test results of children suffering from control group and ADHD were similar, but with a different outline both within group of LDM as well as between ADHD and LDM.

2.1 Prevalence data and epidemiology

Presently, are necessary analyzing theoretical models of writing with a view to considering possible connections between writing and ADHD. This connection is not proposed directly by the theoretical models, but given the types of components they include we can make some inferences that will help us to better understand the relationship of overlap or comorbidity between ADHD and LD in writing, for example (Rodríguez et al., 2010). We have seen that the main theories on writing and the main theories on ADHD include aspects that are related to each other. And throughout these theories we can support a common base to explain the relation between the two problems. With this theoretical approaching we have answered another of the theoretical problems, which was to analyse the link between different theories on written composition and theories on ADHD, and also with recent trends of diagnosis and intervention in this disorder.

Secondly, this research line has also opened a way for a future link between the theories on ADHD and the theories on written composition, since we have seen that both models fit with each other in several ways, above all when it comes to the working memory and the executive function (Rodríguez et al., 2010). We can also see that the expected growing importance of the working memory and the attention, within what is called s*luggish cognitive tempo* as a difference to the inattentive subtype in ADHD, make these relations increase since basically all theories support on the working memory, such as the ones of Kellogg or Hayes. They consider this subtype to be the most probable of all three subtypes to have learning disabilities in writing (Rodríguez et al., 2011a; Seidman, Biederman, Monuteaux, Valera, & Doyle, 2005).

As we have known throughout the theoretical support of this line, the whole scientific world agrees on that the problems of ADHD and LD on writing are frequently related. We have also seen this in the analysis of the theories on this type, which are also backed up by empiric studies (Holowenko, & Pashute, 2000; Kadesjö & Gillbert, 2001; Mayes, Calhoun, & Crowell, 2000).

On the one hand the link between ADHD and writing on a theoretical level and on the other on a field research level, contrast the influence of ADHD in school, being one of the most important disorders causing LD in writing. We can also see that these theories are not backed up by scientific empiric studies in this aspect (Rodríguez et al., 2011b).

In this sense we had the aim to find out about the current state of investigation and empiric studies on writing and ADHD. When investigating this it has been found that the scientific research in this aspect – the link between ADHD and writing – was generally limited to mechanical aspects of this ability, simple aspects such as the graph. The few times it is done on a deeper level the samples are not broad enough, or they are based on studies epidemiological or a questionnaire to define the child suffering from ADHD. One could say that generally, the underlying processes to ADHD are neither analysed nor profoundly studied, but studied in a wide, general way and not deeply (Ambalavanan & Loteen, 2005).

An important aspect to consider, and an implication in this chapter, has to do with something very important when this research began, and is based on the aim of analysing new tendencies in the diagnosis and intervention on ADHD, and to put this in relation to problems added to this disorder, specifically LD in writing.

In first place, the sample that we have used in the greater part of our empiric study, consists of a group of children who are clinically diagnosed with ADHD. That can show us, by analysing the results of these children, whether these diagnoses are generally correct. We can also see, if there within the group of children with LD are cases without diagnosis, how the problems of diagnosis are reflected in the comparing analysis of the results of attention, working memory, etc. If we look at the two groups comparing the results, they are quite similar, which is why we consider the diagnosis to be correct. Even so, in the future it would be possible to adjust the group of children with LD a little, trying to find possible cases of ADHD, and then the differences might be bigger.

We also have to mention that even though the tests used to measure the aspects related to ADHD, such as attention and working memory, are many - with the results of a large

evaluation, it would not be entirely enough to do a diagnosis of ADHD. Some of the aspects, such as the sustained attention, would need other tests to be able to state a diagnosis, and for that purpose an individual evaluation would then have been more adequate.

Even so, our purpose was not to state a diagnosis but to simulate situations from school as much as possible. The evaluation and diagnosis have been put together by a professional that knows about the methods of investigation and testing to make a diagnosis, this is of great interest and applicability (Álvarez et al., 2007).

Finally, another purpose of this chapter is to know epidemiological data of our sample, since it is broad and has an important clinical support. In first place we wanted to know if the ratio male-female correspond to other international studies (Egger, Kondo, & Angold, 2006). The results correspond almost exactly, having a percentage of an 80.8 per cent male and 19.2 per cent female in the sample, which correspond to the ratio of four to one explained in other epidemiological studies.

Other interesting aspect (Willcutt & Pennington, 2000) has to do with the percentage of children suffering from ADHD who present LD in writing. Generally, a 59.59 per cent of the children suffering from ADHD suffer also from LD in writing in function of the criteria used, and the remaining 40.4 per cent have not LD in writing. Table 1 shows a summary of these epidemiological data.

	ADHD with WLD	**ADHD without LD**	**WLD**
Male	50/ 50,5%	30/ 30,30%	80/ 80,8
Female	9/ 9,09%	10/ 10,10%	19/ 19.19%
Total	59/ 59,59%	40/ 40,4%	Ratio male/female 4 a 1

ADHD: attention deficit and hyperactivity disorder (ADHD), WLD: writing Learning Disabilities

Table 1. Epidemiological data of the sample, total and percentage

Finally, all the theoretical revision and the empiric studies on ADHD do not answer the question if the relation between ADHD and learning disabilities in writing is possibly an overlap or link. It is a question that is yet not answered, and therefore, with this research, we hope to make progress in answering it, although not completely. We will later extend and reflect on the conclusions we have made on this topic but it is essential to stress that we can partly be satisfied with the results we have made regarding this, and with the partial achievement of our aim.

In short, the theoretical perspective of this chapter has served to let us know about the concept of ADHD, a concept that is under change and that is in need of empirical studies to narrow its current gap. Even so, we have gotten to know a theoretical model which has been of great use, and which we have also been able to apply to our study field. We have also given the disorder a psycho-educational approach, both in terms of diagnosis as well as intervention, agreeing with our aims.

On the other hand, we have focused and related ADHD with other of our main topics in our work, such as LD in writing. The epidemiological relations between both of the problems, and the theoretical relation, seem symptomatic. This conclusion has no empiric support, which creates a gap that we hope to fill with this chapter, even if it is only a little.

With all previously mentioned facts, we have covered partial conclusions. It has also served as an introduction to explaining the conclusions made from our empiric studies, and as will follow we will explain this in a reflexive way. These conclusions are based on the results in the field studies, and keeping in mind the theoretical conclusions we hope to have answers to out aims.

3. Three empirical studies about ADHD and writing

The prevalence of the ADHD is high; between 3 and 6 per cent of all school age children present with it (Jakobson & Kikas, 2007). Other research studies have reported even higher percentages and state that up to 5 to 10 per cent of school age children have ADHD (Frazier, Youngstrom, Glutting, & Watkins, 2007). With these facts and considering the education system, it must be borne in mind that there is at least one child in each classroom that has a diagnosis of ADHD (Barkley, 2007). Considering the high prevalence and the large coincidence as well as the fact that people with ADHD show a lack of control of their impulses, it is probable that this will reflect in their written compositions and its learning disabilities.

Therefore, the need and relevance of furthering the research as regards the coincidence between ADHD and LD is evident. Given that few researchers have tried to identify the relationship between the various and frequently occurring subtypes that present in students with ADHD and writing learning disabilities, we aim to further the research in this area (Gregg et al., 2002). In addition, it would be important to discover whether if the link between ADHD and writing LD can be considered as relationship of comorbidity, and also whether the problems that this group presents are more serious that the sum of the problems related to working memory, attention and writing that each group presents separately.

In this chapter, the theoretical element attempts to focus the aims and hypothesis of the empirical research about ADHD and writing LD, and therefore includes the pertinent and immediate antecedents. We carried out a review of the empirical studies on ADHD and writing from recent years. The primary conclusions established the deficit of empirical studies related to writing and ADHD. To be more exact, the deficit is even more obvious when the written composition is considered in relation to the processes followed by ADHD students and the written products they construct. The only studies that have been carried out only face the problem in a superficial way, without entering in detail.

It is predictable that we can achieve some understanding about the problem that these people face by doing research into composition written, but we also need more specific and in-depth research studies. Furthermore, there is a lack of research, from an educational perspective, regarding the coincidence of ADHD and composition writing. At the same time, there are also theories that consider the relationship between writing and ADHD, and

this could lead to the creation of a specific model which accounts for both aspects, as a first step in future research (Rodríguez et al., 2009a; 2009b)

This research line exampled in this chapter would be both important and relevant, as it is a study into ADHD and writing LD covering the various aspects which link these disorders using various research designs. In the first place, children with normal development (cuasi-experimental study in attention and writing) are the subject. Secondly, ADHD children both with and without writing LD and without both problems, in attention, writing revision and working memory measurements (first comparative study) are the aim of investigation, and finally the attention is given to the writing product, processes and its orchestration (second comparative study).

3.1 Experimental study

First study aims to describe the role that attention plays in the writing process. The independent variables are subjected to different kinds of manipulation in the evaluation of written compositions. We investigated the effect of different psychological aspects related to ADHD in the main processes involved in composition writing. We also introduced aids, such as graphic organizers, in an attempt to understand its adaptability in the changing tasks of writing, and to show its merit when it comes to facilitating the textual planning and organization.

This study comprised a sample of 326 pupils, aged between 10 and 16 years old, in the 5th and 6th years of Primary School and in the 1st and 2nd years of Secondary School. We used a nest experimental design; we compared the two groups, one of which made use of the graphic organizer during the writing process Each of these groups is divided in two, and evaluated using a register of time intervals, with an average interval of 45 seconds for one group and 90 seconds for the other one, marked by a beep sounded during the realization of the writing task. The pupils must register their activity in the process categories when the beep is heard.

All the participants completed two different writing tasks (argumentative and cause-effect) in order to assess the productivity, quality and structure, as well as the writing processes. A *writing log* which is a time-sampled self-report on-line technique was employed (modified double and triple task) (Olive, Kellogg, & Piolat, 2002; Torrance & Galbraith, 2006). Finally, we tested in the class groups the influence of variables related to ADHD (sustained and selective attention, ADHD symptoms, DSM-IV and working memory).

The results illustrate the negative effect of the interval register used during the use of writing log. It was found that a lower average provides greater information but, at the same time it distorts the task and the obtained results. This may be a result of the greater cognitive effort that the double task requires. We also studied the extent of the practical use of the graphic organizer during the writing tasks, and the consequent improvement in the compositions of the students using it. The results we had confirmed the achievement of the aim, but the most important results are that they indicate very interesting applications and future prospects, and of great applicability.

Finally, it is important to highlight that the positive influence of the planning and organization of the graphic organizer is superior to the distortion provoked by a lower

average in the codification of the processes. This leads to a discussion of the expectations of educational practice in this kind of aid, and what this might imply for future research projects, for example in students with ADHD (García & Rodríguez, 2007).

On the other hand, *writing log* or *the modification of the double and triple task* (García, Rodríguez, Pacheco, & Diez, 2009; Olive, Kellog, & Piolat, 2002) presents a great capacity of evaluation of the psychological processes involved in the written composition. It gives us information about the temporary organization of the students when they carry out a task of written composition, independently of which type of text they had to write.

This kind of evaluation-on-line- also gives us information about the written product, but the results we had on this area showed us that the data on the product are not as reliable as the ones on the process. And here we were presented to an important dichotomy. On the one hand we could make the students register the process of writing in their *writing log* (Figure 1) with a longer average of time, but the information we would obtain would be scarce. On the other hand we could reduce previously mentioned average time, but this study has showed us that that act seriously deforms the product in terms of productivity, coherence and quality, or even the process – even though this last thing is regarding quantity, not regarding the orchestration and temporary organization of the cognitive processes involved with written composition, which is not affected.

DEFINITIONS	ACTIONS	1	2	3	4	5
I'm reading the reference materials.	READING INFORMATION 					
I'm thinking of things to say in my text.	THINKING ABOUT CONTENT 					
I'm writing a plan of what you going to write in the text. From notes to detailed outline.	WRITING OUTLINE 					
I'm editing my definitive text. A neat or a dirty copy of text.	WRITING TEXT 					
I'm reading though all or part of my text.	READING TEXT 					
I'm making changes to my text (orthographic mistakes, changing words, adding words, etc.)	CHANGING TEXT 					
I'm doing or thinking something unrelated to the text (for example: talking to my partner, looking for a pen; looking through the window…)	UNRELATED 					

Fig. 1. Writing log and categories

The experiment carried out by reducing the interval of register within *the modification of the double and triple task* (Olive, Kellog, & Piolat, 2002) tells us that this test possesses great validity and credibility to measure the processes of written composition and to answer the question: *How* do students write? Even so, because of its nature – qualified as an *on-line* test – the evaluation of the textual product, or the answer to; *What* do students write?, does not

have the same validity or credibility. The results in that area are deformed, this deformation depending on the average interval that we use - which the students will use as their base to register their processes. We can solve this limitation in a very simple way. In first place, the students had to carry out *only* a task of written composition to know the textual product, and then later on we applied the writing log to the same type of text to get to know the process – and in that way have both results independently.

Everything we have seen so far seems to indicate that complex tasks, such as the written composition, demand a higher attention effort, something that does not occur with mechanical tasks. Therefore, if the task is not adapted to the complexity that a child who suffers from ADHD can manage, the failure seems unavoidable. From this result we see the need of schools and teachers to adapt the tasks when they have a situation which involves a child with ADHD, and it can also, in a way, explain why children with high intelligence and ability but who suffer from ADHD can end up failing in school. This theory has support from the other conclusion, which has to do with the emotional ingredient the child feels towards the task.

The results on attitudes and self-efficiency towards writing within the group that had the worst results in terms of productivity, coherence and quality – that is the group of 45 seconds – showed that they noticed this problem in their efficiency, and they also answered worse about their attitudes towards the task, being more negative. In short, we see that the emotional ingredient is also involved, even though it has to be mentioned that even if this study gives us these results, there would have to be more specific research necessary in terms of the emotional ingredient of ADHD and writing to settle on these terms.

Moreover, results show us something that has hardly been studied before, and that is the capacity of the graphic organiser to focus the attention and cognitive effort of the student in the task of written composition. In that way, it helps avoiding the interference and distortion that any situation can have; in our case it is the manipulated variable, and in the case of a real school hall situation it could be any of the natural variables that could distract the student, keeping them from focusing their limited attention (Rodríguez et al., 2011a; Shalev & Tsal, 2003) on the task of written composition.

In short, the capacity of the organizing graphic to focus the attention of the written composition is superior to the capacity of distorting the manipulated variable during the course of this task, which was evaluated by the means of writing log (Olive, Kellogg, & Piolat, 2002). If we go away to the everyday practise in education, one could consider the graphic organizer as a help, a scaffolding which might be offered to the student – and not only to any student but to those of which their attention capacity does not correspond to the complexity of the task, for example organization and planning. Its utility can also be seen in different kinds of texts, with a simple and plain design.

In fact, inter-relation between two hypotheses is what is most useful to us from the educational point of view, since the students had never practiced the use of the organizing graphic (Figure 2), and there was practically no knowledge at all about it, which brought as a consequence that its use was practically intuitive. The future action with this kind of help and the practice of for example the self-regulation, might be a link of union on how to intervention in ADHD and LD, as we have already seen in some previous concrete work, even if they have been with a number of limitations (Reid & Lienemann, 2006).

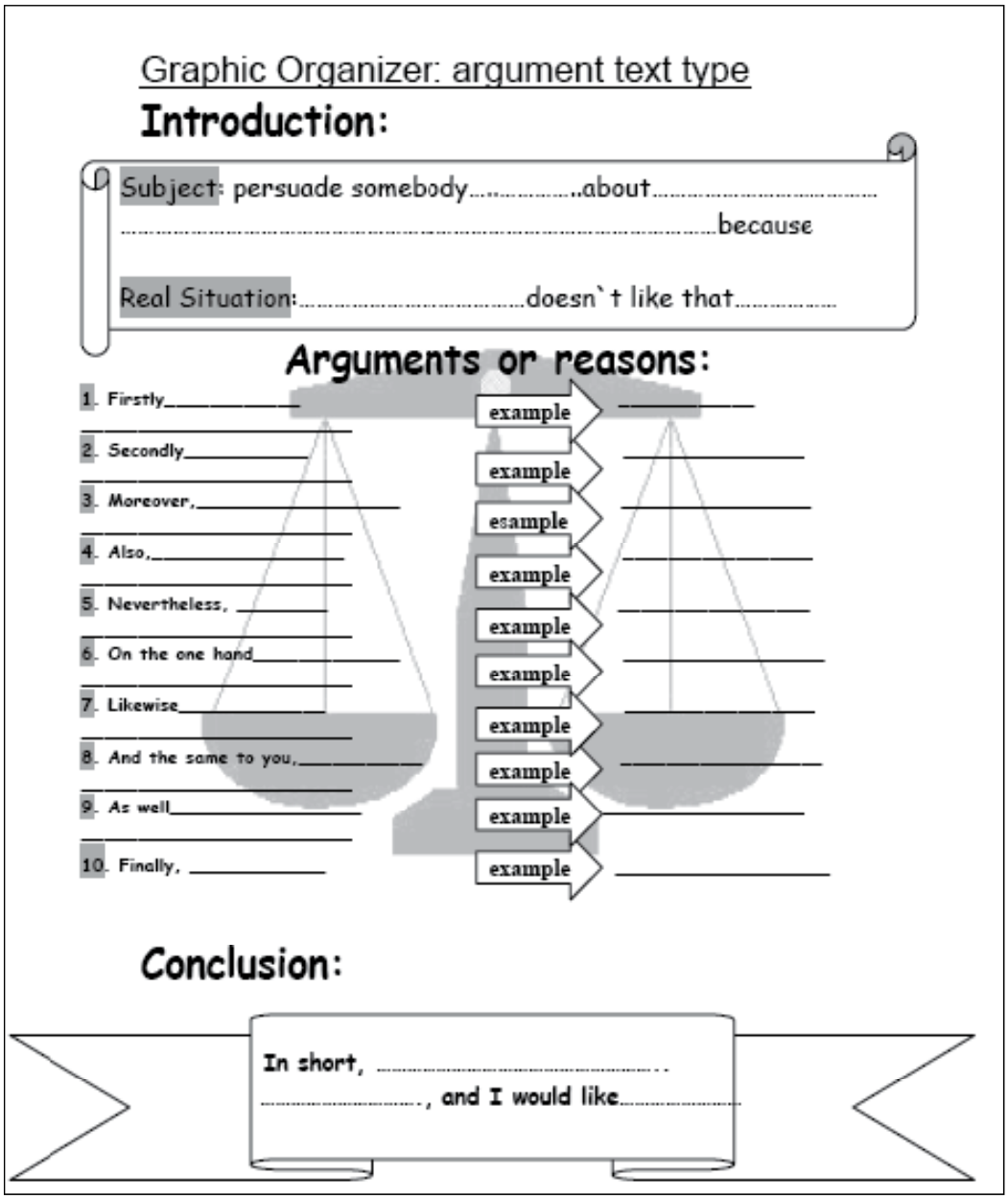

Fig. 2. Graphic Organiser used in the argument text type

3.2 Second comparative study

The second study was a comparative design. The aim of this study was to compare the differences between children with ADHD both with and without writing LD and those with writing LD, in the measurements of different constructs related to ADHD (selective and sustained attention, working memory and cognitive styles). Furthermore we aimed to

compare, the differences between the groups as regards the revision of writing. Finally, we studied the influence of the first measurement in the revision task.

For this study we used a sample of students with ADHD, these students represented practically the whole range of school years except for the first year of Primary School. These children were later separated into the different categories of students; those with ADHD *as well as* learning and writing disabilities, and those students suffering from ADHD *without* these disabilities. In addition to these two categories a third and a forth group were added; students with LD in writing only, and also a control group of normally achieving students. Our sample comprised 339 students from 3rd year of Primary school to 4th year of Secondary School and consisted of four groups: 59 students diagnosed with ADHD and LD, 40 with ADHD without LD, 115 with LD and/or low achievement (LA), and 124 normally achieving students formed the control group. All of the students ranged between eight and sixteen years old. In total, we had four different, independent groups, matched in age and educational level.

The results were observed independently between the groups in all the previously mentioned aspects, as well as the effect on the statistics of the first tests, for example results of the IQ evaluation, attention, working memory, and the re-writing tests.

When we thought of and planned the tasks of re-writing, the way and form of presenting it influenced out thoughts. In open tasks, in which there are other stimulations such as a description, the groups of children suffering from ADHD and LD in writing hardly add any information, which has a negative effect on their final product – they just limit their work to copying. There are smaller differences when it comes to more narrow tasks. That is, the more we set the standard and the more we focus the process of revision, the more the children suffering from ADHD and LD in writing benefit from it. It is also interesting to see that the differences and problems of children suffering from ADHD are found mostly within the fundamental revision, more than in the mechanical revision or automatic processes. An interesting opinion comes up when we focus on the added information of the different groups; the stimulation of the creativity between the children suffering from ADHD makes them add information. This may indicate that the capacity of the ADHD is reflected in the revision. The relation between ADHD and the revision of writing have been used as measurements to investigate the intervention in writing between these kinds of students. It was an opportunity to find out how this task is related to ADHD. In our study, all constructs related with ADHD influenced the measurements of re-writing, but the most important one they influenced was the executive one (working memory and attention), which without doubt is directly related to ADHD and its problems of revision of written material.

In conclusion, lower results were found in children suffering from ADHD and learning disabilities as regards the attention and memory evaluation. These results also reflect in the results of the re-writing task, which might suggest a link between the two disorders. Considering these results, we conclude by making a few remarks on the difficulty of the tasks and its effects on ADHD, and predictions for this group in the revision tasks as regards the inclusion of a greater or lesser amount of detail. Moreover, we suggest the possible influence of the psychological construct difficulties in ADHD and LD (attention, working memory), in the revision task and its importance in training programs, to improve writing in children with ADHD.

3.3 Third comparative study

The last study is also a comparative study, which was intended to complement the previous study, as it has the same sample and design. It clearly explains the nature of the written compositions in the four groups, and how ADHD and learning disabilities affect this writing; both in the productivity and quality of their writing. Furthermore, as the most innovative aspect, it details the time distribution used in the orchestration of writing process.

All the participants completed three different writing composition tasks (free topic, compare-contrast essay and revision), to assess the productivity, quality and structure; as well as writing processes using a time-sampled self-report on-line technique registered on a writing log. Finally, three questionnaires which dealt with the attitudes and self-efficacy towards writing were completed. We also kept in mind the different attention and working memory measurements that the students provided (previous study).

Furthermore, even though it is important to be aware of the final texts that the students produce, this research emphasizes the writing processes rather than the result –the product. Thus, it is possible to understand how students with ADHD and learning disabilities write. Finally, we established the connection between the processes of writing and the final product –quality and productivity-. With these previous facts it is possible to establish an instructional and psycho-educative baseline to attend to the writing disabilities of these children and their different problems. The results showed the influence of ADHD in writing, for example as concerns sustained attention combined with working memory.

Finally, it is important to stress, the important differences in writing time distribution (orchestration) between the groups which would need to be considered in the different instructional programs. Children with ADHD and LD spend much less time on processes such as thinking about the text, reading the text or correcting the text and their resulting compositions reflect this in the inferior levels of coherence and quality. This signals an inadequate use of the planning and revision processes, which is directly related to the lesser quality of their texts. It is important to highlight that such processes must be used adequately along with a logical use of orchestration. However, this is not demonstrated by children with ADHD or LD. This is compared with previous study which concluded that the students carried out the rewriting task in a less than efficient manner.

The educative implications to achieve improvement in the planning and revising, changing the orchestration process in the composition writing of children with ADHD and LD are evident.

4. Conclusion

The conclusions support the idea of a significant relationship between ADHD and writing, on one hand, on a theoretical level, and on the other hand, on a research level. We suggest that the influence of ADHD in school achievement is one of the most important disorders associated with LD in writing. We can also see that these links are not backed up by scientific empirical studies in these aspects. We found that the scientific research about the link between ADHD and writing was generally limited to the mechanical aspects of this skill, textual production skills-, or simple aspects such as the handwriting. On the few

occasions that more comprehensive studies were done, the samples were not broad enough, or they are based on epidemiological studies or used a questionnaire to define the child with ADHD. It could be said that generally, the underlying processes of ADHD are not sufficiently analyzed or studied deeply enough, for example as regards to the orchestration of writing process, but rather they have been only studied in a general way.

The experimental study revealed aspects that have scarcely been studied before, such as the capacity of the graphic organizer to help focus the attention and cognitive effort of the student in the composition writing task. It helps by avoiding the interference and distortion that any situation can have. In our case, the interference took the form of the modification of the double and triple task -*writing log*-, and in the case of a real classroom situation the interference could be any of the natural variables that could distract the student, preventing them from focusing their limited attention on the writing task. Furthermore, the relationship between sustained attention and writing was demonstrated, showing that the writing processes which require the child's capacity to be constant until they finish the writing task. The study also introduces us to the concept named s*luggish cognitive tempo*, which is seen in the inattentive subtype of ADHD and which is the most likely to demonstrate writing LD (Graham & Harris, 2005).

On the other hand, the outline of the poor results for revision in the ADHD and LD group concurs with the obtained outline in the measurements of attention, working memory and cognitive types. This idea supports the possibility that both these syndromes might have an effect on each other. The group of children with ADHD presents a profile indicating a link between the two syndromes – which is also shown in the re-writing task. This relationship suggests that the revision writing process may provide an area of research for the study of intervention in writing between these kinds of students.

We also consider that the research has been profound enough; we have worked with the problems of carrying out these tasks in children with ADHD, their predisposition to carry out writing tasks, as well as including the emotional aspects of the problem. It is clear that that it is possible to develop a higher quality of written composition by improving the cognitive process as well as its organization. Even so, these aspects do not only depend on the child with ADHD, who we know to possess the capacity. The aspects are also concerned with the ability to adapt to the problem in terms of the complexity of the tasks, or the provided strategies. Therefore, these results widen our awareness of the problem, and stress the importance of the need to consider the way our students write.

Moreover, influence of neuropsychological factors such as the working memory and attention, are the least studied ones within the process of writing. The characteristics presented by experts and bad writers, show us the strong influence of the neuropsychological functions on the quality and carrying out of the writing, as well as the direct influence on the processes of writing (Hooper, Swartz, Wakely, De Kruif, & Montgomery, 2002).

At this point, there is specifically one neuropsychological construct which is more affected among the children suffering from ADHD; that is working memory. The hypothesis was to put this type of memory in relation to the measurements of writings that we have carried out. It is true that the size of this effect was moderate, but the influence of the factor of the working memory creates a radical change in the meaning of the variables of writing, which

gives us a hint to a relation between ADHD and written composition. Within this relation it seems as if the average of the processes is what is most important, and is what the process of written composition demands of the child's capacity to remain until the achievement of finalizing the writing task. It also introduces us to the approximation to the concept s*luggish cognitive tempo*, as the one where the subtype inattentive is developed and which is the most probable to express LD (Aaron, Joshi, Palmer, Smith, & Kirby, 2002).

According to recent research, we previously mentioned the executive central, and based on that we could say that there is an increasing relation between working memory and attention when it comes to carrying out of a task. So, the influence of the measurements of the working memory and the measurements of the writing process and product seem to coincide with each other, an area which should be stressed in future research, give us a total of the measurements in terms of carrying out a task – and then contrast this effect with the measurements of written composition.

In short, complexity of written composition is proven by the influence of several neuropsychological factors, which makes this a complex task. Also, these factors should be studied profoundly, as for example the ones used in this research; attention, working memory and indicators of ADHD - opening up for research on the intervention in writing and propounding the use of these factors in the instruction. Finally, ADHD is a disorder which has often other problems added, such as LD in writing. We wanted to verify this relation through the influence of the criteria DSM-IV on ADHD, under the perspective of the teacher, in the measurements of written composition with hopeful results. Parameters such as coherence, productivity and structure are affected, indicating that the influence is not merely a simple theoretical approximation but that the two concepts of ADHD and written composition are really close to each other; we only need to quantify and put limitations to this relation.

Therefore, in the future, the scientific community should pay attention to the writing problems those children with ADHD experience. Moreover, a theoretical model which accounts for the problems of both syndromes may be necessary. This could also provide the key to possible writing instructional programs that would respond to the needs of this kind of student with ADHD and LD, all from a psycho-educational point of view. Finally it is very important to emphasize the idea of co-morbidity between ADHD and writing LD, and consider a writing cognitive design, specifically for the children with both disorders. This group presented greater difficulties in the measures of attention, working memory and writing, than if we consider the sum of the separate problems experienced by the ADHD group and writing LD group. Thus, for this joint group the difficulties are not simply added rather they interact to the detriment of the child in a similar way as occurs for other subjects such math or reading (Rodriguez et al., 2009c).

Many researches study the links of ADHD through large bases of data (Smith & Adams, 2006), but there are few ones that are done through the practice, where samples of children that have been diagnosed are studied – describing and analyzing profoundly their problems. We also know, through the empiric research on the subject that very few of these studies are concerned with the link or overlap between ADHD and written composition. In this chapter, we aim to fill some of the existing gaps with the conclusions we have drawn.

Another aspect to stress in our research are the measurements that make the most difference, which each has a certain power to make a difference – attention and working memory – to what we call the executive. The measurements of attention (in ADHD) might be influenced by other fields, other measurements and/or other psychological aspects as for example working memory, force level etc. (Shalev & Tsal, 2000). The term "executive function" may be more interesting if aspects such as the working memory, the executive attention, the active attention, planning or inhibiting control were included.

In that way, we have to emphasize the use of different measurements to achieve one single construct, which we have extracted from different fields of investigation such as the attention factor. This is a positive result to which we should apply the diagnosis of ADHD. This might be a complex disorder situated in a context in need of contrasting evidence, and that these cover a large range to get to know the difficulties of a child suffering from ADHD.

Following the line of diagnosis, one could hope that there were no significant differences in terms of the IQ of children suffering from ADHD (Breznitz, 2003; Hastings, Beck, Daley, & Hill, 2005; Schuck & Crinella, 2005). We can in this study confirm the results of those empiric studies, stating that the differences in terms of IQ of the group with children suffering from ADHD are not significant, showing that the problems of these children do not base in their capacity, but in the ability to perform the task (Rodriguez et al., 2009a).

As regards the shortcomings of this study, it would be interesting to investigate the assessment of the executive and brain activation in ADHD and LD, or to demonstrate the differences in the writing of the various ADHD subtypes (inattentive, combined, etc.). Finally, the future perspectives indicate that this study is a relevant step towards understanding the writing disabilities in ADHD students. However, it is necessary to establish a common basic model which explains the learning difficulties that children with ADHD experience and those which concerning writing (Gonzalez-Castro et al., 2010; Rodriguez et al., 2009b).

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Part 2

Diagnosis and Interventions of Learning Disabilities

5

Reading and Writing Achievement Tests for Assessing Orthographical and Phonological Impairments of Japanese Children with Developmental Disorders

Kiyomi Yatabe[1,2], Takaaki Goto[1], Katsumi Watanabe[2],
Makiko Kaga[1] and Masumi Inagaki[1]
[1]*National Center of Neurology and Psychiatry,*
[2]*University of Tokyo*
Japan

1. Introduction

This chapter describes our new reading and writing tests which were designed to evaluate not only the severity of the language-related problem of each child, but also what types of impairments each child is experiencing, namely, whether a given child has an impairment which is mainly in the visual sphere, especially in the orthographical processing or in the phonological processing, on the basis of the psychological models concerning the development of reading and writing abilities. It also includes tentative reports on the experiment that we have conducted in order to ascertain the validity of those tests.

The aim of our study was to design a new set of achievement tests in reading and writing for Japanese-speaking children that will help us identify the specific types of learning problems that some children might be facing and would be useful in determining what types of intervention each child needs. One of the more central goals of our tests was to distinguish dyslexic children and children who are having language-related problems as a result of Attention Deficit Hyperactivity Disorder (ADHD). ADHD and dyslexia, the two most commonly diagnosed psychiatric conditions of childhood, each occur in approximately 5% (ADHD 3-7% and dyslexia 4%) of the population in the United States, according to the Diagnostic and Statistical Manual of Mental Disorders, Forth Edition, Text Revision (DSM-IV-TR) (American Psychiatric Association 2000; Willcutt et al. 2005). Though ADHD and dyslexia are separate and distinct conditions, there is considerable overlap and children with ADHD often display language-related problems similar to those caused by dyslexia (Mason and Reid 2011). In order to give appropriate intervention to children with each disability, we need to be able to distinguish the characteristics of the linguistic problems that each condition entails.

What distinguishes our tests from previous test batteries for diagnosing language-related difficulties among Japanese children ((Uno et al. 2006) among others) is that our tests consist of several distinct categories of questions, so that it will be possible to pinpoint the exact

aspects of reading and writing that a given child is having a problem with. Previous achievement tests in reading and writing were designed to detect children having difficulty with reading and writing, and to diagnose the magnitude of the difficulty. Consequently those tests did not allow for construction of a detailed profile of each child's disability.

More specifically, the most important feature of our new tests is that they consist of questions that are more suited to assessing a child's ability in phonological processing and questions that are more suited to assessing a child's ability in orthographic processing. Over the past decade, a growing body of research has shown that reading and writing involve orthographic processing and phonological processing both in alphabetical and in non-alphabetical languages (Afonso and Alvarez 2011; Kandel et al. 2009; Mousikou et al. 2010; Qu et al. 2011). Moreover, a longitudinal developmental study showed that both orthographical and phonological skills accounted for independent variance in later orthographic skills (Sprenger-Charolles et al. 2003). It has been also suggested that both the orthographic and phonological measures contribute to distinguishing various types of dyslexia (Berninger et al. 2008; Coltheart et al. 2001; Hultquist 1997; Plaut et al. 1996); although dyslexia has been strongly associated with a deficit in phonological processing (Ramus et al. 2003; Shaywitz and Shaywitz 2005), reading disabilities may also be linked to problems with orthographic processing. We thus incorporated both orthographical and phonological measures into our reading and writing tests, with the expectation that their inclusion might help us distinguish not only various types of dyslexia but also dyslexia and ADHD.

To state the advantage of our tests in this regard in a more precise fashion, let us go into some details about the way Chinese characters are used in the Japanese language and the way they are taught at Japanese schools. The way Chinese characters are used in Japan is uniquely complicated, even compared to the way they are used in other Asian countries, such as China and Korea (Taylor and Taylor 1995). Whereas the relation between *Kana*, Japanese syllabary, and sounds is relatively transparent, the relation between *Kanji*, Chinese characters used in Japan, and sounds is sometimes opaque and not transparent. While in Chinese each Chinese character corresponds only to one sound in principle, most Chinese characters used in Japanese have two or more pronunciations, which are classified into On/Chinese pronunciations, which reflect the pronunciations that the characters originally had in Chinese, and Kun/Japanese pronunciations, which are sounds representing the Japanese morphemes that are felt to semantically correspond to the meaning of the Chinese characters. The pronunciation of a Chinese character used in a Japanese text often cannot be determined unless the context in which it is used is taken into account.

About a thousand Chinese characters, which are roughly half of the Chinese characters that are commonly used among adults (Jo-yo Kanji), are taught at primary school in Japan, i.e. during Grade 1 through to Grade 6. Children in Grade 1 are taught 80 Chinese characters, those in Grade 2 are taught 160 and those in Grade 3 through to Grade 6 are taught about 200 in each academic year. The average number of strokes of a single character taught at each grade increases from about 5 strokes at Grade 1 to about 11 strokes by Grade 5, which corresponds to almost the same average number of strokes of one character in Jo-yo Kanji used among adults. When Japanese children of each grade are taught a fixed set of Chinese characters, they are typically taught only one of the possible pronunciations of those characters at first; more frequently used, thus more important pronunciations, are taught at earlier grades and other pronunciations are taught at later grades. For example, the Chinese

character 言 ('speech, language') is learned in Grade 2 with a Kun/Japanese reading *i*; then it is learned in Grade 3 with a Kun/Japanese reading *koto*; it is also learned in Grade 4 with an On/Chinese reading *gen* and it is learned in Grade 6 with an On/Chinese reading *gon* (Synthetic Research Institute of Elementary Education 2005; Taylor and Taylor 1995). The number of characters which are taught with a new pronunciation increases from about 40 at Grade 1 to about 200 by Grade 6.

Unlike other tests, our tests take advantage of these features of the use and education of Chinese characters in Japan to obtain a detailed profile of the test-taker's ability to read and write. On the one hand, by using both questions involving characters written with a relatively small number of strokes and questions involving characters written with a relatively large number of strokes, we attempted to determine if the test-taker has any difficulty with dealing with visually complex symbols. On the other hand, by using both questions involving characters for which a different pronunciation has been taught before and questions involving characters for which no other pronunciation has been taught before, we attempted to gain insight as to whether the test-taker has any difficulty with phonological processing.

2. Methods

The content of our new tests and the way they were administered to ascertain their validity are presented in this section.

2.1 Material

In this experiment, participants were asked to read and write Chinese characters that were orthographically and phonologically either complex or simple. Orthographically complex characters are ones that are written with a relatively large number of strokes and orthographically simple characters are ones that are written with a relatively small number of strokes. More specifically, in the tests for second and third graders, the test for fourth graders and the tests for fifth and sixth graders, the orthographically complex characters consisted of approximately six strokes, 11 strokes and 12 strokes respectively on average and orthographically simple characters consisted of approximately three strokes, five strokes and six strokes respectively on average. Phonologically complex characters are ones for which the child (the participant) is expected to have already learned at school more than one pronunciation and phonologically simple characters are ones for which the child (the participant) is expected to have already learned at school only one pronunciation. In other words, participants were asked to read and write Chinese characters which fell into one of the following four categories:

i. characters that consist of a small number of strokes and have only one pronunciation,
ii. characters that consist of many strokes and have only one pronunciation,
iii. characters that consist of a small number of strokes and have more than one pronunciation and
iv. characters that consist of many strokes and have more than one pronunciation.

All the words in the achievement tests had been taught at school for at least more than a year before the test, except those used in the tests for Grade 2 children. All the words consist

of two to four characters and at least one of the characters is a Chinese character. Words which have potentially problematic homophones were excluded.

Factors such as lexical meaning have been controlled by choosing similar words with respect to frequency, familiarity and imageability (that is, the extent to which the representation of a word's meaning has sensorimotor properties and thus evokes a strong image in any given observer (Strain, Patterson, and Seidenberg 1995)) using some of the standard Japanese corpora for both adults and children (Amano and Kondo 1999; Kai 2005; Sakuma et al. 2005).

2.2 Participants

Twelve Japanese dyslexic children (mean chronological age 10 years 3 months [SD 16.6 months], one female, two lefthanders), nine Japanese ADHD children (mean chronological age 11 years 2 months [SD 11.9 months], two females, one lefthander) and 479 control children participated in the achievement tests.

The children of the diagnostic group had been referred to the National Center Hospital of Neurology and Psychiatry, mostly because of learning, attention and/or behavioural problems. All the children of the diagnostic group in the study underwent clinical evaluations by two professional clinicians (certified paediatric neurologists). Their intelligence as measured by Wechsler Intelligence Test, the third edition (WISC-III) (Japanese WISC-III Publication Committee 1998) was within the normal range (mean FIQ 90.1 [SD 12.7] among dyslexic children and mean FIQ 92.7 [SD 6.3] among ADHD children). With regard to the intelligence scores, there was no significant difference between dyslexic and ADHD children. Other psychological evaluations involved a computerized continuous performance test (Inoue et al. 2008); rapid naming tests developed for the clinics (Kobayashi et al. in press), clinical observations of the child during the evaluation; a review of the child's records including school records from Grade 1 to the present, previous clinical evaluations and the child's developmental history. The psychiatric and paediatric evaluations involved a semi-structured interview with the guardians and with the child (including an assessment of the child's history and current symptoms), clinical observations of the child, a review of records and analysis of the questionnaires completed by the guardians for clinics. The diagnoses of dyslexia and ADHD were based on the criteria in the Diagnostic and Statistical Manual of Mental Disorders, Forth Edition, Text Revision (DSM-IV-TR) (American Psychiatric Association 2000). None of the children had psychosis, autism, bipolar disorder, significant hearing or visual loss, or other neurological impairments (such as cerebral palsy). All the experimental procedures were in accordance with the Helsinki Declaration of 1964, revised in 2002, and approved by the ethics committee in National Center of Neurology and Psychiatry.

The 479 control children, all typically developing Japanese children (mean chronological age 10 years 3 months [SD 17.1 months], 251 females, 35 lefthanders), came from 16 classes of a municipal primary school located in a suburban community of average socioeconomic status in the middle of Japan. They went to regular general education classrooms, had no known learning problems and do not receive special educational support concerning learning disabilities. They have no history of developmental disorders reported by the classroom teachers. The experimental procedure had been approved by the headmaster of the school.

2.3 Procedure

The participants took a reading test and a writing test for 10 and 15 minutes respectively. The children with developmental disorders were allowed to extend the time if needed. The order of the tests was counterbalanced among the participants. Both the tests consisted of 24 words for second and third graders and 32 words for fourth to sixth graders which were formatted on B4-sized paper. The participants were asked to read (i.e. write the syllabic, non-Chinese letters representing the pronunciation of) or write one Chinese character of each word. In the test for writing, ruby characters, i.e. syllabic, non-Chinese letters indicating the way the Chinese character was to be pronounced, were provided.

2.4 Analysis

As the number of items in the achievement tests was not equal among different graders, the correct response rate for each grade was calculated as a proportion and hence the arc sine root transformation was applied to the correct response rates (Sheskin 2007). Since the number of children with developmental disorders was limited at each grade, we abandoned the analysis of variance using two levels of each independent variable. Instead, we created new variables using the four categories of items mentioned above.

Specifically, in order to examine the effect of orthographical demand (i.e. visual complexity), we averaged the correct response rate for (i) characters that consist of a small number of strokes and have only one pronunciation and (iii) characters that consist of a small number of strokes and have more than one pronunciation on one hand to create a variable representing the participants' performance for visually less complex characters, and averaged the correct response rate for (ii) characters that consist of many strokes and have only one pronunciation and (iv) characters that consist of many strokes and have more than one pronunciation on the other hand to create a variable representing the participants' performance for visually more complex characters. Two more variables representing their performance for phonologically less complex characters and their performance for phonologically more complex characters were created in a similar manner.

The mean correct response rate for typically developing children at each grade was further analyzed using the statistical tests according to its distribution after the test for the homogeneity of variance and the test for the normality of distribution. Since the mean correct response rates were not significantly different between the gender groups of typically developing children at each grade according to the Mann Whitney U test, we calculated the mean and the standard deviation of the entire group, containing both girls and boys. Using this mean and the standard deviation as the basis, we then calculated the Z-scores for children with developmental disorders at each grade, although the proportion of males and females was different between typically developing children and children with developmental disorders.

3. Results

The result of the experiment seems to support the following three statements:

a. Overall performance
First, while children with dyslexia had trouble both with writing and with reading, children with ADHD had trouble mainly with writing and not necessarily with reading.

b. Orthographic performance
Second, compared to children with dyslexia, children with ADHD had more trouble writing Chinese characters which consist of many strokes and thus are visually more complex, although both children with ADHD and dyslexia seemed to have less trouble reading visually more complex characters.

c. Phonological performance
Third, compared to children with ADHD, dyslexic children had more trouble reading (if not writing) Chinese characters which have more than one possible pronunciation and are thus arguably phonologically more complex.

3.1 Overall performance

3.1.1 Overall performance by typically developing children

Fig. 1 reports the mean correct response rate of typically developing children at each grade for the reading achievement tests. Error bars indicate one standard deviation of uncertainty. The sampling distribution was similar among different grades, according to the Kruskal-Wallis test (p = .1).

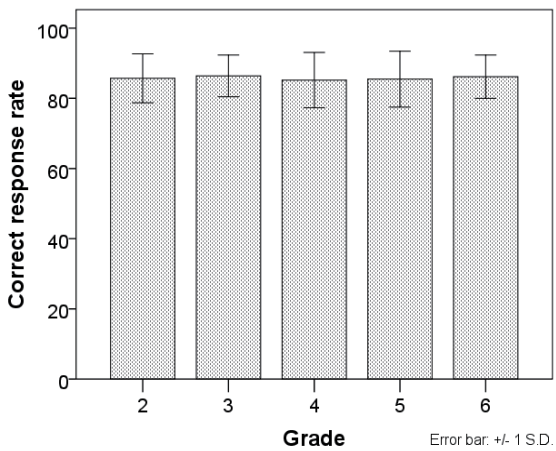

Fig. 1. Overall correct response rate of reading by typically developing children.

Fig. 2 represents the means of the correct response rate of typically developing children at each grade for the entire writing achievement tests. Error bars indicate one standard deviation over sampling distribution. The sampling distribution was significantly different among different grades, according to the Kruskal-Wallis test ($p < .0001$). The post hoc tests revealed that the mean correct response rate of Grade 4 and 5 was significantly lower than that of Grade 3 (U=3830.5, Z=-3.22, r=-.23; U=3652.0, Z=-4.07, r=-.28, respectively) after Bonferroni corrections.

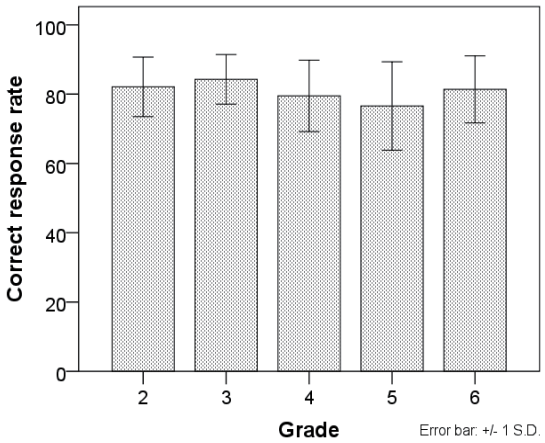

Fig. 2. Overall correct response rate of writing by typically developing children.

3.1.2 Overall performance by children with developmental disorders

Fig. 3 represents the Z scores for the correct response rate of both dyslexics and ADHD patients for the reading and writing achievement tests. The left side column shows the Z scores of the reading tests and the right side column shows those of the writing tests. Each row shows the Z scores of each grade. Filled data points in black represent the cases with dyslexia whereas unfilled data points represent the cases with ADHD.

From those graphs we see that Z scores for writing tend to be low with both developmental disorders, that dyslexics' reading scores likewise tend to be low, but that ADHD patients' Z scores for reading tend to be close to normal (around -1.0 SD or above), suggesting relatively minor impairment of reading abilities.

The pattern of overall performance alone does not necessarily allow us to distinguish ADHD patients and dyslexics. In other words, some ADHD patients and some dyslexics show an indistinguishable pattern of overall performance, as we see with Case 4 (dyslexic) and Case 13 (ADHD) in Grade 3 and Case 12 (dyslexic), Case 16 (ADHD) and Case 17 (ADHD) in Grade 5. Thus, in order to distinguish the two types of disorders on the basis of reading and writing achievement tests, it is necessary to examine not only the overall performance of the children, but also their performance for each of the four (two by two) question types.

3.2 Performance as a function of orthographical complexity

3.2.1 Orthographical performance by typically developing children

Fig. 4 reports the typically developing children at each grade's mean correct response rate for reading achievement tests as a function of orthographical complexity. Error bars indicate standard deviations. There was significant difference between the mean correct response rate for orthographically complex characters and that for orthographically simple characters at Grade 2. The correct response rate was higher when the character was orthographically complex than when the character was orthographically less complex ($Z=2.51$, $p<.01$, $r=.27$). The sampling distribution was similar between the levels of orthographical complexity in other grades, according to Wilcoxon's signed rank test.

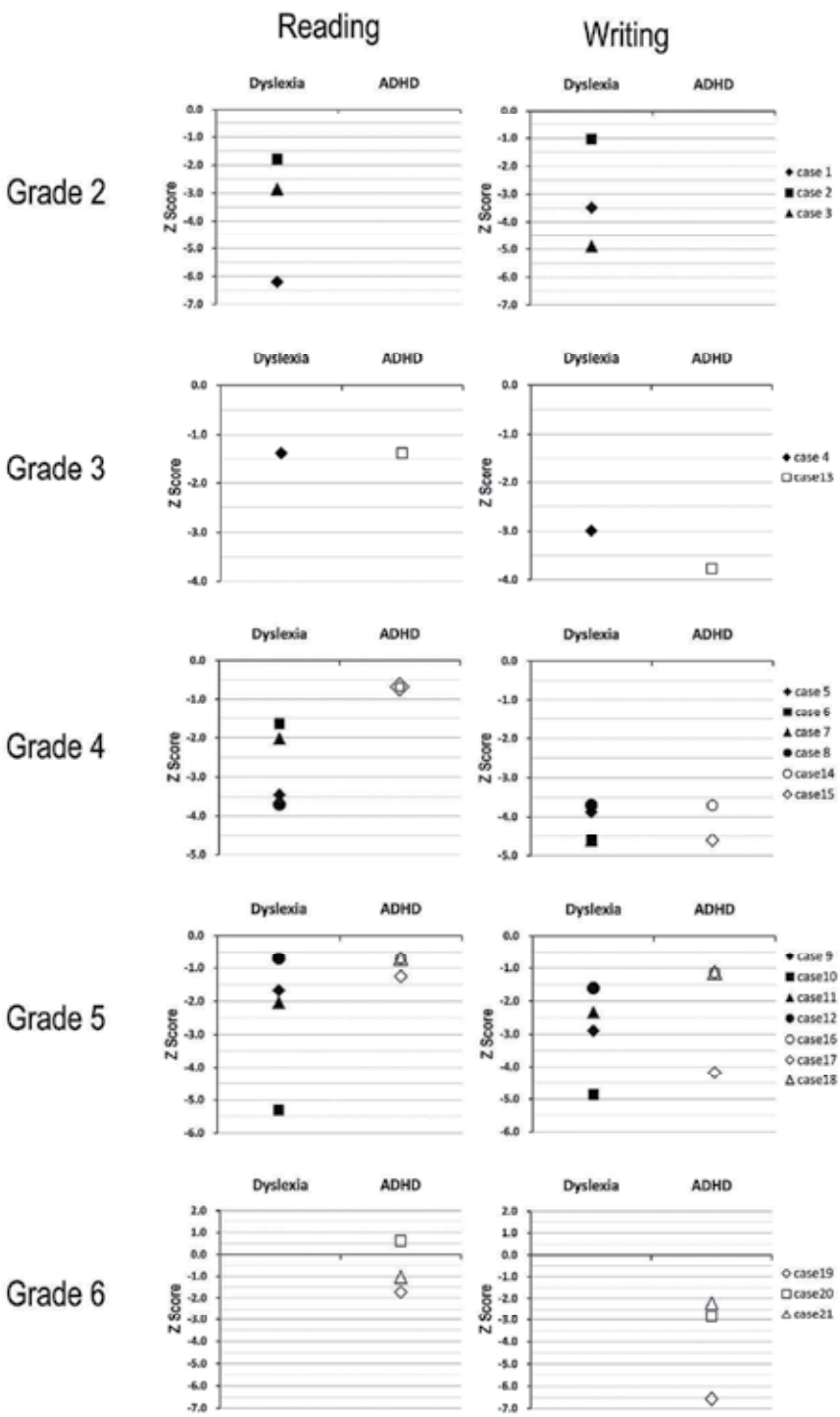

Fig. 3. Overall Z scores of children with developmental disorders.

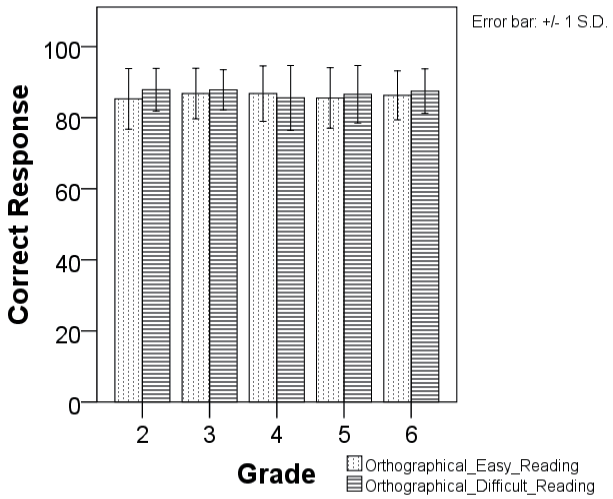

Fig. 4. Correct response rate of reading as a function of orthographical complexity by typically developing children.

Fig. 5 represents the typically developing children at each grade's mean correct response rate for writing achievement tests as a function of orthographical complexity. Error bars indicate standard deviations over sampling distribution. Statistical analysis revealed that the mean correct response rates were different between the levels of orthographic complexity at Grade 5 and at Grade 6. In both grades, the mean correct response rate was significantly lower when the character was orthographically complex than when the character was not (Z=-4.27, p<.0001, r=-0.43; Z=-2.29, p<.05, r=-0.23 respectively). There was no significant difference between the mean correct response rates at different orthographical levels in Grade 2, 3 and 4.

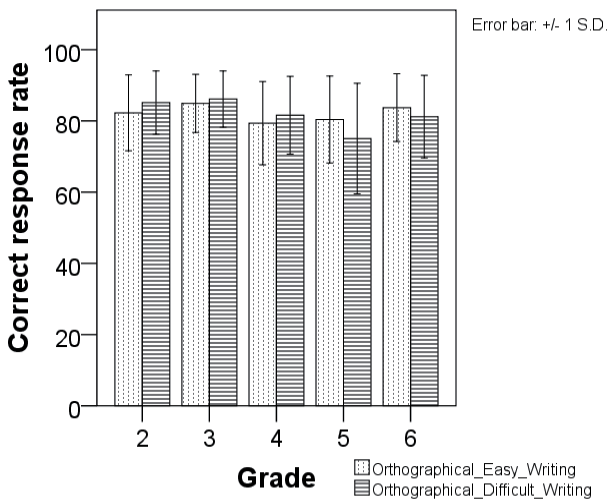

Fig. 5. Correct response rate of writing as a function of orthographical complexity by typically developing children.

3.2.2 Orthographical performance by children with developmental disorders

Fig. 6 represents the Z scores for the correct response rate of both dyslexics and ADHD patients for the reading and writing achievement tests as a function of orthographical complexity. The left side column shows the Z scores of the reading tests and the right side column shows those of the writing tests. Each row shows the Z scores of each grade. Filled data points in black represent the cases with dyslexia whereas unfilled data points represent the cases with ADHD.

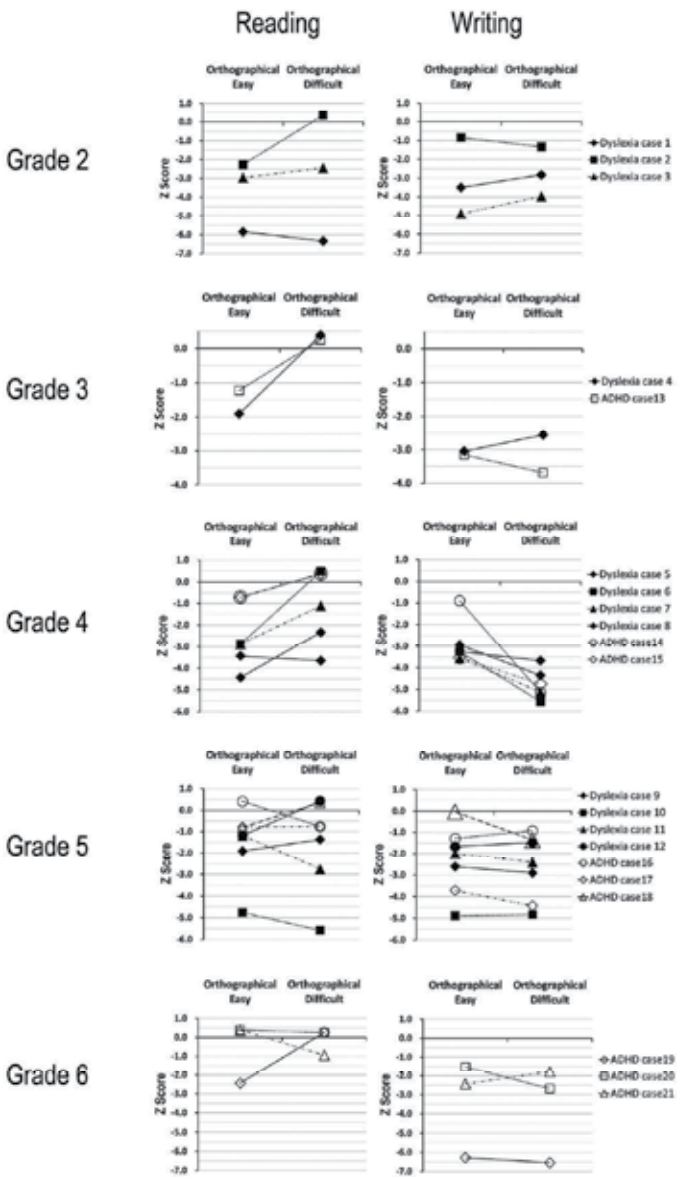

Fig. 6. Z scores as a function of orthographical complexity by the children with developmental disorders.

From those graphs we see that, with both developmental disorders, Z scores for reading tended to be higher when the characters were orthographically complex, whereas Z scores for writing tended to show different patterns for participants with ADHD and for participants with dyslexia. With ADHD, the Z scores tended to decrease when the characters were orthographically complex. With dyslexia, on the other hand, such a tendency was not seen at all in Grade 3 and was less pronounced in Grade 4 and Grade 5, compared to the cases of ADHD patients in the same grades.

Of particular importance in our study was whether the pattern of Z scores as a function of orthographical complexity can distinguish the cases when overall performance alone does not necessarily allow us to distinguish ADHD patients and dyslexics. The pattern of Z scores of Case 4 (dyslexic) and Case 13 (ADHD) in Grade 3 and that of Case 12 (dyslexic) and Case 17 (ADHD) in Grade 5 showed a different pattern in the writing achievement test. Those cases with ADHD showed that the Z scores decreased when the characters were orthographically complex, while this did not agree with the cases with dyslexics.

3.3 Performance as function of phonological complexity

3.3.1 Phonological performance by typically developing children

Fig. 7 reports the means of the correct response rate of reading achievement tests as a function of phonological complexity by typically developing children at each grade. Error bars indicate the standard deviations. The means of correct response for reading were significantly lower in Grade 4 and 6 when the character was phonological complex than when the character was not ($Z=2.22$, $p<.05$, $r=.23$; $Z=3.18$, $p<.01$, $r=.32$ respectively). There was no significant difference between the means of correct response at different orthographical levels in Grade 2, 3 and 5.

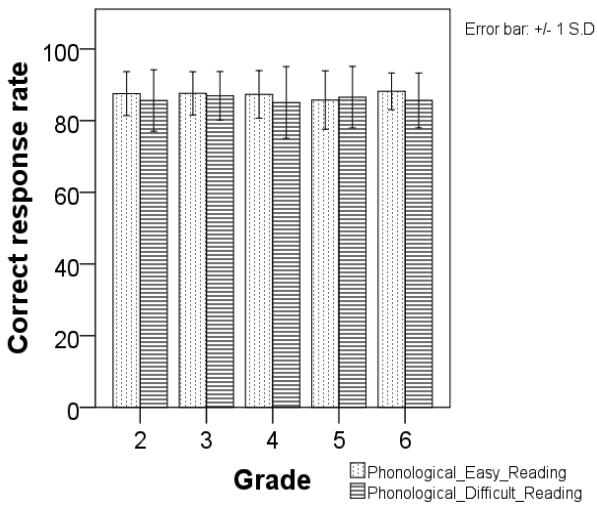

Fig. 7. Correct response rate of reading as a function of phonological complexity by typically developing children.

Fig. 8 reports the means of the correct response rate of spelling achievement tests as a function of phonological complexity by typically developing children at each grade. Error bars indicate standard deviations over sampling distribution. Statistical analysis by

Friedman's test revealed that the mean score of correct response rate was different between the levels of orthographic complexity at Grade 4. The mean of correct response for writing was significantly lower when the character was phonological complex than when the character was not (Z=3.29, p<.001, r=.34). There was no significant difference between the means of correct response at different orthographical levels in Grade 2, 3, 5 and 6.

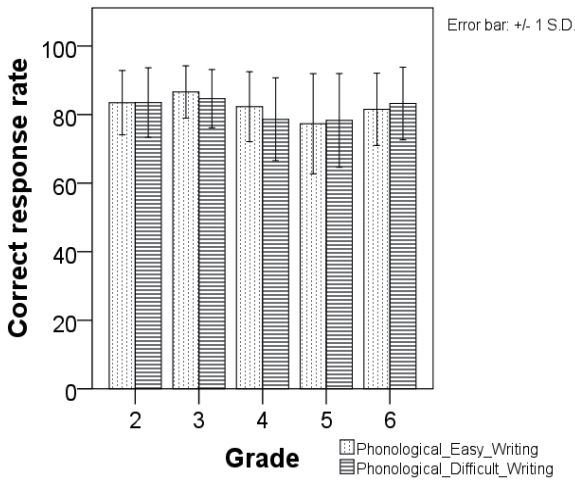

Fig. 8. Correct response rate of writing as a function of phonological complexity by typically developing children.

3.3.2 Phonological performance by children with developmental disorders

Fig. 9 represents the Z scores for the correct response rate of both dyslexics and ADHD patients for the reading and writing achievement tests as a function of phonological complexity. The left side column shows the Z scores of the reading tests and the right side column shows those of the writing tests. Each row shows the Z scores of each grade. Filled data points in black represent the cases with dyslexia whereas unfilled data points represent the cases with ADHD.

As seen in these graphs, the dyslexics tended to do worse in reading phonologically complex characters than in reading phonologically simple characters. Some of the children with ADHD showed a similar tendency, but many of them did not, and even those who did showed the tendency only to a lesser degree, compared to dyslexics. On the other hand, Z scores for writing seemed to be slightly higher for phonologically complex characters than for phonologically simple characters, both for dyslexics and for ADHD patients. This unexpected result might have been due to the control group scoring particularly low for phonologically complex characters.

Since dyslexics, but not ADHD patients, apparently tend to do worse in reading phonologically complex characters than in reading phonologically simple characters, we might be able to use the pattern of Z scores as a function of phonological complexity to differentiate dyslexics and ADHD patients, when overall performance alone does not allow us to. For instance, Case 4 (dyslexic) and Case 13 (ADHD) in Grade 3 showed different patterns of Z scores in the reading achievement test and could have been differentiated on that basis.

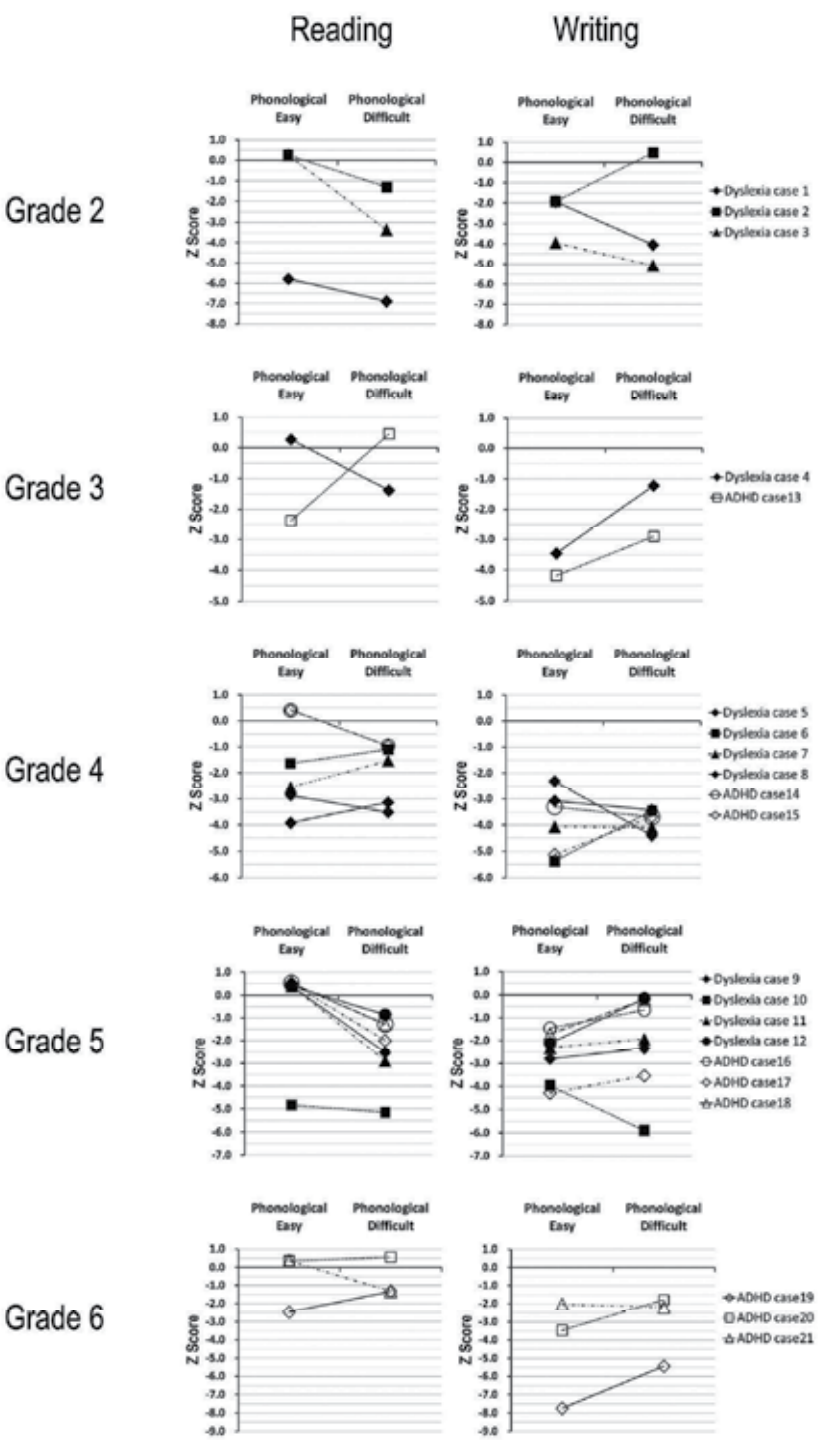

Fig. 9. Z scores as a function of phonological complexity by the children with developmental disorders.

4. Discussion

Now we would like to examine each of the three main observations that we made in the previous section.

4.1 Overall performance

It was found that the children with dyslexia had trouble both with writing and with reading, whereas children with ADHD had trouble mainly with writing and showed little evidence of impaired reading. Our finding about dyslexics seems to accord fairly well with previous findings. On the other hand, our finding about ADHD patients should be treated with caution, given the frequent co-occurrence of ADHD with language-related learning problems. Though ADHD has been reported to co-occur with problems in writing more often than with problems with reading in accordance with our results, several independent studies have reported that ADHD patients have problems not just with writing, but also with both reading and writing when they have any language-related problems (Rucklidge and Tannock 2002; Willcutt et al. 2005). If a further study involving a larger number of ADHD patients confirms our finding, that will constitute new information about ADHD.

As was particularly obvious in the overall performance of children with ADHD and with dyslexia at Grade 3 in Fig. 3, there was not always a difference in performance between ADHD patients and dyslexics, possibly because of the small sample size. At the moment, overall performance does not differentiate ADHD patients and dyslexics as reliably as orthographic performance and phonological performance, to be discussed below.

4.2 Orthographic performance

As noted in the previous section, children with ADHD in our patients seemed to have more trouble writing Chinese characters which consist of many strokes and thus are visually more complex. This may be due to the fact that ADHD patients do not have long attention span (Bellgrove et al. 2006; Manly et al. 2001). This observation may point to a potential cause of literacy learning difficulties among Japanese ADHD children.

Both ADHD patients and dyslexics seemed to have less trouble reading orthographically more complex characters. This may be due to the fact that visually more complex characters tend to have more orthographical subunits which could function as clues as to their pronunciation. The majority of Chinese characters are phonograms which consist of a phonetic subcomponent that provides information about the character's pronunciation and a semantic subcomponent that provides information about the character's meaning, though sometimes the combination between the pronunciation and the orthographic (sub)component is entirely arbitrary as we noted in the example of 言. For example, 時 ('time') has On/Chinese reading *ji,* has the same orthographic unit as its phonetic component 寺 ('temple') which has also the same On/Chinese reading *ji.* Children with ADHD and dyslexia may be resorting to the same method that beginner readers are said to use (Bowey, Vaughan, and Hansen 1998), namely orthographical analogy, whereby components of characters are used as clues as to their pronunciation. In fact, even among typically developing children, Grade 2 children, many of whom can probably be classified as beginner readers, they had less trouble reading orthographically more complex characters in Fig. 4.

4.3 Phonological performance

Compared to children with ADHD, dyslexic children were found to have more trouble reading (if not writing) Chinese characters which have more than one possible pronunciation and are thus arguably phonologically more complex. This is consistent with the previous findings about dyslexia, but it is notable that ADHD patients did not show an analogous tendency. This observation indicates that the learning problems experienced by dyslexics and those experienced by ADHD patients are distinct from each other, possibly reflecting the difference in innate cognitive abilities between the two groups

4.4 Limitations and future directions

Although our tests thus seem to have brought out some differences in performance between ADHD patients and dyslexics, there are obviously a number of issues that are left unresolved. For example, dyslexics' writing performance seemed not to be affected either by phonological complexity or by orthographical complexity. This leaves open the possibility that there are factors other than the above two factors that need to be taken into account, or that the sample size in this study was too small to allow us to detect an effect that is really there.

One purpose of our study was to facilitate intervention for children with ADHD or dyslexia by investigating the nature and magnitude of the learning problems faced by each group of children. The above results arguably have some implications in this regard. For instance, since children with ADHD were found to have difficulty in writing Chinese characters consisting of many strokes, it will probably be advisable, when we teach such children, to show them explicitly how to break visually complex characters into simpler components.

There are some limitations to this study that affect the generalizability of our results. First, the number of children at each grade was limited and consequently we could not ascertain the results using statistical tests. The use of our achievement tests in large groups of patients with developmental disorders in the future is likely to provide stronger evidence and further insight into the nature of learning problems among children with ADHD and dyslexia. Likewise, it will be possible to test the implications of this research more thoroughly if a longitudinal examination of children with developmental disorders is conducted.

Second, the control group was not a reading-level-matched group, but merely an age-matched group with similar socioeconomic status. In order to mitigate the adverse effect of this limitation, we used material which includes only those Chinese characters that the children had learned at school more than a year prior to the experiment, so that we could ensure that the material would not be too difficult even for children with language-related problems, since some previous research has suggested that children with language-related problems may be delayed by as much as two years in a wide range of skills ((Kolb and Whishaw 2008; Wright and Zecker 2004) among others). However, future replications should use a reading-level-matched control group, as the failure to use such a control group in this study may have inflated the group difference between the children with developmental disorders and the typically developing children.

Nevertheless, in light of the fact that each condition affected some individuals in the same diagnostic groups similarly in comparison with the typically developing children, we

believe that the results of this initial, exploratory study do give us some indication as to the types of learning problems caused by ADHD and dyslexia.

5. Conclusion

The result of our work suggests that children with dyslexia and children with ADHD have problems mainly with the phonological processing (i.e. conversion between characters and their sounds) and the orthographical processing respectively. Moreover, the fact that the achievement tests allowed us (if not in a statistically significant way at the moment) to discover differences between the two groups of children suggests that our achievement tests are successful in assessing some aspects of each child's cognitive profile and that it can therefore be useful in determining whether and what type of intervention is needed for each child.

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6

Interventions in Specific Learning Disabilities Through Families

Patricia Robledo-Ramón and Jesús-Nicasio García-Sánchez
University of León
Spain

1. Introduction

Specific learning disabilities (LD) are a heterogeneous group of disorders that are manifested through significant difficulties in verbal expression-comprehension, reading, writing and mathematical reasoning and ability, and presumably stem from a dysfunction of the central nervous system (Lerner & Kline, 2006). The internationally established diagnostic criteria specify a delay of at least two years and two standard deviations below the mean performance on the skill value against the normative reference group. They also establish the subject must have a normal intellectual capacity and not suffer any associated developmental disorders that could account for her/his limitations or difficulties. Lastly, the subject must also have received adequate and normal schooling (American Psychiatric Association, APA, 2002; National Joint Committee of Learning Disabilities – NJCLD 1997). However, while these conditions are essentially conceptual and define LD as intrinsic to the individual and with a biological-genetic basis, they can coexist with problems in self-regulatory behaviors, social perception and interaction. They can also exist together with other disabilities, such as sensory impairment, mental retardation, severe emotional disorders or with extrinsic factors such as cultural differences or inadequate schooling. These factors, while not the cause of the LD, can influence its course (Individuals with Disabilities Education Improvement Act – IDEA 2004. Public Law 108-446; NJCLD 1997).

If we focus on the latter perspective, which focuses on the environmental aspects, there is a proliferation of ecological models and, within them, it is common to find research tendencies that analyze the influence the specific people that make up the context for the pupil's development and difficulties (Jiménez & Rodríguez, 2008; Montiel, Montiel, & Peña, 2005; Pheula, Rohde, & Schmitz, 2011; Snowling, Muter, & Carroll, 2007; Shur-Fen, 2007). Current psychoeducational research is increasingly focusing on the contextual aspects of the factors that determine children's academic performance, studying the interrelation of the pupil's personal variables and those of her/his socioemotional context.

Several studies have focused on the mutual influence of the family of the child's difficulties. Some of the studies have pointed out that resilience and protection are a result of personal variables of the pupil and LD and the environment in which s/he develops, essentially the family. It is therefore to be expected that a family environment which provides emotional support, care and stimuli for the child with LD will promote her/his development, the opposite being true for disadvantaged environments (Alomar, 2006; Barkauskiene, 2009;

Bodovski & Youn, 2010; Dyson, 2010; Foley, 2011; Ghazarian & Buehler, 2010; Heiman, Zinck, & Heath, 2008; Marks 2006; Pérez, Ferri, Melià, & Miranda, 2007; Ruiz, 2001). Therefore, specific interventions aimed at promoting protecting factors and minimizing risk factors require identifying these prior to the intervention, contextually and in a wide sense. This enables a global intervention which fosters all the positive aspects and tries to reduce the negative ones.

Based on the above, the present research aims to offer a wide view of possible contextual interventions regarding LD in the home. In order to do so, we start by providing a detailed analysis of international research that has focused on the family as a means of improving the situation of children with LD. We analyze the main points of interest of these interventions, describing them in detail. We also analyze some procedures to stimulate families' collaboration in helping children with LD with their homework. Finally, we justify the need to work directly with parents, and suggest procedures or resources related to the development of programs for parents, support groups or associations that would be efficient in this respect.

2. General studies on LD and families

There is currently a dearth of scientific production addressing the family environment of children with LD. This is perhaps due to the atypical legal recognition of these problems (Dyson, 2010; Feagans, Merriwether, & Haldane, 1991). Most of the research focuses on the socioemotional context of pupils of the subgroup named Special Educational Needs (Hegarty, 2008). However, due to international interest in this area, and due to the legal recognition attained in Spain (LOE, 2006), there is an increasing production of studies in this area. Thus, when we use international databases specialized in social education we find that the terms learning disabilities, specific learning disabilities, dyslexia, dyscalculia, dysgraphya and together with terms referring to the family (parents, parental, family, home) produce studies with differing orientations. One focuses on the relationship between genetics and LD. Most of these studies confirm LDs are inherited, though they agree that their course can be determined by environmental variables. They point towards the influence of purely educational factors, such as the role of teachers, the teaching method or procedures followed, as well as family variables related to home provision of resources, parental level of education or the family's socioeconomic situation (Berninger, Abbott & Thompson, 2001; Lyytinen, Eklund, & Lyytinen, 2005; Monuteaux, Faraone, Herzig, Navsaria, & Biederman, 2005; Shalev, et al., 2001; Snowling, et al., 2007). The thesis that despite the LD being part of the individual there is a high influence of environmental aspects on its course and severity is further reinforced by these studies.

Another group of studies (some of which are summarized in Table 1) focus on analyzing and evaluating families' knowledge of LD, what they are, their origin, course, consequences, etc. They evaluate the impact of these disorders on family members as well as the functioning on the family microsystem. They also analyze the type of attention granted by relatives and the involvement, especially of parents, in education and their level of satisfaction with schools or teachers (Buswell, Norwich, & Burden, 2004; Espina, Fernández, & Pumar, 2001; Norwich, Griffits, & Burden, 2005). There are also studies that focus either on the effects of LD on the family (acceptance, coping, stress) or on the consequences of family variables on LD (socioeconomic status, family atmosphere, parents' training, parents' perception of the child, etc.) (Antshel & Joseph, 2006; Strnadová, 2006).

Objectives	*Participants*	*Evaluation*	*Results*
Phillipson, 2010. Analyze relationship between parental factors, intellectual ability of students and their performance	780 families of students divided into high, middle and low cognitive abilities.	Students: Raven; scores in Math, ESL and English. Parents: Parents' attributions and perception questionnaire.	High-average group skills: parental factors mediate potential ability to predict performance; parents, more beliefs and expectations about children skills. For low ability students parental factors have a direct impact on performance.
Sabina, Sáez & Roméu (2010) analyze the existence of differences between two groups of students (with and without LD) in relation to risk factors dependent on themselves, school and family.	42 children with LD and 40 without LD, aged between 7 and 9 years	Parents-teacher interviews. Test of Perception of Family Functioning (FF-SIL). Indicator System for the Diagnosis of Social Disadvantaged Children. Non-participant observation	School and personal factors related to the presence of LD. Family Risk factors: low level of parent education, authoritarian educatiional styles, family dysfunction and alcoholism, violence, delinquency and marginality
Barkauskiene, 2009. Knowing patterns of parenting practices and of showing affection of parents of students with one or more LD	204 students, 8-11 years old; 102 LD.	Child behavior checklist. Involvement in child's learning scale. Feeling toward the child scale.	High parental control and negative affect in children with multiple LD as opposed to a single LD and without LD. Mothers of children without LD positive affect and home involvement.
Jordan & Levine (2009) Review work on the relationship between mathematics learning difficulties in students and their families' socioeconomic status.	Review empirical research.	Meta-analysis of research	Differences in math skills among children from families with low socioeconomic status compared to those whose families are middle or upper class. Socioeconomically disadvantaged students enter school with fewer skills, unfavorable beliefs towards mathematics and receive less support-help at home. Socially deprived families are unaware of LD and their treatment, few resources for dealing with them and do not work in coordination with teachers. Parents'

Objectives	*Participants*	*Evaluation*	*Results*
			socioeconomic status and lack of collaboration in teaching mathematics to children are risk factors for LD.
Heiman, Zinck, & Heath, 2008. Examine perceptions of parents and children of family relationships and communication.	104 families of students, 12-15 years old; 52 LD and 52 without LD.	Parents: Family assessment measures; Parent-adolescent communication scale.	Both parents perceive their children over-or under-involved with them and identify the same communication problems. Students identify bigger problems with maternal involvement than recognized by them. Students perceive less openness and more communication problems than parents.
Murray & Greenberg, 2006. To examine children's perceptions of their relationships with parents, teachers, peers and social, behavioral and emotional development.	96 Primary students with LD, borderline, or with emotional-behavioral problems.	Students: People in my life; Social Competence Scale for Children; Reynolds Child Depression scale; Delinquency rating scale of self and others; Seattle Personality Questionnaire for Children;	Relationships with parents, teachers, peers, associated with social, behavioral and emotional adjustment of students with LD. Communication with parents associated with lower crime.
Guoliang, Zhang, & Yan, 2005. Explore characteristics and relations between loneliness, acceptance and family functioning in children with and without LD.	34 students with LD, 64 students without LD, enrolled in 4th-6th year of Primary and their families.	Loneliness and Social Dissatisfaction Scale. Peer Nomination Inventory. McMaster Family Functioning Model Scale. Raven.	Positive correlation between peer acceptance and family functioning. Lack of relation between family functioning and loneliness.
Trainor, 2005. Examine perceptions of self-determination for students with LD during transition and students' perceptions of parents' and teachers' influence.	15 students with LD (16-19 years old) divided into: Afro-American, Europeans and Hispanic	Analysis of students' documents (individual transition plan), observations, focus groups and individual interviews.	Students feel that their self-determination efforts are thwarted at school and have more opportunities at home when they are supported by parents .

Objectives	*Participants*	*Evaluation*	*Results*
Domínguez y Pérez, 2003. Determinar funcionamiento de familias de niños con DEA, su afrontamiento de dificultad y del ingreso en educación especial.	43 familias de alumnos de primaria con trastornos del aprendizaje.	Prueba de evaluación de las relaciones intrafamiliares (FF-SIL). Cuestionario de afrontamiento familiar.	Funcionamiento familiar inadecuado en niños con DEA. Estilo afrontamiento más utilizado fue el centrado en el problema.

Table 1. Empirical research about family and LD.

Finally, we have located a third group of studies, which based on the results of the above, address specific interventions in the family context for pupils with LD from different perspectives. It is precisely this set of studies that are the subject analysis of the present work.

3. LD interventions in the family context

Naturalist approaches consider the ideal to be to support the student through all his/her surrounding formal and informal educational agents. This is especially important if s/he presents problems in learning and requires specific personal measures and materials (Gortmaker, Daly, McCurdy, Persampieri, & Hergenrader, 2007; Polloway, Bursuck, & Epstein, 2001). Also, regarding treatment, it is important to start intervention as soon as possible in order to guarantee higher efficacy. Based on all this, we can posit the family context as the optimal space for work in this area.

Families have a great potential to help students, as well as being capable of increasing learning environments and opportunities. They can also offer children individualized attention and make immediate modifications when the child requires it. Despite all this, parents are often not aware of how to play these aspects to their advantage. They often lack the strategic knowledge needed to help their children with academic tasks, even though with adequate support, they can be very effective intervention agents (Persampieri, Gortmaker, Daly, Sheridan, & McCurdy, 2006), which makes work with families highly commendable. There are two branches of intervention in LD using the family. The first focuses on getting the families to help in consolidating specific knowledge and/or to continue teachers' work at home. The second branch focuses on improving family interactions and helping parents naturally stimulate the development of the child's area of difficulty at home. Both branches can be used at the same time and are often enriched through family training activities. In spite of this, there is not yet a systematic and organized approach to collaboration with families in the current support model for LD. This model is still not very specific or developed in most Spanish regions. Another factor is that specialists in LD do not have much time to work with the children, since they travel between different schools. There are, therefore, time and space constraints that hinder the development of collaboration with the family.

There are empirical experiences at the international level that have led to the development of specific intervention methods through homework with families of children with LD. These can be used as a guide to teachers' professional practice with these kinds of children. The following section focuses on this area.

3.1 Empirical experiences of interventions on LD in the home

The inclusive perspective on intervention on LD considers family-professional collaboration to be a crucial element. Contextual activities for children with whichever LD in the real contexts in which they take place are one of the alternative treatments that are recommended.

For example, if we take language learning disabilities we must consider that the problems in this area are often related to phonological awareness and can be seen in the use of language in everyday situations. There are learning interventions designed to stimulate early spoken language for classroom use. However, general group interventions might not have the desired effects on children with LDL, for whom interventions based on real communication context are more efficient. It is because of this that the family is an optimal locus for treatment, as, in some regards, it allows for intervention in spontaneous events and communication situations arising from daily routines, as some practical work has shown.

In 2003 Quintana carried out a study which aimed to understand each child's educational needs by studying the contexts for its development and seek to address them through family-school collaboration. Two families with children with LDL collaborated. The work carried out was based on the experience of skills and experiences of both the families and the school. At the initial meeting between the teachers and the parents the study group presented the intervention program. An evaluation process was then carried out with the aim of getting to know the family members' view of the child's difficulties, her/his level of effort and interests, the treatments or measures already carried out and his/her level of functionality. Objectives and changes were then agreed upon. In summary, the program took the family's opinions on what the areas of difficulty were as a starting point, including family functioning, and used this to define goals. After this, they started the specific treatment for each child. It included strategies and/or activities such as modeling to correct pronunciation mistakes, creating game situations to increase opportunities for communication, how to use didactic materials, the use of words, tempo, voice, tone, etc. The results of this work were very positive, both for the children themselves and for their families. The children enhanced their social relationships and their interest in communication. Families improved their daily routines by increasing communication situations or joint activities. Due to the intervention families were the protagonists of these changes, which increased their self-esteem and allowed the changes to become more permanent. The parents' interest in the child's disability increased and so did their consciousness of it. Parents' anxiety was also reduced by sharing their worries with experts, who also offered them information on LDL. The relationship with the school was also enhanced.

Justice, Kaderavek, Bowles and Grimm (2005), also conducted a study to determine the effectiveness of a phonological awareness intervention program implemented by parents at home that was aimed at improving language development in twenty-five 5 year old

children with LD-L. To this end, instructors went to the family homes and verbally explained to parents the intervention's objectives as well as the procedure for carrying it out. They then performed a modeling activity in which the researcher taught the family how to carry out each task. Next, parents practiced the tasks with the researcher. This meant they were offered the feedback necessary to make sure they got it completely right. The parents' job was to read different stories with their children and then perform various phonological awareness activities (rhyme, similar sounds, phonics etc.). After a period of ten weeks reading the stories provided by the researchers and working with the proposed activities there was a noticeable improvement in the children's phonological awareness. There was a relationship between the improvements observed and the age of the children, with the eldest being those who benefited most from experience. Parents were satisfied with the experience, noting that they enjoyed it and all of them carried out the treatment in full.

We can conclude that in the specific case of LDL, intervention in everyday contexts and including the children's attachment figures is very positive, as it allows carrying out specific actions in a very personalized way and in everyday communicative situations. It is not a great effort for parents but is extremely beneficial to children.

Let us now look at reading. Parental involvement in its teaching can have positive effects on children, especially due to the fact that it requires continuous follow up, which means that during the summer period there tends to be a decrease in the achievements reached during the year. One way of reducing the negative effects of the summer holidays on children with specific reading disabilities (LD-R) is to use parents and to help them to implement stimulating interventions at home (Gotmaker, Daly, McCurdy, Persampieri, & Hergenrader, 2007). Having parents as tutors increases, among other things, reading fluency, though they must have specific tools, strategies and techniques to encourage them to help their children with this skill.

Persamperi et al (2006) carried out a study whose object was to increase reading fluency of LD-R pupils through parents' implementation of a specific program. It was carried out on children aged 8-9 over the summer holidays and based on narrative or essay texts. Parents received training 3-5 days a week, for 10 to 15 minutes. It was based on the following steps: a) the professional described the goals and the specific procedure b) s/he acted as a model, carrying out an example with the child, while the parents watched, c) the parent carried out the activity with the child and the expert offered feedback and tutoring until the parent could carry out the teaching procedure flawlessly. Parents were also handed a written protocol for the intervention. The tasks were to correct mistakes through sentence repetition and contingencies of rewards in order to improve. The child was required to read the passage while the parent wrote down the mistakes. The parents then modeled correct delivery and asked the child to read the word and full sentence again, which reinforced the steps the child carried out correctly. The study's results show that these types of tasks enabled children to improve their reading fluency over the important summer months and that these improvements were stable over time. Parents' ability and potential to intervene from home was therefore verified.

Based on the same perspective, Gortmaker, et al. (2007) carried out a program to increase reading fluency of high and low frequency words in three students aged 9 with LD-R through parental collaboration. As in the previous case, there were three steps in parent

training: 1) Oral explanation of the program, including its different aspects and solving any initial questions 2) Expert acted as a model acting out the tasks with the child with the parent present 3) The parent carried out the procedure with the child while the expert corrected and gave feedback until it was carried out perfectly. This was accompanied by a written protocol for parents to keep. The intervention was based on parents and children reading stories together 10-15 minutes a day, 3-5 days a week for a month. While the child read, the parent corrected any mistakes. S/he would repeat the mispronounced syllables, words or sentences and thereby making their reading automatic. Results once again showed an increase in reading fluency and both children and parents were satisfied with the results of the treatment.

Based on this evidence we can confirm that parents can be an effective alternative to address some of the problems typical of children with LD-R, but in many other cases their collaboration is sought to prevent the occurrence of these problems. Thus, a study by Van Otterloo, Van der Leij and Veldkamp (2006) tried to establish parents' potential to develop prereading skills related to phonological awareness of 32 children at risk of genetic dyslexia enrolled in second year of kindergarten. The first step was an initial meeting with parents to present the protocol and the exercises, which were demonstrated and discussed. Parents were given a week to study the protocol, after which researchers phoned them to solve any doubts that may have arisen. Parents then started working with their children. This consisted of pronouncing sounds and the working with grapheme-phoneme relationship through rhymes and games for 10 minutes a day over 14 weeks. Once the treatment was finished it was established that a high number of families had completed all the sessions. The quality of implementation was likewise high, though the results obtained were more influenced by the quantitative than the qualitative aspect. Carrying out all the sessions was more important than doing them perfectly. We can therefore conclude that even if parents are not experts it is sometimes sufficient for them to show interest in the program and carry it out with acceptable quality in order to achieve highly satisfactory effects. However, we must try, whenever possible, to reach the highest quality, as there are other intervening factors, such as parents' level of education. In this study it was found that the children whose parents had reached higher education gained better prereading skills. However, this can be due to the general stimulation the home offered and the family's linguistic capital. Therefore, it is necessary in family interventions for experts to carry out an ongoing monitoring of families. Parents are not experts and have very different and peculiar characteristics that may mediate the results. Programs must thus be tailored to parents' needs by providing more support to those families who, due to their characteristics, need it the most.

Feiler (2003) elaborated on the aspect of connecting naturally stimulating environments in the home with an improvement in children's performance after the implementation of specific treatments. Feiler (2003) analyzed the viability of a model of intervention based on home visits to children at risk of literacy LD in order to prevent them by giving parents guidelines. Over the first year of schooling, experts visited families on a weekly basis teaching parents basic reading and writing activities, such as reading books, helping the child write his/her name, and offering them materials or instructions. The results of this seemingly simple intervention were evidenced at the end of the school year. At the beginning of the year children in the experimental group learnt these skills at a significantly

slower pace than their classmates. However, at the end of the school year there were no significant differences. Families were also satisfied with their work and showed a high degree of interest in continuing with the activities they had learnt as well as with becoming more involved in their child's education.

Lastly, there is a study on the role of the family on writing LD (Jones & Christensen, 1999). It tested how effective a program aimed at improving the writing skills of children with mechanical difficulties was. The program could be carried out by family or faculty. Over 8 weeks and for ten minutes a day the relatives who volunteered worked with their children on activities regarding letter's shapes, correcting motor mistakes and fluid writing. Children improved both their motor writing and the quality of their stories. It was also shown that they did so regardless of whether it was the teachers or the family that carried out the tasks. Once more, there is evidence of parents' potential to stimulate the academic development of children with LD.

3.2 Family help with homework for children with LD

Most of the work which addresses family collaboration to prevent or solve LD focuses on language, reading and reading-writing and on young children at risk of LD. However, when the children with LD are older they usually present, apart from the diagnosed difficulties, difficulties with doing their homework. In some cases they get professional help from their schools. They, nevertheless, lack that professional support with their homework at home, which means that help from relatives is basic (Bryan, Burstein, & Bryan, 2001).

Some of the variables related to the problems with homework that students with LD present seem to be related to the lack of communication and coherence between the goals of the school and the family (Polloway, Bursuck, & Epstein, 2001). That means that in these cases direct contact between faculty and the family is essential to ensuring meeting and maintaining academic goals. In order for intervention programs to be really effective it is necessary for professionals to develop strategies to obtain parents' active collaboration, in addition to meeting with the child. It is also advisable that the family's involvement begin as early as possible. The perspective should be one of prevention, helping to avoid an increase in the disability. Parental satisfaction with the school means they will continue their favorable disposition towards collaboration. However, it is common for teachers to wait until the situation is out of control to ask for parents' collaboration. Likewise, there are but few parents who contact schools of their own accord to show interest in collaborating. This is sometimes due to time constraints, or to their being dissatisfaction with the school after finding that their child has problems that the school has not provided tools for overcoming. Teachers must therefore offer families as many options for collaboration as possible. This means that apart from defining schedules, times and spaces for homework, families can work on other specific aspects with their children with LD and keep frequent and fluid contact with the faculty.

It has been demonstrated that teaching parents how to work with their children on psychological variables that can influence their homework production pupils improve not just the quantity of homework produced, but also its quality, and even leading to higher exam marks. This means that if we provide families with the materials, procedures and concepts to participate in a systematic and structured way in the child's homework by

providing them organizational, self regulation or applied structures there will be clear benefits to the children's performance. We must, nevertheless, take into account that parents of children with LD report they have more problems than usual doing their homework and require more dedication. We must take the family's characteristics into account – number of children, profession and even the effects of involvement – which all affect its collaboration. This means taking its structural and functional traits into account in order to adapt the collaboration required to its real capacity, especially regarding children with LD, who may live in a highly stressful environment and whose parents may also suffer LD. In the next section we explore procedures, guidelines and resources that can guide direct work with families of pupils with LD.

4. The family as the locus of intervention: Support resources

The families of children with LD increase their degree of involvement if they perceive their help to be efficient, due to the big effort required to help their children, especially if they have other family members or work to take care of. It is therefore very important to give parents tools to ensure their actions will be effective and thus avoid them becoming frustrated and not collaborating further. Making them aware of how important their help is and of the positive effects of their collaboration, through their own evidence, is crucial. When starting to work with families of children with LD we should follow some guidelines.

First of all, it is very important that teachers address family crises in order to count with their collaboration. A common stress factor for families is their children's difficulties at school, so it is this institution that can best address them. Promoting parents' involvement is also considered a quality trademark for teachers (Tungland, 2002). However, it is important to consider the barriers to parents' collaboration and their possible solutions. Table 2 shows some of them.

Barriers that limit parent cooperation	Solving Strategies for Professionals
Language shortcomings	Use appropriate communication skills and effective and understandable language.
Work problems or time constraints.	Provide flexible schedules and locations to work with the professional.
Low self-awareness of one's skills.	Identify parents' skills and make them aware of them. Introduce parents to ways to help children
Negative school experiences, feelings of inferiority in relation to teachers, minimizing the importance of education.	Treatment of professionals and families as equals. Recognizing parent's educational potential and their responsibility.Avoid negative attitudes regarding family collaboration. Set goals together
Not understanding LD or denying them.	Specific interventions, parent support groups, associations.

Table 2. Family elements that limit their involvement in the education of children with LD and strategies to overcome them (adapted from Tungland, 2002).

When parents don't recognize their children's LD it might be due to them not knowing what these disorders are and therefore not addressing them. Karende, Mehta and Kulkarni (2007) confirmed this during their diagnostic procedures of LD for children. They then ran a specific session to train parents on LD. They asked parents a set of questions on what a learning disorder is, its causes, course, treatments, etc. These issues were debated for about 45 minutes and they were made aware of the correct answers. This allowed them to verify that their children had a real problem that required intervention. After this session parents became aware of LD and the need to treat them specifically, which required their collaboration. The results therefore proved to be very satisfactory.

In the 80s Stoll (1985) detected that families' lack of understanding of the diagnosis of LD was a factor contributing to the low relationship between parental expectations and children's potential, and therefore a low probability of acceptance of treatment. Therefore, he decided to carry out a seminar for families aimed at raising their awareness, which was expected to lead them to not resist the diagnosis and offer their children the help they really required. The starting hypothesis was that knowledge of the problem and its treatment would help decrease parental anxiety and increase their receptiveness. The seminar consisted of a week of 90 minute sessions both parents needed to attend, which addressed the following topics: definition of LD, family life, school life and future prospects. The sessions initially presented a general framework and progressively worked their way to each particular case. The facilitator asked questions parents had to answer. The answers were then fed back into the group and opened a debate. As the seminar progressed individual cases were addressed with the goal of decreasing stress through a cognitive understanding of reality which aimed to identify problems to then solve them. The results of the seminar met all the goals, increasing parents' awareness of the problem, helping them express it and understand it. It also helped them adapt their expectations regarding their children and increase parental collaboration.

Rolfsen and Martínez (2008) also carried out family training. They developed a psychoeducational program which aimed to guide parents of children with LD on how to use the resources available in their environment to prevent more serious difficulties. The participants were 8 parents of primary school children with LD. The program was 6 sessions long, which covered topics such as organization of family routines, support with children's homework, relationship between the family and the school, enriching everyday experiences, communication and family relationships and educational practices. The sessions, which were 90 minutes long and took place at the school, aimed to inform parents of assertive behaviors that favored children's adaptative behaviors and their school progress. The program addressed parents' needs. They showed a lot of interest in the content and raised their expectations regarding their ability to help their children together with the school.

Apart from these kinds of interventions there are other procedures which aim to help parents of children with LD, such as support groups, which can help families deal with the child's difficulties.

4.1 Family support groups

In Spain it is still unusual to find support groups for parents of children with LD, despite them being popular in the US and in other European countries, such as the UK. In the UK

we find the British Dyslexia Association, which has regional support groups created by parents for parents of children with LD. The general goal of the groups is to offer families social support through meetings, practical information and by addressing the needs of their members. They seek to exchange emotions, offer courses for families to learn how to help their children with homework or activities to improve relationships among siblings. They also have hotlines, rules for becoming a member, resources, etc.

The presence of different initiatives at the international level allows us to know and analyze their functioning and efficiency, as well as their limitations. An analysis (Bull, 2003) has shown that relatives who attend activities have different motivations for doing so, depending on their personal circumstances. We must take into account these interests before starting an association. For example, parents may go to support groups soon after diagnosis in search of information on LD or to find educational treatments they can carry out at home. They may also need to find effective support to help diminish the stress caused by their child's disability. Other relatives go to parents' groups after being referred by a professional or just to talk to other people who are in the same situation. Initial motivations are very important because they determine parents' satisfaction with the support group and, therefore, influence their functioning and proliferation. When starting up these groups it is important to consider members' characteristics and propose diversified, systematic, well organized and structured activities that address the needs of all of them (Bull, 2003).

4.2 Associations

In Spain there is a low level of awareness of LD – diagnostic criteria, different typologies and specific needs. Due to this, despite significant progress in terms of the law and the number of associations, the services offered are significantly more limited than those available to students with special needs and their families, due to these being much more conceptualized. The number of Spanish federations and local associations on development disorders far exceed those focused on LD, which shows a delay in this area. The number of associations in this area is, however, increasing, as can be seen in the following table on LD associations in Spain.

These associations often use dyslexia in their title though, according to their own descriptions, they offer services to all children and adults suffering from any type of learning disability and are not restricted to people with reading difficulties. Most of these associations have been created and financed by parents of children with LD, sometimes together with professionals. Their goal is an activist one, as they do not agree with how the Spanish education system is treating LD. On 15th July 2006 the Spanish Federation for Dyslexia and other Specific Learning Disabilities was created in order to join forces so as to better face different levels of government and allow each association to be more effective. It main objectives are: a) Raise society's awareness of Learning Disabilities, how they can be prevented and how to solve the problems associated with them; how LD are one of the causes of school failure; b) Bring Educational Institutions' attention to what the real situation is, enabling them to offer adequate measures, both in regards to how the real education system addresses specific children's needs as well as the training received by teachers and professionals and the quality of help provided to families; c) Find and publicize the latest research, promote research and funding for research lines and the development of treatments for these disorders.

ASSOCIATION NAME
Nationwide
Spanish Federation of Dyslexia and Other Specific Learning Problems (Federación española de dislexia y otra dificultades especificas de aprendizaje, FEDIS)
Dyslexia without Barriers (Dislexia sin Barreras)
National Association for Learning Disabilities and their Rehabilitation (Asociación Nacional para las Deficiencias de Aprendizaje y su Rehabilitación, ANDAR)
Spanish Association for Special Education (Asociación Española de la Educación Especial, AEDES)
Learning Disorders Specialist Unit Sant Joan de Deu Hospital (Unidad especializada en trastornos de aprendizaje Hospital Sant Joan de Deu, UTAE)
Dyslexia and the Family Association (DISFAM) Asociación dislexia y familia (DISFAM)
Regional
Canary Islands Dyslexia and other Learning Disabilities (Dislexia Canarias y otras dificultades de aprendizaje, DISLECAN)
Catalan Association for Dyslexia and other Specific Difficulties (Asociación catalana de dislexia y otras dificultades específicas, ACD)
Dyslexic Association Murcia (Asociación disléxicos de Murcia, ADIXMUR)
Valencian Association for Dyslexia and other Learning Disabilities (Asociación Valenciana para la Dislexia y otros problemas de aprendizaje, AVADIS)
Galician Association for Education, Development and Diversity (Asociación Gallega de Educación, Desarrollo y Diversidad, AGAED)
BROT Educational Foundation (Fundación pedagógica el BROT).
Association for Dyslexia and Learning Problems of Asturias (Asociación para la dislexia y problemas de aprendizaje de Asturias, ADISPA)
Cantabrian Dyslexia Association (Asociación Cántabra de dislexia, ACANDIS)
Association for Children with Dyslexia and other Learning Disabilities of Reus (Asociación de niños disléxicos y otras dificultades de Aprendizaje de Reus)
Galician Dyslexia Association (Asociación gallega de Dislexia, AGADIS).
Positive Dyslexia Andalusian Association (Asociacion Andaluza Dislexia en Positivo, ASANDIS)
Dyslexia Association Biscay (Asociación Dislexia Bizkaia, DISLEBI)
Jaen Dyslexia and other Learning Disabilities Association (Asociación Dislexia Jaén y otras Dificultades de Aprendizaje, ASDIJA)
Overcoming Dyslexia (Superar la dislexia)

Table 3. Regional and nationwide Spanish LD associations.

The associations are generally aimed at an audience of families and people affected, and not so much at professionals. Among the services offered, most of them have webpages that offer information. Their content is usually very similar – articles and other materials,

forums, contact numbers, FAQs, etc. Some of them, usually the associations aimed at or related to psychology or educational psychology professionals, which generally have an evaluation function, offer diagnosis. Other services they offer are stimulation and leisure activities, treatment and guidelines, counseling and information for families. Most of them also offer information, courses and seminars for professionals who work with these pupils.

Among the materials offered we would like to point out information on the disorders, how the family can face them, recommended treatment for the school and on the current legislation around the matter. They also often present screening protocols, guidelines for assessment, psychometric tests or intervention programs, treatment strategies and techniques, and practical proposals.

To sum up, the development of Spanish LD associations is underway but still insufficient. However, there is another type of association, which is private and generally works at the national level, which has been founded and run by professionals from different areas whose aim is therapeutic and to offer guidance. They are focused both on treatment and family and teacher guidance.

5. Conclusions

This chapter has addressed intervention with pupils with specific LD from a contextual point of view, based on the inclusion of the family as a focal point of development. We started by analyzing the studies which focused on the family and found it to be ideal for specific interventions. We then went on to describe empirical experiences in which parents were responsible for the application of specific intervention measures with children with LD. These were both remedial-preventive as well of collaboration with school tasks including homework.

The results of the studies reviewed support the need for a comprehensive assessment and intervention for students with LD (Gortmaker, et al., 2007; Polloway, et al., 2001). Intervention with the students themselves and treating their problems is necessary, but it is also necessary to take their family into consideration. Parents of students with LD need help to educate their children and to deal with their problems, but their own needs also require attention (Dyson, 2010; Karende, Mehta, & Kulkarni; 2007; Rolfsen & Martínez, 2008). Due to this, we finished by looking at the need to work directly with parents. We offered suggestions on activities, procedures for them to help their children effectively, such as parents' programs, support groups and associations. We have presented this with a focus on general guidelines which can help professionals actively work with and through the family. The empirical practices revised have shown parents to be effective for working with LD students. Therefore, intervention with and through families in the case of learning disabilities is well-established as necessary. We, thus, intend to continue this line of work and research to improve the situation of children with LD and their families.

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Correspondence should be addressed to Departamento de Psicología, Sociología y Filosofía. Área Psicología Evolutiva y de la Educación. Campus de Vegazana s/n, 24071 – León, Spain. Phone: +34-987291041 (university); +34-987222118 (home); +34-652817871 (cell); Fax: +34-987291035 (university). E-mail: jn.garcia@unileon.es.

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7

Preventing Children's Writing Difficulties Through Specific Intervention in the Home

Patricia Robledo-Ramón and Jesús-Nicasio García-Sánchez
University of León
Spain

1. Introduction

In recent times there has been a wealth of studies, both from the empirical (Bodovski & Youn, 2010, Burnett & Farkas, 2008; Mensha & Kiernan, 2010; Powell, Son, file, & John, 2010; Robledo & Garcia, 2009; Xia, 2010; Yun & Kusum, 2008) and from the legal point of view, confirming the need to consider the family, and especially parents, in educational processes, both due to their natural impact on student learning and for their potential to successfully stimulate students (Cayo, 2008; Hegarty, 2008; Hood, Conlon, & Andrews, 2009; Rogers, Wiener, Marton, & Tannock, 2009). Moreover, in the European context, given the constant changes the education systems are facing and the increasing educational requirements (Novoa, 2010), the context that supports the important role of parents in the academic progress of their children is especially relevant.

Nowadays, skills development it an established priority (Muñoz, 2008). Skills development is defined as the sets of knowledge, skills and attitudes required to transfer and apply knowledge from different areas and subjects to reality in order to understand it and solve real problems with expertise and efficiency across different types of contexts (Junta de Castilla y León [Government of the Region of Castile and Leon], 2009). So from this perspective, it is believed that the involvement of people and everyday environments in students' lives could be an excellent supplement to formal educational institutions in their efforts to empower children to develop lifelong learning applicable to real life. When we take into account the fact that the natural context where students spend more time other than school is the family it becomes apparent how ideal it is to involve parents in the improvement of basic skills, including the most important area in compulsory education – linguistic communication competence (Fernández, 2007).

Communicative competence refers to the use of language as a means of oral and written communication, learning, building one's thinking and personal and behavioral regulation. It is therefore highly relevant in the field of education and is very applicable to the social field, which means it can be approached through different contexts (Frijters, Barron, & Brunello, 2000; Hood, et al., 2009; Reyes, Alexandra, & Azuara, 2007; Strasser & Lissi, 2009). Thus, the goal of educators is to train competent communicators to operate naturally in different everyday communicative contexts that involve both the use of oral language and reading and writing (Pérez & Zayas, 2007). However, despite the triple configuration of this competence, empirical experience confirms that its stimulation in schools tends to offer a

limited systematic treatment of writing, especially with regard to text composition (Fabregat, 2009; Gilbert & Graham, 2010; Lecuona, Rodríguez, & Sánchez, 2003). Meanwhile, at home, the parents themselves, in their natural process of encouraging their children's communicative development, sometimes also seem to forget writing (Cusumano, 2008). Consequently, the writing aspect of communicative competence is poorly addressed by schools and families, which tend to focus, when they devote their attention to writing, primarily on mechanical elements. They do so to the detriment of the more complex issues, aspects of higher order that would lead to true written competence, and whose complexity, according recent theoretical models, requires greater attention. This model emphasizes that writing is a highly demanding task, dependent on several modulating factors of cognitive and emotional nature, that requires the implementation of a set of specific mental processes related to planning, editing and revising the text, which require a big cognitive effort and mean it is unlikely for students to complete them successfully exclusively through the use of natural abilities (Alamargot & Chanquoy, 2001; Galbraith & Torrance, 1999; Graham, 1999; Kellogg, 2008; MacArthur, Graham, & Fitzgerald, 2006; Wong, 1999; Wray, 1998). Consequently, it is argued that learning to write requires explicit instruction that promotes and facilitates it.

At present, the complexity of the process of composing written texts is widely recognized, as well as its practical nature as a socially applicable communication tool. All of this points to the need to take action to overcome traditional cultural limitations in its teaching. The development of this skill can take place in the context of everyday communication, the family context being one of such settings (Pardo, 2009).

In line with the above, research confirms that the habit of writing is more common in students whose families provide models and positive attitudes towards written composition tasks (Reyes, et al., 2007; Romero, 2007). It also states that the daily writing activities carried out at home, where children and parents interact, exert an important influence on students understanding the usefulness of writing, awakening a love of it in them (Lacasa, Gomez, Queen, & Cosano, 1999). Similarly it has been shown that children acquire the ability to perform better text compositions when these tasks are carried out in context with real communicative purposes (Reyes, et al., 2007).

Aware of this, some practitioners have developed guidelines on how to assist families with children in the stimulation of writing through natural tasks and by offering models that demonstrate its applicability (Elish-Piper, 2010; Rasinki & Padaka, 2009). Meanwhile, other teams of professionals have increased the role of parents in the teaching of writing, implementing specific training programs, in which parents are taught strategies to successfully develop children's literacy, help them with their homework or increase the number of activities that involve writing at home (Axford, 2007; Saint Lauren & Giasson, 2005). Other practices undertaken at the empirical and practical level, focus on the prevention or treatment of learning difficulties in this area through family support. Generally, these give parents advice, through home visits or regular meetings, on how to help their children with writing. They are also taught patterns for enriching the literacy environment of the home, activities for working with children and basic notions about the importance of providing feedback or reinforcement. Usually, these practices are highly effective. They have shown how families' interventions cause students to adjust their pace of learning to the level expected for their age or level of education, and even manage to overcome their specific difficulties to improve their writing further (Feiler, 2003; Jones & Christensen, 1999).

This evidence confirms that parents, with adequate support, can develop students' written competency, thus demonstrating the potential and effectiveness of direct intervention (Cutler & Graham, 2008; Dunsmuir & Blatchford, 2004; Lacasa , et al. 1999; Neuman, Hood, & Neumam, 2009; Persampieri, Gortmaker, Daly, Sheridan, & McCurdy, 2006; Reyes et al. 2007; Romero, 2007). Nevertheless, specialized research is still scarce, especially when compared to the set of empirical research on family collaboration to stimulate oral language and reading (Lozano, Galian, & Cabello, 2009; McElvany & Arlet, 2007; Policastro, Mazeski, & McTague, 2010). It is also limited in relation to the age of the children, the type of skills addressed or the process of training offered to parents (García & Fidalgo, 2003; Montealegre & Forero, 2006).

These findings justify the development of research that analyzes the ability of families to contribute to the teaching of written composition from cognitive-communicative perspectives, as well as the need to develop and empirically validate the effectiveness of parent training programs aimed at enabling them to increase their involvement in the optimization of this competence, which is precisely the purpose of our research study. We intend to broaden the field of research regarding written composition, seeking to overcome some of the constraints identified in the teaching and study of this competence, mainly related to the intervention in central aspects belonging to different communicative contexts.

Thus, the first objective of this study is to explore the effectiveness of an intervention program in written composition, focusing on the written product and the activation of higher cognitive processes involved in word processing, to increase the children's performance in writing, both in terms of its product and of the process, and to optimize other motivational-affective variables. The aim is also to find if any improvements are stable in time and if not, generalize to different textual typologies. The secondary objective of the research project is to find out whether there are differential effects on program effectiveness in relation to the environment (school and home) and the figures (parents and teachers) involved in its implementation. The third objective is to determine whether increasing parental involvement in writing homework is sufficient to improve outcomes for children or whether families require prior training to enable them to do so. This objective seeks to find the effectiveness of parent training specifically aimed at enabling them to teach written composition by helping with homework. Finally, in line with this, we studied the children's awareness of parents' help and their assessment of it.

To achieve this, we used four experimental groups according to the modality of written composition intervention students had received in connection with the degree of implication of agents in charge of implementing it. In the first one, called EFP (parental training school), parents, after training at a school, implemented the intervention program in written composition with their children at home through the use of homework. Teachers, meanwhile, continued the regular process of teaching writing, except they increased the amount of homework related to the composition of written texts to meet the demands of the research project. In the second group, called PAD (parents help in homework), teachers operated similarly, while the parents increased their assistance with text writing homework, without receiving any specific prior training. In the third group, called PRO, it was teachers themselves who carried out the intervention program in the classroom, while families acted as usual, not having been asked for any specific collaboration. In the last group (CO, ordinary curriculum), teachers maintained the traditional teaching of writing and families offered children the usual academic support.

2. Methodology

2.1 Participants

For the purpose of this research we needed the collaboration of students and their parents. The sample was made up of 112 primary school children, with ages ranging from 10 to 13 (mean = 10.46 years), distributed according to study groups, grade and sex as shown in Table 1.

	PRO			EFP			PAD			CO		
	Boys	*Girls*	*Total*	*Boys*	*Girls*	*Total*	*Boys*	*Girls*	*Total*	*Boys*	*Girls*	*Total*
5th grade	11	11	22	8	8	16	5	8	13	7	6	13
6th grade	7	6	13	6	4	10	6	6	12	7	6	13
Total Sx/Gr	18	17	35	14	12	26	11	14	25	14	12	26

Table 1. Sample of students according to their experimental group, course and sex

All participants attended school regularly and none of them had any specific educational support needs. The children of the different groups did not initially differ, according to our pretest in any of the assessed variables.

As for families, the following table describes the main characteristics of the parents that were actively involved.

	Sex		Age			Child's grade		Parent's highest level of education achieved			Labor market participation	
	Men	*Women*	*Mi*	*Ma*	*M*	*5th*	*6th*	*Primary*	*Secondary*	*University*	*Active*	*Non active*
EFP	0%	100%	36	52	42	62%	38%	12%	41%	47%	56%	44%
PAD	8%	92%	33	51	41	52%	48%	36%	48%	16%	72%	28%

Table 2. Characteristics of EFP and PAD family groups

In the other two study groups family collaboration was not explicitly required although their main features may be of interest. Their ages ranged from 32 to 52 years, with a mean age of 42.9. In terms of levels of education, 21% had reached primary, 50% secondary and 29% higher education. Finally, 77% were working, while 23% were stay at home parents.

2.1.1 Sample selection

The process of selection and distribution of the sample across different groups followed a procedure which aimed to achieve a correct and comparable distribution of participants to experimental conditions.

First, to select the schools, we took several criteria into account with the aim of achieving the maximum possible similarity between them, both with regard to their structure and organization, and with regard to the characteristics of students and families. Specifically, we selected state schools in which the teachers' profile, teacher-student ratios and the availability of human and material resources or infrastructures were similar. In addition, these centers hosted middle-class families with traditional structures and were mostly Spanish. Finally, based on the objectives of our the research and considering the interests and availability of schools and families we established the need to involve four schools. As noted, we tried to control their differences, thereby trying to overcome the possible handicaps resulting from the impossibility of making a completely random distribution of participants to experimental groups, as the involvement of parents and teachers was voluntary.

Of the institutions addressed, two of them declined the option of increasing family collaboration, and were thus assigned to the PAD and EFP experimental groups. In these cases, only the parents who showed interested in family training were enrolled in it, which determined the group of students in EFP. Other parents of those schools, unable to attend the training sessions, chose the option of assisting their children more actively with writing assignments and were assigned to the PAD group. Therefore, children in groups FP and PAD were enrolled in the same schools, were classmates and had the same teachers, so that one group served as control for the other. PRO was carried out at a third school. The faculty of the third cycle of primary was responsible for the direct implementation of the intervention program in written composition in 5th and 6th year of primary. The last school took part in the CO group. It therefore only carried out the relevant assessments of students in grades 5 and 6, maintaining the ordinary curriculum regarding teaching of writing and regular family help with homework, thus also acting as a control for the PRO group.

2.2 Instruments

2.2.1 Performance assessment in written composition: product and process measures

To evaluate the written performance of students we sought to cover their written products as cognitive processes activated in word processing, using different tools previously validated by the research team.

Product Measures

The written products were evaluated using two types of measures, some based on objective evidence collected in the text or text-based measures (MBT). Others used subjective criteria, based on the overall interpretation of the text by the reader (MBL). Table 3 lists the parameters included in the MBT, as well as the criteria to be observed by the reader to estimate their subjective ratings.

We would like to emphasize that since all these measurements, imply an opinion, assessment or interpretation on the part of the evaluator, corrections were made by two experts who worked independently. We then calculated their rates of agreement, which ranged overall between quite high (between kappa 0.6 and 0.8) and very high (kappa greater than 0.8 points).

ASPECT	ASSESSMENT
	Text-based measures
Title	Presence or absence of a title, yes or no.
Productivity	Total no. of words: content, functional and determinants.
Coherence	Referential coherence: referential and lexical indicators Relational coherence: structural and meta-discursive (structuring, connectors, reformulated and argumentative).
Other coherence measures	Relevant ideas. Correct link between the ideas. Coherent and well defined paragraphs. Coherent storyline.
Structure	Introduction, body and conclusion.
	Reader-based measures
Structure	On a scale of 1 to 4, we assessed the presence in the text of: introduction, purpose and theme, signs of structure, organized and structured development, paragraph coherence and unity and conclusion.
Coherence	On a scale of 1 to 4, we assessed compliance of the text with parameters such as identification and presentation of the topic without digressing, presence of a context to guide the reader, organization of details in a plan, distinguishable presence of links connecting sentences/paragraphs, flow at the conclusion of speech and sense of purpose.
Quality	On a scale of 1 to 6, we evaluated: clear sequence of ideas, good idea organization, vocabulary, variety of details, correct sentence structure, punctuation and spelling.

Table 3. Textual measures based on the text and on the reader

Process Measures

To measure the activation and deployment of cognitive processes involved in writing tasks we used a variation on Kellogg's triple task (Olive, Kellogg, & Piolat, 2002) that had been used previously by the research team in several research projects (García & Fidalgo, 2006; Torrance, Fidalgo, & García, 2007). This technique works as follows: as students are writing their texts, they hear an audible signal (beep) distributed randomly over time (with a mean onset interval of forty-five seconds), when they must make a direct and immediate retrospection on their thoughts and actions and choose between seven response categories that assess the major cognitive processes involved in writing. For planning, the categories used were: read about the subject, think about the content and develop an outline. As for the editing process, the category included was writing a text. Finally, to assess the review process we considered categories of reading and changing text. Finally, we added a seventh category called "not related to the task".

Prior to the self-reports, students were trained through example to identify and memorize the seven categories. After this, in order to verify the reliability of the process, we presented them with a case study with a total of 25 possible items that Luis, our example of a student,

carried out when writing (e.g. Luis thinks "What things can I tell about my city?"). Students had to identify to which of the 7 categories each of the 25 items belonged. When we compared the children's result with that of an independent expert we obtained an average agreement of .957 (kappa index). Students were then asked to write their own text and record their progress on a writing log.

2.2.2 Instruments for the evaluation of motivational-affective elements

A second group of scales were intended to meet different motivational-affective aspects of how students relate to writing, specifically to examine their attitudes, attributional patterns and perceptions of self-efficacy.

Attitudes

The survey of attitudes toward writing, included in the test evaluation of planning and writing psychological factors (EPP and FPE, Garcia, Marbán, & de Caso, 2001), allows us to evaluate students' attitudes toward writing tasks. It consists of ten items - statements to which children have to respond "yes", "no" or "neither agree nor disagree" depending on how well each claim applies their own real attitudes.

Attributions

The questionnaire Motivation to Write II (MOES II, Garcia, Marbán, & de Caso, 2001), examines the actions performed by students in essay writing tasks. It allows us to see whether students attribute their success/failure to their own work, effort, ability or luck. It consists of thirty-two claims in eight scales based on the attribution component considered. Children must respond according to their degree of agreement with each statement on a scale of 1 (strongly disagree) to 5 (strongly agree).

Self-Efficacy

The Self-Efficacy in Written Composition Questionnaire (developed by the research team) considered all the high and low cognitive level factors that are involved and influence the writing of texts and over which a person can exert voluntary control. It consists of twenty items evenly distributed among low and high cognitive level processes. Ten items measured mechanical processes such as calligraphy, layout, spelling and grammar and the remaining ten covered substantive processes categorized into information generation, prior knowledge, organization, monitoring, and draft review. The scale asks the student to what extent s/he thinks s/he can achieve/include each item in a text (e.g.: To what extent can I write my text with correct spelling? To what extent can I include many ideas in the text?). Each response is graded on a scale of 0-100, where 0 means "very sure not to" and 100 means "very sure to". The questionnaire was explained and applied immediately before the start of the writing assignment.

2.2.3 Instruments to assess family involvement: Family Opinions (FAOP)

For the perception of children about parental involvement in education and in written composition of specific academic subjects we used the scales *Family opinions: parental implication in education* (FAOP-HI-IM) and *Family opinions: writing practice* (FAOP-HI-PRAES), which are widely described elsewhere (see chapter in this book).

2.3 Training programs

Here we describe, first of all, the instructional program for students in the EFP and PRO groups, and secondly, the training program developed with the parents group in the EFP group.

2.3.1 Instructional program in written composition

The instructional program in written composition, applied by the mothers in the EFP group and teachers in the PRO group, consists of eight intervention sessions. The order of the sessions was based on the objectives of the study and on the cognitive processes involved in written composition.

As for the teaching-learning procedure followed, each session consisted, in general, of an initial activation of prior student knowledge and then to proceeded to the presentation of new content and strategies, offering in most cases modeling and implementation of different strategies to this end, including the initial observation of the model and the subsequent practice of repeating in pairs or individually (depending on the session). We provided external expert feedback and finished by reviewing the content covered in the session. Table 4 presents a summary of the program by collecting the main elements of each session, its objectives and the teaching-learning process followed in both the EFP and PRO groups.

Focus	*Objectives*	*Teaching-learning procedure*
Motivation for writing. Overview of the process of written composition.	Increasing students' interest in writing, showing its relevance. Activate students' prior knowledge about the process of written composition. Provide students with the main processes involved in writing.	Explain the importance of explicit writing. Interactive stimulation of prior knowledge about the writing process, brainstorming. Transmission mnemonic rule "Perdidos" (Lost in Spanish) Writing a text (Family Adventures) and stimulating the use of writing in everyday tasks. - PRO: individual text written and read in class. Everyday classroom tasks (mail suggestions, friends little notes, etc.) - EFP: Family material. Daily chores (shopping list, notes, e-mail).
Text planning process	To develop students' ability to address the planning of texts effectively, according to their different threads. Promote the development of students' "PLAN-L" planning strategy, corresponding to	Session 2: Activation questions guided by prior knowledge about the writing process (remember "Perdidos"). Instruction on/explicit explanation of mnemonic strategy and Plan-L. Teacher models the use of strategy by thinking aloud based on the text

Focus	*Objectives*	*Teaching-learning procedure*
	the "P" in "Perdidos"	(Comparison-contrast- CC). - PRO: Children. - EFP: My school today and my parents' school. Joint teacher-students/mother-child development of first draft. Session 3: Text from previous session, strategy work in pairs. - PRO: pairs of students, a think-aloud, another feedback. Teacher supervision. - EFP: mother-student work together. The child thinks out loud, and the mother gives feedback. Public Reading (family/class) made text and displayed strategy used to encourage memorization.
Text editing process	Ensure that students acquire the skills necessary to properly edit text, spinning planning and editing. Encourage use of graphic organizer, "Child".	Session 4: Memory stimulation through guiding questions on the sequence of "Perdidos" and strategy PLAN-L. Explicit explanation and interactive editing using "Child" graphic organizer The instructor gives an example of its implementation based on the first text, highlighting the improvements resulting from its use. Session 5: Different applications according to their method of application. PRO: Work in pairs of students on a new text (CC: mammals and birds) to implement the PLAN-L strategy and the graphic organizer. Feedback from the instructor. EFP: mother-child work together on new text-duties (CC: fun today and our parents) using PLAN-L strategy and graphic organizer. Family feedback. Parent and child review the whole process.
Review process	To develop students' skills to deal with the review process, so that the text is of the highest possible quality.	Session 6: Understanding interactive strategy review process and REC. - PRO: Partners exchange the final text and review using the REC

Focus	*Objectives*	*Teaching-learning procedure*
	Facilitate learning strategy review "REC".	strategy, offering suggestions for improvement. Feedback from the teacher. - EFP: Mother and child apply the strategy to their joint review of the final text. They read the text to a relative before and after the review to be aware of their improvement. Review all processes and strategies to develop a text. Session 7: Development of an individual text CC (PRO: basketball, handball; EFP: Spanish families vs. families from other countries) with all materials. - PRO: Reading the text to large group and evaluation. - EFP: reading text in class (with the teacher's permission).
General essay writing process	Working in a joint process to compose texts encouraging use of any learned processes.	Session 8: The instructor goes over thinking aloud, and the text writing process (Perdidos: P: Plan-L, E: Editing, R: BER), using incomplete models that students have to detect and correct. Individual composition of a text, without teacher or material assistance. Checking with the help of the review of materials that they have followed all the steps, positive reinforcement, instructor corrects texts produced.

Table 4. Summary of the written composition instructional program implemented

According to the instructional pattern followed in the intervention program, the teaching procedure for written composition was based on the mnemonic and motivational aspect of the acronym Perdidos, on which we based the teaching of the various planning and text revision comparison-contrast strategies and introduces the use of a graphic organizer to guide the editing stage.

2.3.2 Parent training program

The parent training program consisted of six main foci, one per session which are detailed in Table 5, together with the methodology implemented.

The sessions maintained a structure that can divided into four interconnected stages. In the first stage, we started by remembering what was learned in previous sessions and

SESSION No.	MEETING	METHODOLOGY
Session 0	Participants and program presentation The importance of family performance Written composition: performance, everyday tasks.	PowerPoint presentation explaining instructor and program. Presentation of participants. Briefing and reasons to enroll in the training program. Reflections on the importance of the family in performance, in a large group. Explanation on the importance of writing. Set homework.
Session 1	Self-knowledge of writing skills Processes involved in written composition	Activating prior knowledge of the writing process working in a large group. Brainstorming. Instructor models writing process. Explanation of mnemonics of Perdidos. Presentation homework, simulation application. Role-playing instructor. Homework presentation and models of speech in your application (Perdidos and planning strategy PLAN-L).
Session 2	The school-family relationship. The text planning process	Discussion of advantages/disadvantages of cooperating with teachers. Discussed proposals of ways of effective and workable school involvement. Explicit explanation of the mnemonic strategy and Plan-L. Instructor models use of strategy, thinking aloud, in relation to the text the group is working on.
Session 3	The editing process	Activation of what was learnt regarding the writing using Perdidos and Plan -L strategies. Disaggregated presentation of graphic organizer to help in editing (Child). Instructor modeled thinking aloud, teaching children the complementary use of PLAN-L and Child organizer based on the acronym Perdidos. Sets of parents, role-playing, where mothers represent a parent and a child carrying out the teaching strategies. Instructor feedback. Setting homework, questions
Session 4	The importance of reinforcement. The review process	Exposure to different types of reinforcement, virtues and functions; personal use of large group analysis; every mother presents and focuses on the proper use of writing tasks. Activating prior knowledge and review of knowledge of writing strategy.

SESSION No.	MEETING	METHODOLOGY
		Practice in pairs of parents, role-playing, complete processing of a text with all the strategies. Instructor feedback. Homework presentation, questions.
Session 5	The potential of parental expectations General essay writing process.	Analysis of evidence of the potential for adult expectations to inform children's performance. Sharing of thoughts and opinions. Presentation of incomplete modeling and instructor implementation. Finding parents' mistakes, general review of the writing process. Presentation of homework, questions.
Session 6	Final evaluation	Program evaluation, suggestions for improvement, effects on children and writing. Exemplification of application of what was learnt to other types of texts.

Table 5. Synthesis program for parents

commenting on aspects of interest regarding its implementation at home. Immediately afterwards we activated parents' knowledge of the content that we were going to work on during that session and then proceeded to address it through various training activities. We generally used active learning methodologies, such as analysis and reflection on real life situations, practical assumptions or empirical information. We used group techniques such as guided discussions, collaborative work among peers, practicing together and reading and analyzing documents. Also, since we sought to build behavioral skills in parents who were offered conceptual and procedural knowledge in relation to higher order cognitive processes involved in writing, providing them with useful resources and strategies was important to enable them to transmit this knowledge to their children at home. We used techniques such as role-playing, behavioral rehearsal, cognitive modeling, thinking aloud, cognitive strategies to guide the writing process, and resources and tools such as graphic organizers and mnemonic pictures.

Finally, given the need to set the practical applications of what was learnt in the home, the different ways of application in the home were discussed and analyzed (which were related to writing assignments that teachers proposed as homework).

2.4 Procedure

We initially carried out the design of the approach and of the instructional program. Following this, we planned and developed the parent training program. This program was adapted from the Families Training School format. Once designed, we selected the potential schools to participate in the research project following the process described in the participants section.

Then, in the case of the schools that declined the inclusion of families (schools 1 and 2), we proceeded to send newsletters and open registration for the training school to all parents of students in grades 5 and 6. Only thirty four mothers enrolled, of which we only considered to be participants in the EFP group those whose attendance was over 95%, resulting in a total of 26. In these same schools, twenty-five additional families showed interest in the training initiative but had difficulty attending parent training. These were included in the PAD experimental group. As for the schools that had opted for the PRO group, we held a first meeting with the faculty on the program and all materials necessary for its implementation. Finally, we went to the fourth school to confirm their collaboration as a control group.

Immediately after this, we carried out a pre-assessment of all students, in their class groups, and proceeded to the implementation of the interventions. To this end, proper instructional groups, PRO and EFP were created. An expert not pertaining to the schools conducted the training for teachers and families respectively. In the case of the PRO group, the expert met with teachers on a weekly basis where the following meeting was prepared, and was also present in the classroom during most of their implementation to verify their correct application. As for the EFP group, we began with the development of parent training in which, in addition to training mothers to implement sessions with their children at home, they discussed their experiences in working cooperatively with their children. They raised the difficulties and doubts they were facing, allowing for the continuous evaluation of the appropriate application of the skills they were learning. The parent training sessions were held on school facilities during the second school term, fortnightly and lasting between 90 and 120 minutes, depending on the demands and availability of mothers.

This continuous monitoring of the process of training parents and teachers allowed us to evaluate the adequacy of the implementation of the intervention program.

We also held fortnightly meetings with all faculty in the PAD group, who were asked to set homework assignments based on the comparison-contrast text fixed by the researchers. They were also asked to organize them in a portfolio for each student for their timely collection. Thus, we ensured that the children in the PAD group also performed the proposed writing practices, but also, through periodic monitoring and verification of the portfolios (for all students), it was found that all participants had completed the tasks properly.

After the interventions we carried out an assessment of students. Then, within the following three months, we carried out a follow-up assessment to verify the stability of the improvements.

On completion of the fieldwork the expert staff carried out the correction of the assessment tests. Finally, we computerized the data for statistical analysis and obtained the results presented in the next section.

3. Results

The results presented were obtained by statistical treatment of data with the Statistical Package for the Social Sciences (SPSS) version 18.0.

First, we conducted an analysis of variance with repeat measures of 4 x 2 taking the repeated measure time (pre/post-test) as inter-subjects factor and the experimental group students belonged to (EFP, PRO, PAD, CO) as inter-factor.

Second, we conducted an analysis of the measures repeated 3 X 3. We considered the group as intersubject factor (PRO, EFP and PAD, as the CO group was not evaluated after three months due to lack of availability) and as intra-subject factor the repeated pretest, posttest and follow-up measures.

3.1 Effects of interventions on written composition performance

We first present the results relating to products written on the cognitive processes activated in the drafting of the texts.

Product Measures

Multivariate contrasts of variance showed statistically significant results and a large size effect for all measures based on the text and the reader, as shown in Table 6.

Between-effects tests show statistically significant differences in text-based indicators of productivity [$F_{(3, 108)} = 7.169$, $p < .001$, $\eta^2 = .166$], referential coherence [$F_{(3, 108)} = 11.241$, $p < .001$, $\eta^2 = .238$], relational coherence [$F_{(3, 108)} = 24.245$, $p < .001$, $\eta^2 = .402$], overall consistency [$F_{(3, 108)} = 18\ 506$, $p < .001$, $\eta^2 = .340$], other measures of consistency [$F_{(3, 108)} = 11.927$, $p < .001$, $\eta^2 = .249$] and overall structure [$F_{(3, 108)} = 38\ 367$, $p < .001$, $\eta^2 = .516$], as well as structure [$F_{(3, 108)} = 40.055$, $p < .001$, $\eta^2 = .527$], consistency [$F_{(3, 108)} = 14701$, $p < .001$, $\eta^2 = .290$], quality reader-based indicators [$F_{(3, 108)} = 11.606$, $p < .001$, $\eta^2 = .244$] and the resulting total [$F_{(3, 108)} = 22.842$, $p < .001$, $\eta^2 = .388$] in all cases, with a large size effect.

Post-hoc analyses have shown statistically significant changes across groups following the implementation of different instructional methods. The data is shown in the Table 7.

This analysis shows a significant improvement in all text-based measures and in the reader of the groups who developed the specific interventions for the EFP and PRO groups, compared to CO and PAD groups.

Three months after the implementation of the various forms of intervention, we detected that in groups where actual instruction had taken place there was a partial maintenance of the gains resulting from the interventions. In these cases, as in the case of text-based measures, although there were significant decreases between the post-test and follow-up in overall coherence and other consistency items, there was significant improvement vis-à-vis the initial situation (pretest). Regarding structure, the gains following the implementation of the different interventions were almost entirely maintained within the three months following the intervention. As for reader-based measures, we detected maintenance and even further development compared to the post-test.

The application of learning to other types of text was also corroborated. In this case, we saw a considerable improvement in the follow-up compared to the pretest ($p = <.001$) in the EFP and PRO groups, compared to the PAD group in the *other coherence* text-based measures (pretest comparison-contrast: $M_{PRO} = 1.2$, $M_{EFP} = 0.9$ and $M_{PAD} = 1.2$; coherent storyline: $M_{PRO} = 2.2$, $M_{EFP} = 2.8$ and $M_{PAD} = 1.1$) and *structure* (pretest: $M_{PRO} = 1.1$, $M_{EFP} = 1.1$ and $M_{PAD} = 1.3$;

Variables	EFP (n = 26)				PRO (n = 35)				PAD (n = 25)				CO (n =26)				Time (pre-post)			Time x Group x		
	M *pre*	*SD* *Pre*	*M* *post*	*SD* *Post*	*M* *pre*	*SD* *pre*	*M* *post*	*SD* *post*	*M* *pre*	*SD* *pre*	*M* *post*	*SD* *post*	*M* *pre*	*SD* *pre*	*M* *post*	*SD* *post*	$F_{(1, 108)}$	*p*	η^2	$F_{(3, 108)}$	*p*	η^2
Text-based measures																						
Productivity	74.85	44.31	91.96	21.04	72.86	23.63	90.68	31.42	63.68	28.36	66.88	27.13	76.19	21.37	49.46	22.53	.621	.432	.006	.813	<.001	.187
C. referential	6.42	4.95	13.04	4.10	8.11	5.32	12.11	6.18	5.04	3.42	7.48	5.41	6.73	4.73	4.04	3.96	18.82	<.001	.148	10.33	<.001	.223
C. relational	5.85	4.04	12.31	2.90	5.43	2.31	12.03	5.22	4.92	2.73	5.64	3.30	4.92	2.56	3.77	2.55	54.11	<.001	.334	21.73	<.001	.376
C. total	12.27	8.31	25.35	6.34	13.54	6.69	24.14	10.88	9.96	5.21	13.12	7.84	11.65	6.74	7.81	6.13	38.87	<.001	.265	16.98	<.001	.321
Others C.	0.96	0.77	3.08	0.84	1.20	0.83	2.71	0.89	1.20	1.04	1.52	1.08	1.38	0.85	0.69	0.88	62.32	<.001	.366	35.85	<.001	.499
Structure	1.15	0.46	2.81	0.40	1.14	0.43	2.69	0.53	1.28	0.54	1.24	0.52	1.19	0.40	1.23	0.51	163	<.001	.601	54.59	<.001	.603
Reader-based measures																						
Structure	.69	.61	3.08	0.89	0.85	0.49	2.63	1.06	0.68	0.62	0.92	0.75	0.73	0.45	0.46	0.58	126.4	<.001	.539	45.33	<.001	.557
Coherence	1.23	0.71	2.96	0.87	1.20	0.67	2.63	0.87	1.2	0.95	1.36	0.95	1.30	0.61	1	0.74	60.88	<.001	.360	25.54	<.001	.415
Quality	1.57	0.85	3.38	0.94	2.08	0.61	3.34	1.02	1.76	0.92	2	0.76	2.11	0.58	1.69	0.83	56.22	<.001	.342	26.38	<.001	.423
Total	3.53	2	9.81	2.26	4.22	1.68	8.97	2.66	3.84	2.56	4.44	2.25	4.15	1.43	3.27	1.97	124.44	<.001	.535	48.17	<.001	.572

Table 6. Results of repeated factorial measures designed 4 x 2, measures of written product

flow of argument: M_{PRO} = 2.3, M_{EFP} = 2.8 and M_{PAD} = 1.5) and in all the reader-based measures including the total (pretest comparison-contrast: M_{PRO} = 4.2, M_{EFP}=.4 and M_{PAD} = 3.8; flow of argument: M_{PRO} = 6.7, M_{EFP} = 8.7 and M_{PAD} = 3.2).

Variables	*EFP vs. PRO*	*EFP vs. CO*	*EFP vs. PAD*	*PRO vs. CO*	*PRO vs. PAD*	*PAD vs. CO*
Text-based measures						
Productivity	n.s.	.008	.028	.009	.035	n.s.
C. Referential	n.s.	.001	.017	<.001	.003	n.s.
C. Relational	n.s.	<.001	<.001	<.001	<.001	n.s.
C. total	n.s.	<.001	<.001	<.001	<.001	n.s.
Others C.	n.s.	<.001	.017	<.001	.022	n.s.
Structure	n.s.	<.001	<.001	<.001	<.001	n.s.
Reader-based measures						
Structure	n.s.	<.001	<.001	<.001	<.001	n.s.
Coherence	n.s.	<.001	<.001	<.001	.003	n.s.
Quality	n.s.	.024	.018	<.001	<.001	n.s.
Total	n.s.	<.001	<.001	<.001	<.001	n.s.

Table 7. Post-hoc contrasts in the textual product measures

Process measures

Following the process measures, multivariate contrasts and inter-subject effects tests show statistically significant differences in overall task frequency [$F_{(3, 108)}$ = 3.409, p = .020, η^2=.087], frequency of making an outline or draft [$F_{(3, 108)}$ = 4.250, p = .007, η^2 = .106] and percentage of time thinking about ideas [$F_{(3, 108)}$ = 4141, p = .008, η^2 = .103].

The post-hoc analysis showed a significant improvement in the groups that received explicit instruction in writing processes (EFP y PRO) compared to the CO and PAD. Thus, the EFP group increased the total task frequency compared to CO (p = .022; pretest: M_{EFP} = 15.7 and M_{CO} = 19.7; post-test: M_{EFP} = 25.8 and M_{CO} = 14.2) and in time preparing a draft (pretest: M_{EFP}= 0.07 and M_{CO} = 2.1; post-test: M_{EFP} = 5.5 and M_{CO} = 0.3). This general increase in the time spent drafting was also significant among the PRO and CO groups (p=.032; pretest: M_{PRO} = 0 and M_{CO} = 2.1; post-test: M_{PRO} = 6.3 and M_{CO} = 0.3).

3.2 Effects of interventions on the motivational and contextual elements

Regarding attitudes, multivariate contrasts do not show statistically significant results.

When looking at attributions, on the other hand, the results were statistically significant regarding time-intervention interaction in the failure-effort attributional pattern [F (3, 108)=3.545, p = .017; η^2 = .090]. The inter-subject effects test was also statistically significant [F (3, 108) = 2.800, p =.044, η^2 = .073] and post-hoc contrasts showed differences very close to statistical significance between EFP and PAD groups (p = .059), both showing a decrease from pretest to post-test (pretest, M_{EFP}= 11.40 vs. M_{PAD}= 9.04; post-test, M_{EFP} = 9.96 vs. M_{PAD}=. 80).

As for self-efficacy, multivariate contrasts show statistically significant results in the time-treatment interaction in both areas – mechanical [F (3, 108) = 3.453, p = .019, η^2 = .088] and fundamental [F (3, 108) = 6.560, p = <.001, η^2 = .154] - with medium and large size effects,

respectively. However, the pre/post differences in interaction with the intervention in the trial of inter-subject effects was not statistically significant for mechanical [F (3, 108) = 1.479, p = .224, η^2 = .039] nor fundamental indicators [F (3, 108) = 2.330, p = .078, η^2 = .061] so we chose to individually analyze some items of interest. In this case, significant differences were found in item number 11 - organization of ideas into paragraphs [F (3, 108) = 6.277, p = .001, η^2=.148]. The inter-subject effects test confirmed this [F (3, 108) = 4.329, p = .006, η^2 = .107] and the post-hoc indicated that the only differences were between the CO and the EFP (p=.032), PAD (p = .043) and PRO (p = .035) groups. These groups somewhat improved their writing practices in all measures (pretest, Mco = 60.1, M_{EFP} = 62.4, M_{PAD} = 70.7 y M_{PRO} = 67.4; post-test, Mco = 47.7, M_{EFP} = 84.1, M_{PAD} = 74.7 y M_{PRO} = 76.03).

Three months after completion of the intervention, in general there have not been statistically significant changes in any of the motivational-emotional elements.

3.2.1 Family opinions: Implication and writing practice

This time we designed 2x2 repeated measures because only PAD and EFP students completed this scale. Thus, the intra-subject factor considered as the repeated measure was the pre/post-test and the inter-subject factor was the experimental group students belonged to.

Multivariate contrasts showed no statistically significant results for any of the FAOP-PRAES variables. They did, however, for three IM FAOP - Total: home involvement [F (1.47)=4.529, p = .039, η^2 = .088], school involvement [F (1.47) = 4.529, p = .039, η^2 = .088] and total involvement [F (1,47) = 8.720, p = .005, η^2 = .156].

The intersubject effects tests show statistically significant differences in indicators of home involvement [F (1.47) = 3.985, p = .052, η^2 = .078], in school [F (1.47) = 8.427, p = .006, η^2=.152] and [F (1.47) = 6.405, p = .015, η^2 = .120], with medium/large size effects. Such group differences favor the EFP group, as evidenced in Figure 1.

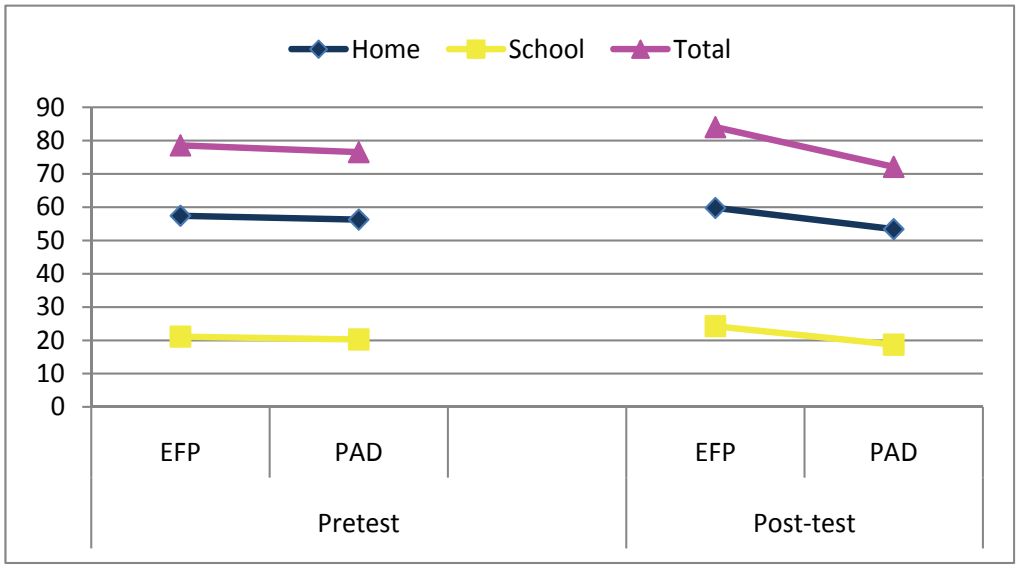

Fig. 1. Differences in FAOP-IM measures between groups at the time of evaluation

4. Discussion and conclusions

The new European education guidelines establish the need to stimulate the development of students' skills (Llach & Alsina, 2009; Fernández, 2007; Muñoz, 2008) and stress the importance of compulsory education specifically in the promotion of communicative competence in its oral reading and writing forms (Pérez & Zayas, 2007; LOE, 2006). Nevertheless, it is common for formal education to address the written aspect of this competence in a less profound manner than the other dimensions. The prevailing psycholinguistic teaching trends focus on aspects with lower cognitive load, at the expense of communicative approaches (Clemente, Ramínez, & Sanchez, 2010; Fabregat, 2009; Gilbert & Graham, 2010; Lecuona, et al., 2003). The other main context of children's learning - the family – which could also help optimize the student's written communication skills (Axford, 2007; Cutler & Graham, 2008; Feiler, 2003; Jones & Christensen, 1999; Rasinki & Padaka, 2009; Reyes, et al., 2007; Saint Laurent & Giasson, 2005), also shows little interest in developing them. Thus, the consideration that composing written texts is a complex process that requires instruction and practice set in context and motivation to promote and facilitate its assimilation (de Caso & García, 2006a; de Caso & García, 2006b) led to our interest in finding whether the teaching of written composition through psycho-communicative methods in different educational contexts could redress the imbalance and fill the gaps resulting from the incomplete traditional educational approach. Based on this perspective, we developed this research, which sought to test the differential effectiveness of a writing intervention program, implemented in two different contexts (school and home) and by two different educational figures (parents-teachers), to optimize students' writing competence. We also sought to determine families' ability to carry out this type of instruction and indirectly validate the effectiveness of a training program designed and implemented to prepare them for this. The results obtained in the course of this research project lead us to several relevant conclusions.

First, the instructional program designed to address the teaching of written composition focused on the product and process, was highly effective in promoting the improvement of the quality of pupils' written texts. This was as expected, considering that the effectiveness of these interventions had been tested by this research team in previous studies (Arias & García, 2007; García, Fidalgo, & Robledo, 2010; Fidalgo, García, Torrance, & Robledo, 2009; Fidalgo, Torrance, & García, 2008). However, this study's main contribution is the finding that the context and the figures of implementation produce no differential effect on program effectiveness. Both family members at home (EFP group) and faculty in the classroom (PRO group) successfully carried out instructional sessions with children, passing on knowledge and methods useful to significantly enhance their writing proficiency when compared to control groups (CO and PAD). Thus, in addition to ratifying the internal efficiency of the program, we can confirm the potential of both environments to optimize the learning of writing, as well as similarities in the teaching capacities of teachers and parents. In both cases, the teaching carried out resulted in students producing better structured, more consistent and higher quality texts. Moreover, in both cases these improvements were maintained over time and, most noticeably, were applied across different text typologies.

Families, despite not being teaching professionals with relevant training have specific advantages (interest in their children's education, availability, direct contact with the child, bonding, etc.). They can therefore contribute very effectively to the optimization of writing,

as the few previous localized empirical studies in this area had shown, although these mostly focused on initial stimulation or in recovering less complex elements from long-term memory (Axford, 2007; Feiler, 2003; Saint Lauren & Giasson, 2005) and did not systematically address higher-order processes in older children, which was the focus of our work.

This intervention program, which addressed the cognitive aspect specifically, we can confirm encouraged in both groups of students subjected to systematic instruction (EFP and PRO) the efficient activation of the psychological processes involved in written composition and was conducive to greater efficiency in this task, although it had a greater impact on the planning process specifically. This again confirms the potential for parents, not only to promote ways of helping their children improve their textual production, but also for advising them on the use of cognitive strategies that enable them to effectively activate the higher cognitive processes involved in writing.

In terms of motivational elements, we have to acknowledge that the program did not produce statistically significant changes in attitudes toward writing in any context, nor has it stimulated more adaptive attributional patterns. However, in the latter case, both peer groups (EFP and PRO) show a positive trend apparent in the increase of attributions to internal factors (effort) and the decrease in external factors (luck). This is possibly due to the stability of these personality constructs and the resulting difficulty in modifying them in a few sessions. The difficulty of optimizing them has been found in specific interventions aimed at motivation for writing (Garcia & de Caso, 2006). Moreover, with respect to efficacy, although there was an increase in the EFP and PRO groups compared with the PAD and CO groups, neither reached statistical significance. Perhaps this result is a consequence of the evolutionary trend that the development of self-efficacy follows, which is exemplified by the overestimation of students' writing ability in the initial stages of education, such as Primary (Pajares, Valiente, & Cheong, 2006).

Thirdly, as to whether increasing parental involvement in homework is sufficient to improve children's outcomes or whether prior training is required to enable them to do so, the results conclude that training contributes to a significantly higher level of success than just natural collaboration, as evidenced by the comparison of the EFP and PAD groups.

As for the parent training program, it has proven very effective and has managed to prepare parents to enhance the development of their children's written composition, not only by participating as role models or providing materials and resources, but also specifically instructing them in the higher-order cognitive processes that make up that skill through the use of homework.

Despite the limitations of this study we can confirm its positive results. The limitations are mainly related to low family involvement and high parents and teacher motivation to engage in instruction, which might account for the degree of positive effect of the program in encouraging the review process or stimulating motivational elements. Thus, the effectiveness of the intervention program to enhance improvements in students' written products in the third cycle of Primary education, its stability and application to other forms of writing, as well as to encourage the activation of the mental processes responsible for efficient text processing, especially in regard to planning, are all confirmed. Similarly, we conclude that the family context, and parents in particular, perfectly complement the teaching of writing. Their potential to stimulate their children's writing competence through

help with homework was confirmed, while we found that for this to be truly effective it is necessary to provide prior systematic training. In this case we chose to create a parent training program, which has proven effective. Therefore, based on our research findings and considering that writing is a complex learning process requiring high doses of motivation and that all environmental stimulation appropriate to the characteristics of child favors its assimilation, we confirm the need for two elements. Firstly, to continue developing teaching schemes focused on this competence based on psychological and communicative approaches. Secondly, to increase the cooperation between school and family, uniting their efforts to improve educational conditions and to enable the students' optimal development, which will enable them to successfully adapt to the growing social demands placed on them (Torío, 2004).

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Correspondence should be addressed to Departamento de Psicología, Sociología y Filosofía. Área Psicología Evolutiva y de la Educación. Campus de Vegazana s/n, 24071 – León, Spain. Phone: +34-987291041 (university); +34-987222118 (home); +34-652817871 (cell); Fax: +34-987291035 (university). E-mail: jn.garcia@unileon.es.

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8

The Family Environment of Students with Learning Disabilities and ADHD

Patricia Robledo-Ramón and Jesús-Nicasio García-Sánchez
University of León
Spain

1. Introduction

In recent decades there has been a proliferation of studies on the empirical aspect of the family influence on school development of children, and trends have emerged which analyze the effects of household structural and dynamic variables on student learning (Xia, 2010). Results show that family socioeconomic level (Dearing, McCartney & Taylor, 2009; Gil, 2011, Liu & Lu, 2008; Park, 2008), its typology characteristics (Burnett & Farkas, 2008; Gennetian, 2005), a suitable home environment (Barkauskiene, 2009; Bodovski & Youn, 2010; Campbell & Berne, 2007; Ghazarian & Buehler, 2010; Khan, Haynes, Armstrong, & Ronher, 2010) and parents' positive outlook on education and their active involvement in it (Flouri & Buchanan, 2004; Phillipson, 2010; Powell, Son, File, & San Juan, 2010; Regner, Loose, & Dumas, 2009; Sirvani, 2007; Mo & Singh, 2008) are factors affecting the academic development of the vast majority of children. This influence is even more relevant for pupils with complex problems that can affect their ability to learn, such as specific learning disabilities (hereafter LD) or attention deficit disorder with/without hyperactivity (ADHD). Such pupils usually have special educational needs which require specific attention in all microenvironments in which education takes place, including the family (Snowling, Muter, & Carroll, 2007; Shur-Fen , 2007).

LD is a concept that encompasses a heterogeneous group of disorders that manifest in significant difficulties in understanding, speaking, reading, writing, reasoning, and mathematical ability, presumably of biological origin and related to the functioning of the central nervous system (Kavale & Forness, 2000; Lerner & Kline, 2006). As for ADHD, it is a neuropsychological disorder that is characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity that affects the social, academic and/or work life areas of the sufferer's life (Frazier, Youngstron , Glutimg, Watkins, & Marley, 2007; Jakobson & Kikas, 2007). Therefore, it is maintained that ADHD and LD are disorders of biological-genetic origin which are intrinsic to the individual. However, there has now been a shift in focus towards environmental variables, including the family, which are it is claimed can enhance or minimize the negative effects of these difficulties and, therefore, must be thoroughly examined and taken into consideration (Pheula, Rohde, & Schmitz, 2011; Snowling, et al. 2007; Shur-Fen, 2007).

The research available on learning and environmental conditions confirms the importance of adequate family functioning, as well as the existence of a satisfactory home environment to

the children's correct academic development (Barkauskiene, 2009; Campbell & Verna, 2007). Specifically, studies suggest that pupils whose families help them and functionally interact with them, use effective educational styles and where there are few arguments and low levels of stress, do better at school and learn more easily (Bodovski & Youn, 2010; Guoliang, Zhang , & Yan, 2005; Halawah, 2006; Heiman, Zinck, & Heath, 2008). However, in troubled or dysfunctional families subjects receive fewer stimulation and of lower quality, and their academic development is therefore slower (Ghazarian & Buehler, 2010; Sheppard, 2005). These factors can also be risk factors present in homes where there are children with LD or ADHD (Dyson, 2010; Foley, 2011). Usually in these pupils' homes there is a level of stress which impairs family functioning and the development of the person with the problem (Biederman et al. 1996; Hishinuma, 2000; O'Connor, McConkey, & Hartop, 2005; Strnadová, 2006, Trainor 2005). Additionally, parents' educational styles tend to be very directive and very ineffective (Johnston & Mash, 2001; Presentation, Pinto, Melia, & Miranda, 2009; Schroeder & Kelley, 2009). However, results are inconclusive. Some studies even fail to find a difference in the climate of families of children with LD and families of pupils without disabilities (Dyson, 2010; Heiman & Berger, 2008). Therefore, it is necessary to undertake further studies in this area.

Other factors that influence children's learning are attitudes, perceptions and parental expectations regarding their academic performance. Apparently, parents' positive attitude towards their children and family support increase pupils' confidence in their abilities and awakens the child's interest in satisfying and meeting parents' expectations (Campbell & Verna, 2007; Figuera, Daria, & Forner, 2003). However, in families where there are children with deficits parents' negative attitudes towards their children tend to predominate. In such families there is usually fewer expression of feelings and emotions, and adults tend to provide negative feedback to their children on their behavior and ability, criticize them or underestimate their abilities, and show pessimistic expectations about their academic future (Dyson, 2010; Goldstein, Harvey, & Friedman, 2007; Stoll, 2000). These behaviors may help the child forge a negative self-image, thereby damaging the development of her/his personality (Taylor, Chadwick, Heptinstall, & Danckaerts, 1996). Given the importance of these elements, further studies are needed to verify these facts in the cases of LD and ADHD.

Another important aspect for pupils' academic success is the cooperation between their families and schools (Powell, et al., 2010). In this regard, it has been shown that parental involvement in education stimulates pupils' motivation toward academic work, their commitment to school and their perception of competence, control and efficiency (González, Willems, & Doan, 2005; Urdan, Solek, Schoenfelder, & 2007; Mo & Singh, 2008). Thus, parental involvement promotes children's proper academic development in general and is therefore of special interest in the case of LD or ADHD. In these cases, coordinated academic support between family and school, and an adequate level of family collaboration on academic work are factors that promote optimal learning (Martinez & Alvarez, 2005). In this case, there is also a degree of correlation between parental satisfaction and educational involvement (Gershwin, Singer, & Draper, 2008; Seitsinger, Felner, Brand, & Burns, 2008; Spann, Kohler, & Soenksen, 2003). It is, however, necessary to continue to analyze these interactions in the case of LD and ADHD.

There are some important controversies in research findings regarding the parents' offer of stimulating learning environments at home. While some studies found no difference

between families of children with LD or ADHD and children with standard performance (Rogers, Weiner, Marton, & Tannock, 2009; Sanchez García, Jara, & Cuartero, 2011), the majority indicate that most households of pupils with problems focus on enhancing the personal growth of family members and provide more stimulation and support for academic tasks (Huston & Rosenkrantz, 2005). In the latter cases, however, some studies indicate that helping children excessively on a daily basis can relate to high levels of parental protection (Tarleton & Ward, 2005), which, coupled with inadequate management of conflict of school issues contributes to parents developing parental anxiety and dissatisfaction. This in turn affects parents' ability to interact sensitively regarding the demands of the child and can lead to developing an intrusive and ineffective educational collaboration (Hedor, Anneren, & Wikblad, 2002). Whatever the case, it is necessary to further study this aspect, as the specific findings for LD and ADHD are not yet final.

Finally, structural elements such as low family income, parents' low level of education or a high number of siblings are risk factors for school failure (James, 2004; Marks, 2006). Some studies have shown that pupils with LD or ADHD disproportionately come from poor family backgrounds who do not support their education (Rydell, 2010), although more research is needed to enable a full understanding of these environmental influences on learning for children with LD or ADHD (Jordan & Levine, 2009; Xia, 2010).

In summary, to this day the real impact of each family contextual factor on the academic performance of children with LD or ADHD remains unknown. In addition, the existing studies present some limitations related to the samples, due to only with involving a parent or child, or the use of subjective assessment instruments (Antshel & Joseph, 2006; Murray & Greenberg, 2006; Smith & Adams, 2006, Trainor 2005). Therefore, there is a need for new studies that overcome these limitations and shed light on such a seldom studied field as the relationship of family and academic development of pupils to LD or ADHD. This is precisely the purpose of the present study.

The first objective of this study is to analyze the differences in family dynamics and structural variables in relation to the pupil's typological characteristics. To do this we compare families in which there are children with LD or ADHD and families of pupils with standard academic performance (normal achievement, NA).

The second objective is to compare the parents' views versus the children's views in each of the experimental groups (families of pupils with LD with ADHD or NA) to identify whether the perceptions of environmental variables differ from parent to child and if they do so more in some groups than others.

2. Methodology

2.1 Participants

Participants were 87 families of pupils enrolled in four Spanish private and state schools. This sample was drawn from a larger sample of 610 families studied. The selection process consisted of us looking at the smallest group (ADHD, n = 29) and then selecting and additional 29 cases of families of pupils with LD and 29 families of children with NA, taking several criteria into account, regarding the characteristics of the children and their families .

The first intersample balance criterion was pupils' intellectual capacity. We considered necessary for all children in our sample to have an IQ within the normal range. In this case it was confirmed that all pupils had an IQ of 80 or over.

The second pairing criterion was the school year, since this study that addresses issues related to learning, such as performance, and this factor is closely related to the year of study or grade. This item has a total balance in the distribution of participants to experimental groups as reflected by the absence of statistically significant differences between groups ($\chi^2 = .000$, $p = 1$). In addition, consideration of the educational level has enabled the matching of groups according to children's age ($\chi^2 = 19.989$, $p = .530$).

We then looked at the family elements in order to ensure the maximum similarity between the groups and verified that no statistically significant differences existed between groups in any of the factors analyzed, as evidenced by Chi-square statistic: father's age ($\chi2 = 45.981$, $p = 0.238$), mother's age ($\chi2 = 47.845$, $p = 0.131$) father's employment status ($\chi2 = 5965$, $p = 0.427$), mother's employment status ($\chi2 = 2413$, $p = .660$), parents' marital status ($\chi2 = 3105$, $p = 0.540$), number of people living in the home ($\chi2 = 11,586$, $p = 0.314$) and square meters of housing ($\chi2 = 71.188$, $p = 0.251$).

Regarding the criteria for inclusion of pupils in each sample group according to their types, several elements were taken into account.

To identify pupils with LD we used internationally established criteria (American Psychiatric Association, APA, 2002; National Joint Committee of Learning Disabilities - NJCLD 1997).

We first established the need for a diagnosis of a specific delay of at least two years and two standard deviations below the average yield from the normative age group and level of education. To this end, we conducted systematic interviews with teachers, which allowed us to identify pupils who had poor performance in writing, since, as already noted, this study's area of interest lies essentially in writing learning disabilities. We also carried out a direct assessment of pupil's writing competence. All the children, led by a researcher and in their own class groups, conducted an essay writing task with a free theme and length. The essays were subsequently corrected in a comprehensive manner by experienced and highly qualified professionals specifically trained for this purpose, using the text correction protocol developed by the research team headed by J. N. García. The results of each pupil were matched to the scale of regulated scores produced by the researchers, thereby assigning each child a position in that scale. This allowed us to identify those pupils whose writing performance was two standard deviations below the mean expected based on age and/or academic year.

Secondly, we required normal IQ in pupils, so we asked all children to perform Catell and Catell's (2001) G Factor test, which provides an overall intelligence score and the possibility of a collective application.

International standards for the diagnosis of learning disabilities also explicitly require the absence of any other developmental disorders which could explain the limitations associated with the field analyzed and to receive standardized and adequate schooling. Therefore, in our interviews with teachers we also verified these aspects, confirming that

pupils with LD did not have any other documented developmental disorder and received proper schooling.

The assessment procedure for the identification of writing disabilities was applied to all the pupils sampled, which also allowed us to identify children who make up the NA group. Faculty interviews were also used to rule out types of learning disabilities (reading or math) in these children, thus confirming that their overall performance in different areas was normal. Moreover, the fact that these pupils were classmates of children with LD meant both groups had received the same instruction in written composition.

The ADHD group was made up entirely of pupils with neurological and psychological clinical diagnoses, performed by multidisciplinary teams within the area of pediatric neurology at La Fe hospital (Valencia), Hospital de León (León) and the Universities of León and Valencia. However, in order to confirm the diagnosis we verified that all the children met the following criteria: 1) clinical diagnosis of combined ADHD subtype according to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition, revised (American Psychiatric Association, 2003) and agreement between parents and teachers about the presence of at least six symptoms of inattention and at least six symptoms of hyperactivity/impulsivity; 2) the duration of symptoms exceeded a year, 3) the problem had appeared before age 7; 4) not suffering psychosis, neurological damage, epilepsy or sensory deficit. In addition, subjects T scored over sixty-three in scales of hyperactivity, inattention and total index of the Conners test, in its parental (CPTRS-R: S) and teacher versions (CTRS-R: S) (Conners, 2001).

The family participants were the mothers in 57.7% of cases, only 6.9% were the fathers, although 33% of the cases involved both parents (in 2.4% of cases the family participant did not indicated her/his relation to the pupil). The average age of the father figures was 44.5 years while that of the mother figures was 42.33 years. Regarding their education, in the case of families of children with NA, 10% of the parents had only reached primary studies, 56% secondary studies and 33% of parents had university studies. For families of pupils with LD, 32% of the families had primary studies, 64% secondary and 4% university studies. Finally, the parents of children with ADHD had reached 40% primary, 34% secondary and 26% university studies.

2.2 Instruments

In order to assess how parents and children perceive the different dimensions of the family educational context, we used the parental (FAOP-PA Robledo & Garcia, 2007) and the children's version of the Family Opinions Instrument (FAOP-HI, Robledo & Garcia, in press). This instrument has suitable psychometric properties in termsn of validity and reliability, with Cronbach's Alpha .921 for children and .929 for parents and includes different levels, as detailed in Table 1.

The set of questions also allows us to know the aspirations and expectations of parents and/or children regarding the educational and vocational future of children.

Similarly, the Personal Information section, allows us to look into the structural dimension of the home.

Scale	*Construct assessed*	*Dimensions*
Family opinions: satisfaction with education (FAOP-SE)	Satisfaction with education received, the school and its professionals (parents only)	- Communication and training: teacher-family communication and effective teacher training. - Attention to pupils and confidence: teachers' level of attention to children's needs and trust in and overall satisfaction with the teaching professionals. - Difficulties: interest of teachers in children's learning and having the training to deal with these difficulties. - Attitudes of teachers: respect, availability, friendliness and approachability of the faculty. - Collaboration and individual attention: degree of individual attention given to pupils and teachers' collaborative attitudes.
Family opinions: parental involvement in education (FAOP- IM)	Parental involvement in education (parents' and children's perception).	- Family involvement dimension: Family's motivation and support towards schooling. Collaboration and stimulation at home: stimulating behaviors and the promotion of learning environments within the home or at the family's initiative. - School involvement dimension: School-based collaboration, activities and behaviors that parents do in school with children, professionals, other families. Communication with school: contact between parents and teachers.
Family opinions: writing practice (FAOP-PRAES)	Parental role in teaching and motivation of written communication skills (parents' and children's perception).	- Practice reinforcing motivation: motivation to write by parents. - Practice effectiveness: parental ability to help in writing. - Practice psychological processes: parental involvement in teaching writing by helping with homework and with mechanical and higher-order aspects. - Practice writing stimulation: stimulation to write using everyday tasks, and specific models and materials.
Family opinions: home (FAOP-HOME)	Provision of a household with characteristics conducive to learning: resources, enhancing autonomy and maturity,	- Encouraging Learning Materials: home offer of stimulating materials and spaces for academic development. - Acceptance-love: acceptance, positive interactions and positive management of the child's feelings and behaviors. - Rejection-hostility: Rejection, hostility, anger, bitterness, resentment or lack parental interest in their children.

Scale	*Construct assessed*	*Dimensions*
	parenting styles, emotional control (parents' and children's perception).	- Educational styles: permissive, authoritarian or democratic, used by parents to exert control over their children. - Encouraging children's self-reliance, maturity and responsibility.
Family opinions: atmosphere (FAOP-FES)	Social and environmental characteristics of families (parents' and children's perception).	- Relationship Dimension: Cohesion, Expressiveness and Conflict - Personal Growth Dimension: Independence, Performance orientation, Cultural-intellectual orientation and Leisure-oriented activities. - System Maintenance dimension, stability: Organization and Control

Table 1. Description of the scales within FAOP

2.3 Design

We used two factorial designs, a 3×1 (type) and a 2×1 (role). The former to compare the three groups of families (LD, ADHD or NA) on the different dependent variables (FAOP). In the latter, for each of the groups considered, we compared parents' perception with those of their children.

2.4 Procedure

We requested the cooperation and consent of the management teams of each school and the teachers were informed of the object of the research and the nature of the help required from them. We asked them to answer questions about the children in order to classify them according to our typology and discard several problematic situations. Similarly, they had to enable researchers to carry out the evaluation sessions with pupils in which they underwent, once families' informed consent was obtained, all the relevant assessments. These assessments were carried out in groups over two sessions of one hour each. They also had to hand the FAOP questionnaire to families, along with a letter explaining the study and requesting their participation and that of their children, and be responsible for its subsequent collection. To ensure parents really filled in the scales and that they consented to their children's the evaluation they were explicitly asked to sign the questionnaire or return it in person.

Once the field work was completed, we corrected the assessments and computerized the results. We then proceeded to select the subsample which we used to perform the statistical analysis. In order to do this we used the Statistical Package for the Social Sciences (SPSS) version 17.0. Its results are presented below.

3. Results

In order to address our first objective (typology) we considered the type of pupil (LD, NA and ADHD) as a fixed factor, addressing the family's opinion as a whole, based on the

individual point of view of parents and children, although we only present the results relating to the general family view as we consider it to be the most representative.

To address the second objective (role), after selecting each target group (families with LD, NA and ADHD), we introduced being a parent or a child as an independent variable.

In both cases we included the dynamic family dimensions obtained through the FAOP as dependent variables, but in the first case we also considered structural factors (parental education and family size). In this first case, the univariate analysis of variance (ANOVA) performed to determine if relationships between the typological characteristics of pupils (NA, LD and ADHD) and household structural variables (educational level and family size) exist show the existence of statistically significant or close to significant differences regarding both the mother's (F=3.240, p=.045) and the father's level of instruction (F=2.608, p=0.081), as well as for the number of children (F=5.401, p=.006). Post-hoc contrasts confirmed results close to statistical significance in the educational level of fathers (p=0.093) and mothers (p=.086) of pupils NA (Mfather=3.32; Mmother=3.64) compared to children with LD (Mfather=2.4; Mmother=2.79). As for family size, data indicate that families of children with ADHD are larger than the other two groups (M_{ADHD}=2.22 vs. M_{NA}=1.69, p = .011 & M_{LD} = 1.76, p=.033).

3.1 Typology of children

Multivariate contrasts indicate high and statistically significant results, with a very large effect size [F (48, 74) = 2.655, p <.001, η2 = .633]. Meanwhile, tests of inter-subject effects show statistically significant results with effect sizes ranging from medium to large for 41.93% of the variables (see Table 2 for details).

VARIABLES	*NA*		*LD*		*ADHD*				
	M	*ST*	*M*	*ST*	*M*	*ST*	*F*	*p*	η^2
Communication with the school	31,36	5,93	30,2	5,73	34,5	4,9	3,451	,038	,103
Involvement in school	63,5	8,58	60,6	10,82	69,5	10,56	4,283	,018	,125
Efficacy in writing instruction	37,1	4,32	33,1	5,12	34,62	5,66	3,446	,038	,103
Stimulation towards writing	25,64	3,52	23,55	3,63	22,3	3,07	5,017	,010	,143
Rejection	31,8	6,24	34,2	7,65	38,6	7,56	4,894	,011	,140
Expressiveness	11,9	2,28	10,1	2,72	10,05	2,59	3,666	,031	,109
Conflict	13	2,81	14,1	2,22	11,3	2,63	5,790	,005	,162
Relationships	40,9	6,57	38,8	6,40	35,8	5,86	3,622	,033	,108
Cultural-intellectual orientation	13,2	2,56	12,25	3,02	10,71	3,69	3,646	,032	,108
Recreation	15	2,16	11,7	3,71	12,2	2,68	7,972	,001	,210
Total growth	49,32	5,36	45	9,02	43,6	6,91	3,677	,031	,109

Table 2. Intersubject test results for group.

When collating the post hoc contrasts we detected statistically significant differences in the perceptions of families whose children have problems vis-à-vis families of NA pupils in: expressiveness (LD vs. NA, p = .089; TDAH vs. NA, p = .063) and recreation activities (LD vs. NA, p = .002; TDAH vs. NA, p = .011), where the NA group received higher scores. The families of ADHD children also differed from those of NA children: Stimulation towards writing (p = .011), rejection (p = .012), relations (p = .034) and cultural-intellectual orientation (p = .033); all cases, except for rejection, showed higher scores for the NA group. But the families of ADHD children also differ from those of children with LD in communication with the school (p = .049) and involvement in school (p = .022), with higher scores for the ADHD group. We observed the same in the case of positive conflict resolution (p = .005), where LD families score higher. Finally, families of children with LD also differ from those of the NA group in parental efficacy in writing instruction (p = .042), with higher scores than the NA group. See Figure 1.

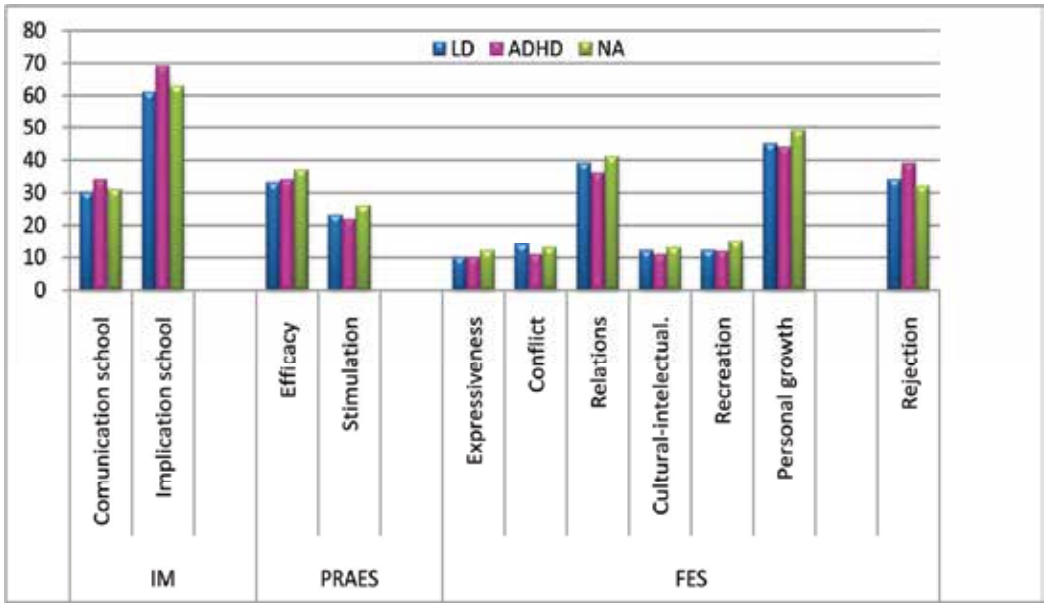

Fig. 1. Perceptions of families by family dynamic variables, according to the type of students.

We performed a final analysis, a univariate variance (ANOVA), to determine whether there were any differences in educational expectations of the family as whole, parents in particular and the pupils themselves, depending on the type of children. In all cases we found statistically significant results (family expectations, F = 7.277, p = .001, parental expectations, F = 11.451, p = .001 and pupil expectations, F = 3.103, p = .050). These were confirmed after post-hoc contrasts that showed differences in family educational expectations between the NA, LD (M_{NA} = 6.8 vs. M_{LD} = 5, p = .007) and ADHD groups (M_{ADHD} = 5, p = .009). We confirmed these results by looking exclusively at parents' opinion (M_{NA} = 3.7 vs. M_{ADHD} = 2.5, p = .002, and vs. M_{LD} = 2.3, p <.001). In terms of the children's own expectations there are also differences close to statistical significance between NA children and children with ADHD (M_{NA} = 3.2 vs. M_{ADHD} = 2.5, p = 0.068).

3.2 Parent vs. child role

Multivariate contrasts indicate high and statistically significant results, with a very large effect size for both the group of *families of children with NA* [F (24, 26) = 3.777, p = .001, η2 = .777], and for *families of children with ADHD* [F (24, 23) = 2.847, p = .007, η2 = .748]. For *families of pupils with LD* we found no statistically significant differences by including all FAOP scales together as dependent variables [F (24, 21) = 1.710, p = .109, η2 = .661]. Nevertheless, they were found when we did an individual analysis of each of the FAOP subscales, except for the FAOP-HOME scale.

Tests of inter-subject effects show which variables and between which groups there are statistically significant differences. Taking the variables obtained through FAOP-IM as a starting point, we observed that in both the NA group of families and the families of ADHD children parents' perceptions of home involvement (NA: Mparent = 60.2 vs. Mchild= 53.7, p <.001; ADHD Mparent = 56.6 vs. Mchild = 51.3, p = .008) and academic co-stimulation at home are higher than that of their children (NA: Mparent = 28.4 vs. Mchild = 25.1, p = .001; ADHD Mparent = 26.2 vs. Mchild = 22.1, p = .003). Likewise, parents of NA pupils report more motivation and academic support at home (Mparent = 31.8 vs. Mchild = 25.5, p <.001) and greater educational involvement in general than that recognized by their own children (Mparent = 91.2 vs. Mchild = 84.5, p = .011). For families of pupils with LD, the main differences between the views of parents and children, close to the statistical significance, are in terms of school-family communication (Mparent = 3.78 vs. Mchild = 4.21, p = 0.065) and overall involvement in it (Mparent = 29.1 vs. Mchild = 32.4, p = 0.084), with children's perceptions scoring higher.

In the FAOP-PRAES subscale, differences occur between parents and ADHD children in relation to the level of motivation towards writing offered at home, with parents scoring this type of activity higher (Mparent = 12.4 vs. Mchild = 10.3, p = .003). Meanwhile, families of pupils with LD showed the greatest statistically significant differences between parents and children. In this case, the children themselves identified a higher stimulation towards the use of higher psychological processes involved in writing composition than their parents (Mparent = 11.1 vs. Mchild = 12.6, p = 0.060), as well as feelings of effectiveness in writing instruction (Mparent = 35.1 vs. Mchild = 39.8, p = 0.019) and in the overall development of written composition (= 70 vs. Mparent. Mchild = 76.8, p = 0.049).

Regarding the FAOP-HOME scale, there are differences in the case of families of children with NA in the perception of the use of an authoritarian management style, with children scoring this higher (Mparent = 10.4 vs. Mchild = 12, p = .001). Meanwhile, in the case of families of children with ADHD, parents report feeling more acceptance (Mparent = 34.5 vs. Mchild = 32, p = .037) and rejection of their children (Mparent = 20.4 vs. Mchild = 17.5, p = .035) than reported by their children, similar to what happens in NA families, but only regarding acceptance (Mparent = 35.2 vs. Mchild = 32.8, p = .017).

Finally, in the FAOP-FES subscale, there are significant differences between parents and children in the three groups in expressiveness, with parents scoring higher (NA, p = .006; LD, p <.001, and ADHD, p = .013). For NA (Mparent = 21.4 vs. Mchild = 19.7, p = 0.097) and LD families (Mparent = 21.3 vs. Mchild = 18.4, p = .010) parents also report better family relations. ADHD families report a higher degree of stimulation towards intellectual-cultural activities (Mparent = 5.92 vs. Mchild = 4.79, p = 0.068). LD children perceive more parental

control than is recognized by parents (Mparent = 4.5 vs. Mchild = 5.6, p = .013), whereas in NA families children perceive greater independence than recognized by parents (Mparent=4.41 vs. Mchild = 5, p = 0.074).

In terms of expectations, statistically significant differences exist only between the views of parents and the children in the NA group, with higher parental expectations (M_{parent} = 3.73 vs. M_{child} = 3.21, p = .022).

4. Discussion and conclusions

Interest in LD and ADHD has been gradually shifting towards more holistic perspectives in terms of analysis and treatment, where not only the person is considered, but also all the social agents surrounding her/him (Dyson, 2010; Gortmaker, Daly, McCurdy, Persampieri, & Hergenrader, 2007; Mautone, Lefler, & Power, 2011; Polloway, Bursuck, & Epstein, 2001). However, despite progress in this area, there have been few and inconclusive results up to now (Dyson, 2010; Hegarty, 2008; Heiman & Berger, 2008; Xía, 2010). Therefore, it is necessary to conduct further research to jointly analyze the family dynamic and stable variables in relation to the academic performance of children with ADHD or LD. This will allow us to offer alternative multicomponent forms of intervention to promote these pupils' development.

The main objective of this research was to analyze the possible differences in the structural and dynamic family variables in relation to the characterization of pupils by comparing three groups of families organized by their children's typology and to study parents' and children's perceptions within each group.

When we look at the results for the structural variables in more detail, we see that the level of education of parents of children with LD is lower than that of parents of NA children. Families with lower levels of education provide less stimulating and literate home environments, so that children are at risk of starting school with lower levels of development of basic skills, which is particularly important in the case of LD (Dearing et al. 2009; Jordan & Levine, 2009; Park 2008; Van Stennsel, 2006; Williams & Dawson, 2011).

Furthermore, it should be stressed that LD has a strong genetic component, so that the limited education level of parents which was identified in this subgroup of children can be related to their own learning difficulties and thus biologically explain the deficits inherited by children (Berninger, Abbott & Thompson, 2001; Lyytinen, Eklund, & Lyytinen, 2005; Monuteaux, Faraone, Herzig, Navsari, & Biederman, 2005; Shalev, et al. 2001; Snowling, et al., 2007). Notwithstanding these circumstances, parental learning disabilities were not verified in the sample studied, and may be a future focus of analysis.

Also in relation to structural variables, the results of this study indicate that families of children with ADHD are bigger than those of the other two groups analyzed. Pupils with ADHD need a lot of academic support, and demand more attention from their parents than usual. Parents who have several children need to split their attention between them, so they can become overworked and stressed. This can affect their ability to interact sensitively with the child's the demands, leading them to develop an intrusive educational style (Ryan, 2002).

Secondly, when we look at the *dynamic dimension* and organize our data around the elements evaluated through the FAOP scale, we can draw several interesting conclusions.

Looking at the variables addressed through *FAOP-IM* we can conclude that parental educational involvement is greater in families of children with ADHD (Smith & Adams, 2006), even when compared with families of children with LD. One possible explanation for this is that the Spanish legislation at the time of the research had not yet enacted measures to address the specific needs of pupils with LD. Therefore, the pupils studied received no specific attention for their LD. This, together with the fact that LD is less apparent in external behavior than ADHD and the problems become apparent in writing when the pupil already has a fairly advanced schooling, may hinder parental diagnosis and explain the lack of continuous contact with the teachers (Bull, 2003; Dyson, 2010; Karende, Mehta, & Kulkarni, 2007; Rolfsen & Martinez, 2008; Stoll, 2000). It is also important to recognize a specific limitation of this research - a certain bias in the selection of the sample. Participants were obtained through intentional sampling, based on the voluntary cooperation of families. Also, in the case of families of children with ADHD, we found them mainly through associations or groups of families, so parents were aware of the problem the child faced.

In terms of home involvement, the parents of NA children reported more academic collaboration than those of pupils with LD, which is in line with studies that indicate that school success of children is positively related to the level of parental involvement and support in the home (Alomar, 2006; Knollmann & Wild, 2007; Phillipson, 2010; Pomerantz, Wang, & Fei-Ying, 2005; Regner, et al. 2009; Urdan et al., 2007). However, if we compare the perceptions of parents and children in each group, we see that parents of NA and ADHD children report higher academic involvement at home than that perceived by their children. These data are derived from the opinions of a group of parents that were aware that their responses were difficult to verify and, therefore, were more likely to exaggerate in order to achieve socially desirable responses.

Looking at the results derived from *FAOP-PRAES*, we can conclude that the families of pupils with LD differ negatively from families of NA children regarding parental perception of efficacy in writing instruction and in overall cooperation in teaching writing skills. The lower parental sense of efficacy in teaching writing in LD families may be explained by the fact that because children in this group have disabilities in this area, the help they require from their parents is very specific and they may not feel able to provide it (Bloomfield, Kendall, & Fortuna, 2010; Kay, & Fitzgerald, 1994). As for the degree of involvement in the general teaching of writing in the LD group, previous research has shown that a reason parents fail to cooperate on educational issues is their own lack of training in this respect, which will be even more salient in the case of helping children that require a very high level of expertise (Karende, et al., 2007). Thus, a practical implication derived from this result is the need to develop training programs for parents to enable them to contribute to the education of children with LD.

Finally, families of NA children, unlike those of pupils with ADHD, seem to encourage writing on a daily basis, offering models and materials at home for its development. This may be because children with ADHD often have a wide range of needs that may mean that communicative competence is not especially valued and that even if its is addressed it is done in less depth or in combination with other elements.

Regarding the results obtained from *FAOP-HOME*, we saw that parents of children with ADHD reported feeling more rejection of their children than parents of the other two groups (Presentation, et al. 2009; Shur-fen, 2007, Taylor et al., 1996). However, when comparing the perceptions of rejection/acceptance between parents and children of the ADHD group, adults scored higher on both. In relation to acceptance, the data is indeed negative, as the emotional and behavioral development of children with ADHD is mediated by external variables such as perceived acceptance or rejection of their family (Lifford, Harold, & Thapar, 2008; Murris, Meesters, & Van der Berg, 2003; Shaw, et al., 1998). While we need to be aware that this conclusion is mediated by the fact that perceptions of children with ADHD, obtained through self-reports, may be distorted by their disorder (Bauermeister, et al. 2005; Walcott & Landau, 2004), this is something that should be monitored in the future.

Other conclusions drawn from the data obtained through FAOP-HOME relate to parental educational styles. In this case, the parents of NA children exerted more democratic parenting styles than parents of pupils with ADHD, who seemed to be largely permissive. This may be due to the lack of positive reinforcement that they perceive during child rearing or to the highly prevalent strain the disorder puts on family relationships, as previous research has shown (Goldstein, et al. 2007; Keown & Woodward, 2002).

Analysis of *FAOP-FES* variables has led us to several conclusions. We have confirmed that the families of pupils with ADHD have less adaptive relational patterns than those of children with NA, followed by the LD group. Specifically, in families where the children have no problems there is a greater tendency to act openly, freely expressing one's feelings. One explanation for this result would be that the problems these children suffer affect their socioemotional development, which may account for the lower level of expression in intra-family relationships (Mason & Mason, 2005). It was also found that the level of family cohesion in the case of ADHD was lower than that experienced by the families of NA pupils (Bao-Yu & Lin, 2004; Wells, et al., 2000). The more intense feelings of attachment in families of NA pupils possibly facilitate the positive expression of feelings, and the lack of serious problems means there are no blockages to this dynamic. Finally, results indicate higher levels of conflict in families with ADHD compared with to the families of children with LD, possibly due to higher level of external expression of this disorder.

As for the overall growth dimension, one can conclude that the families of NA children show more favorable patterns regarding their overall development, by offering a variety of cultural and intellectual or leisure activities. This can be explained by the fact that in families where children have no problems parents are able to encourage such activities more often. However, in the case of children with LD or ADHD it is possible that leisure time is used to focus on academic tasks or on trying to alleviate the problems arising from the disorder itself, as demonstrated in studies that confirm that in these households performance-oriented activities are prioritized (Stoll, 2000), therefore the time and interest in leisure or other cultural activities is lower.

Finally, regarding the maintenance stability dimension, results show that such patterns of action are more common in the NA group than in the other two groups, especially that of exercising control, which is much greater in the NA group than in the LD group. Order and family rules promote children's development and learning, which could explain the

better performance of children without problems and be a risk factor in the case of pupils with LD.

When we examined *expectations* regarding the academic future of children, we found that pupils whose parents are more optimistic about them, NA group parents, show better academic performance (Fang, & Sen, 2006; Neuenschwander, Life, Garrett, & Eccles, 2007; Rubie-Davies, Peterson, Irving, Widdowson, & Dixon, 2010). In addition, the high expectations of parents of NA children were projected on the pupils themselves, who were also the most optimistic about their academic future. It is possible that pupils with problems, as well as being aware of their difficulties, perceive their parents really low aspirations and therefore express less favorable opinions about their own academic performance.

Finally, in response to *parental satisfaction with teachers* and based on the results, we can confirm that parents of NA children, as opposed to mainly those of children with ADHD, are those that show higher patterns of satisfaction. The fact that the educational needs of children with standardized performance are not significant and that they demand less attention, possibly means that teachers' performance is appropriate to them and therefore parents are satisfied in this regard (Gershwin et al., 2008). As for parents of children with LD, as we have seen, results indicate that the pattern of satisfaction is quite similar to that of parents of NA children. Possibly, the lack of a clear diagnosis and treatment of LD at the time of the study, made the parents of these pupils unaware that their children had significant learning problems, which is one of the reasons that could explain the level of overall satisfaction. Nevertheless, compared to the NA group, these parents identified a shortage of professional competence of teachers as well as a considerable lack of interest in their children's learning.

In short, this study confirms a trend indicating that contextual family elements are the most affected, and shows characteristics that are less favorable for learning in families in which children have ADHD or LD. These contextual elements emerge as potential risk factors to control. Therefore, these variables require greater empirical attention in the immediate future, in order to provide comprehensive treatment optimized for these pupils and their families. Similarly, we confirmed that the way family life is perceived is not the same for parents as for children, thus providing an overview of the specific needs of each family member, which may facilitate the establishment of specific interventions adapted to each particular case.

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Correspondence should be addressed to Departamento de Psicología, Sociología y Filosofía. Área Psicología Evolutiva y de la Educación. Campus de Vegazana s/n, 24071 – León, Spain. Phone: +34-987291041 (university); +34-987222118 (home); +34-652817871 (cell); Fax: +34-987291035 (university). E-mail: jn.garcia@unileon.es.

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9

Meeting the Needs of Twice-Exceptional Children in the Science Classroom

Manabu Sumida
Ehime University, Faculty of Education
Japan

1. Introduction

Since 2007, special needs education in Japan, in addition to the disabilities targeted in special education in the past - such as visual disorders, hearing disorders, intellectual disabilities, physical handicaps, health impairments, speech disorders, and emotional disturbances – also encompasses Learning Disabilities (LD), Attention Deficit/Hyperactivity Disorder (ADHD), and High-functioning Autism (HA) and Asperger's syndrome. These are considered to be mild developmental disorders in Japan. In the survey results of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in 2002, teaching staff noted pronounced difficulties in learning and/or behavioural problems in 6.3% of students in public primary schools (MEXT, 2003). Based on responses to each item in the survey, it is estimated that 4.5% of these students may have LD, 2.5% may have ADHD, and 0.8% may have HA (Japan Association of the Special Educational Needs Specialist, 2007).

Children screened for disorders are sometimes identified as having gifted characteristics. Children screened for their giftedness are sometimes identified as having academic or behavioural disorders. Regardless of the order in which they are screened, identified children can have the combined characteristic of both giftedness and developmental disorders (e.g. Baum, 2004; Cooper et al., 2005; Weinfeld, Barnes-Robinson, Jeweler, & Shevitz, 2006). "Twice-exceptionality" (heretofore referred to as 2E) is the term used for someone who is gifted or talented and at the same time has one or more learning difficulties or disabilities (Buttriss & Callander, 2005). It is evident in the extant literature that few conceptual or practical studies, which focus on the gifted traits that the majority of these children possess, have been conducted in a specific subject area in detail.

The criteria for gifted identification are usually domain-independent, such as IQ, creativity, and leadership. However there are many good science programmes for the gifted. Sumida (2010) noticed four reasons why 2E children are adept at learning science. These are (1) the domain-specific, dynamic nature of science, which encompasses a wealth of different fields of study, can accommodate children's varied areas of interest; (2) hands-on activities in science learning can promote creative ideas and lead to a persistence in children that often surpasses their teachers' expectations; (3) an integrated scientific approach will be beneficial in that the children's dominant strengths can be reinforced and developed in a broader

context; and (4) science encompasses collaborative learning activities in the laboratory and in the field within self-established norms and the sharing of basic attitudes and ways of thinking. Karns, Shaunessy, & Bisland (2004) suggested that developing 2E students use interest and learning style inventories to become familiar with the strengths of their own strengths.

The purposes of this research are as follows: (1) to design and implement a primary science lesson to meet the needs of a 2E child and (2) to analyse a 2E child's writings on worksheets and laboratory notes, and compare these with those of regular children.

2. Methodology

2.1 Identifying twice-exceptional children in science

In this study, 2E children in science were found in an urban city in Japan. The city board of education has a three-stage systematised framework for profiling children with mild developmental disorders. In the first screening, all children in the city are observed using a general checklist to identify characteristics of children with developmental disorders. The second screening is conducted using a checklist designed to specifically identify the type of developmental disorder. The third screening includes the Wechsler Intelligence Scale for Children-Third Edition-(WISC-III), the Japanese Kaufman Assessment Battery for Children (K=ABC), the Illinois Test of Psycholinguistic Abilities (ITPA), and other similar developmental surveys; scholastic records; and information about home environments and early developmental history.

In the screening for giftedness in science, Sumida's Gifted Behaviour Checklist in Science for Primary Children (Sumida, 2010) was used for primary children at eight schools randomly chosen from 62 primary schools in the city. The checklist consists of 60 items, is focused on: Attitudes, Thinking, Skills, and Knowledge/Understanding in science. Using factor analysis, three factors were proposed as "General Competence in Science," "Competence in Science regarding Natural Thing," and "Creative Competence in Science," and a cluster analysis with subscale points for each factor identified three "gifted styles" in science. These were: (1) Spontaneous Style, (2) Expert Style, and (3) Solid Style. Sumida (2010) found that LD/ADHD/HA children displayed the Spontaneous Style, while non-LD/ADHD/HA children were characterized under the Solid Style. The number of children exhibiting the Expert Style was the lowest, with no significant difference between the two groups.

In Sumida's study (2010), 13 out of 86 children were in the Expert Style Group; five of these children had LD/ADHD/HA. The subject of this study was one of the LD/ADHD/HA primary children in the Expert Style Group.

2.2 Profile of the twice-exceptional child in this study

The twice-exceptional child targeted in this study was a 4th grader at a public primary school in an urban area in Japan. Sumida (2010) classified him as an "Expert Gifted Style" child with LD/ADHD/HA. His scores for "General Competence in Science," "Competence in Science regarding Natural Things," and "Creative Competence in Science" were high, at 2.95, 3.00, and 2.88, respectively.

In this study, before the science lessons were designed, the teacher of the student's class and the science teacher were interviewed about his school life. Both teachers remarked that his difficulties involve unnecessary movement of extremities unless he takes medication. Further, he speaks too loudly, unbefitting the circumstances. Since 4th grade, the child has been prescribed medication but individuals around him claim that there seems to be no notable difference in behaviour when the child takes medication.

The child is well built. He belongs to a softball team and participates enthusiastically, due to the influence of his parents. He exhibits average performance in music, art, and physical education. Generally, he reads many books and has a wealth of knowledge acquired through day-to-day activities. He is well versed in Kanji (Chinese characters) and can sometimes read characters that have not yet been taught in school. He belongs to the *shuji* (calligraphy) club. He has a broad vocabulary and sometimes uses phrases uncommon to 4th graders.

On the other hand, he finds it somewhat difficult to use his imagination and to draw mental pictures. He cannot respond spontaneously and dawdles from time to time. He is not very dexterous with his hands. His sketches and use of colours during art lessons are below average for a 4th grader. He also experiences extreme emotions; there are times when he appears satisfied with the results of his crafts and there are times when he seems very frustrated. He refuses to stop promptly halfway through an activity and has his own mind-set concerning the finishing of an activity. Problems often occur not only during lessons but during break times as well. The child seems somewhat inflexible in his relations with his peers. He may say something unwarranted during break times and set off arguments. Sometimes the child finds it difficult to ignore a friend's comment. Remarkably, troubles have diminished in the period from the first to the second school term.

Prior to these changes in his social behaviour, the child was easily distracted. Presently, he corroborates well with his fellow group members when carrying out experiments and he does not speak as loudly as before. At the same time, his science teacher noted that the child's interest and desire to learn and solve problems became remarkably strong. During science classes, the child responds well to questions raised by the teacher. He can express his own ideas with a wealth of knowledge. When predicting results, he can now thoroughly contemplate the topic and express his thoughts. The child speaks clearly and confidently when commenting. For example, he mainly operates the stand and alcohol lamp properly in the group during an experiment on the three states of water. He takes the initiative and works hard. He does well in tests and seems to show good understanding of the topics that have been studied. Specimens of plant collections submitted for his project over the summer holiday were great. The stems were cut, opened, and taped for display as if a professional in plant collecting had taught the child. However, he seems to show no particular interest in insects.

2.3 Designing science lessons for the twice-exceptional child in a regular classroom

Jewer et al. (2008) proposed a framework and graphic organizational planning tool designed for teachers to use with any instructional materials for 2E students. However, research on the practice and its effects on 2E students are very limited in science. In this study, a science lesson about "How Things Heat Up" was designed for the 4th grade and implemented in a

public primary school. This unit includes activities such as investigating the way three materials (metal, water, and air) heat up, and tapping experiences at home and at school. The important goal of the unit is to inspire interest and curiosity regarding the questions that arise from this investigation and to cultivate scientific ways of thinking about the basic properties of materials by having children pursue these questions further while using these activities as a means to consider how heat is conducted through metal, water, and air. Dole (2000) notes that gifted students with learning disabilities require a problem-based curriculum with hands-on experiences. Characteristics of heating include the way metal quickly conducts heat, whereas water and air can only convey heat through convection, which takes a longer amount of time. The contents of this unit were broadly divided into five parts as shown in Figure 1 (one through five). The unit takes a total of 11 hours.

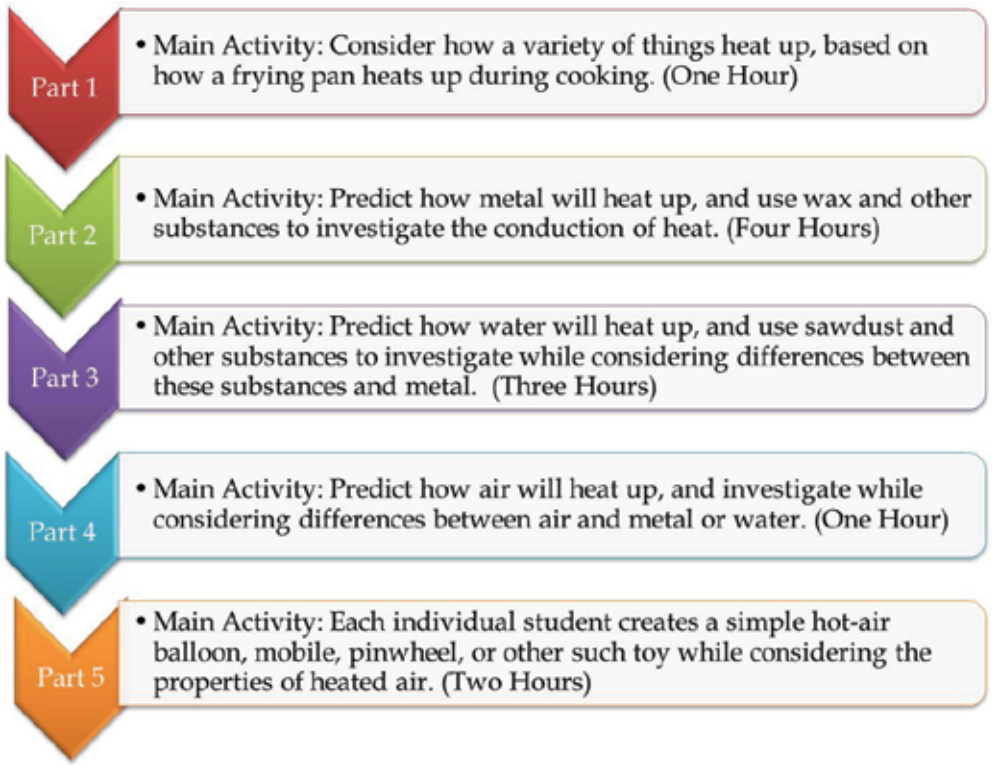


Fig. 1. Unit flow and composition of main activities of the lesson (11 hours)

2.3.1 The first part of the lesson (One hour)

The goal of the first part of the lesson was to "have children predict how a horizontal metal rod will heat up and make them interested in and curious about how a variety of different substances heat up." The students were shown a frying pan and electric stove being used for heating, and were made to consider how heat is conducted, as well as how temperature changes. In order to measure the change in temperature, a radiation thermometer was used to measure the centre and periphery of the frying pan, and by both predicting and

experiencing the changing temperature for themselves, students were inspired to be more interested in and curious about heating.

In this part, the use of a radiation thermometer, which is an advanced measurement instrument that one does not often see, helped the students experience for themselves how the temperature heated up beyond 100° C, especially in the case of metal, which became extremely hot. The experiments not only made it possible for the students to predict that the substance would grow extremely hot, but also taught them how to handle equipment during an experiment, how to clean up after an experiment, and so on, while enabling them to participate in activities designed with safety in mind.

2.3.2 The second part of the lesson (Four hours)

During the first class teaching of the second part of the lesson, the students conducted experiments by watching the melting of wax, to see how a metal rod would heat up and understand the order of heating from area to area. During the second lesson of the second part, the students conducted additional observational experiments using wax with a diagonally oriented metal rod, to understand the order of heating and how it is affected by the new angle. Next, during the third lesson, the students predicted how a plate-shaped piece of metal would heat up while discussing methods of determining how it is heating up and considering for themselves experimental methods and how to make preparations. Finally, during the fourth lesson in this part, the students used the method and materials they came up with during the previous class in their own group, conducted experiments regarding how a metal plate heats up, and summarized their findings.

Specifically, during the first class, the students made predictions about experiments in which they would heat metal rods of approximately 30 cm in length from the centre with alcohol lamps. The students used wax as part of the experiment, in order to verify how the heat was conducted by watching the wax melt. Next, during the second lesson, the students predicted how the rod would heat up with the rod slanted at an angle. During the third and fourth lesson of this part, a 30 cm by 40 cm metal plate was used to investigate the heating of the surface of a flat piece of metal. During these experiments, the children were made to consider methods for telling how the object was heating up, such as whether to use substances that melt or harden when heated. As the lesson proceeded, groups of children were made to discuss what materials and methods to use for the experiment.

The worksheets for predicting how heating would occur were of a format that allowed for filling in elapsed times, with items such as “Beginning,” “After _ Minutes,” another “After _ Minutes,” and so on. The children were made to fill in the times they decided upon in “After _ Minutes” time settings, thereby enabling them to make predictions while being conscious of the time it takes for an object to heat up. In addition, the innovation whereby children are made to record their observations about heating using colours, arrows, lines, and other such methods of classification elicits more concrete and complicated ideas. For the colours, low-temperature parts were coloured in using blue, and high-temperature parts were coloured in using red, making it possible for the children to express their ideas regarding heating both visually and continuously. Children were also made to classify changes in temperature

and the conduction of heat with arrows and lines, to fill in predicted temperature values using numerical values, and so on, and this helped the children to refine their predictions and gain the ability to express predictions numerically.

2.3.3 The third part of the lesson (Three hours)

The third lesson involved investigating how water heats up. During the first class's experiment, a test tube filled with water was tilted and heated from the middle using an alcohol lamp. Thermal tape that would change colour when heated to 40° C or above was placed on a glass rod, and this was used to investigate how the tube heated up. Next, in order to even more closely investigate how water heats up from the top, during the second and third classes, a 300 cm^3 beaker was used in additional water heating experiments. While conducting their own experiments to investigate the convective flow of water, the students also used thermal tape to investigate the changing temperature at several locations inside the beaker, and summarized what they learned.

To investigate convection and heating in the water, the students discussed within their groups how to place items in water, as well as thermal tape affixation methods. To view the water's convection, the students selected substances such as sawdust and tea leaves, while also discussing where to place the substances and how much to use. In addition, four or five glass rods with thermal tape applied were distributed to each group, and the students were asked to think of ways to investigate how the overall temperature would change. Furthermore, as part of a demonstration experiment, a large 3,000 cm^3 beaker, sawdust, thermal tape, and a thermometer were used to observe the water's convection and changing temperatures.

2.3.4 The fourth part of the lesson (One hour)

The experiment in the fourth part of the lesson involved measuring changes in air temperature as a space thermostat heated up the science room. Inside the science room, desks were arranged so that seven groups of four children each could sit, and three locations were decided for measurement at each group, with rod thermometers used to measure temperature twice—before the space heater was turned on and ten minutes after it began heating the room. The three measurement locations were (a) at the height of a standing student's eyes (approximately 1.2 m from the floor), (b) near the floor of the science room (several centimetres off the floor), and (c) as high as a student standing on the desk could reach (near the ceiling). Each group used three thermometers and shared responsibilities for various tasks in the experiment.

An activity that makes use of an everyday situation, where individual students can independently measure temperatures in order to investigate and learn about how air heats up, is not only a better way to increase interest and curiosity on the part of each student than using textbooks and guidebooks but also leads to an understanding that comes from actually experiencing the phenomenon for oneself. Also, to prevent the students from moving around the classroom and disturbing the convection of the air for the ten minutes during which the space heater was heating the room, they were constantly reminded to remain seated and watch audio visual teaching materials about the heating of metal and water. These materials gave the students the opportunity to consider the floating of a hot-air

balloon (the subject of the fifth part) and the characteristics of heated air and to review the concepts they had learned.

2.3.5 The fifth part of the lesson (Two hours)

During the fifth part of the lesson, students verified what they learned about how air heats up, and constructed objects as part of an activity to utilize the property of air whereby it rises when heated. Each child selected a certain item to create from among three options (a hot-air balloon, a mobile, or a pinwheel), and was allowed to use their own creativity and strategies to determine aspects such as the size, shape, and decorations of the item. After a simple explanation of materials and methods of construction, the class was split up into groups of student making the same objects. Furthermore, since this activity involved the use of hair dryers and gas stoves, the children were also given safety instructions and instructions about handling equipment and avoiding accidents.

During the construction activity, each student was provided with materials and methods so that the students could come up with their own way of making their objects. For the hot-air balloons, plastic was provided with a thickness of approximately 0.01 mm and a size of around 90 cm by 90 cm, so that hot air from a hair dryer would heat it up and cause it to float as part of a large and light-weight hot-air balloon created by the children. Also, tools were utilized that made it possible to cause plastic to stick to objects after being heated by a heating wire. This enabled quick and easy construction. For mobiles and pinwheels, a small gas stove was provided, and the students performed the experiment while paying attention to safety issues. Three types of teaching materials were prepared, and students were placed into learning groups according to the options.

3. Results

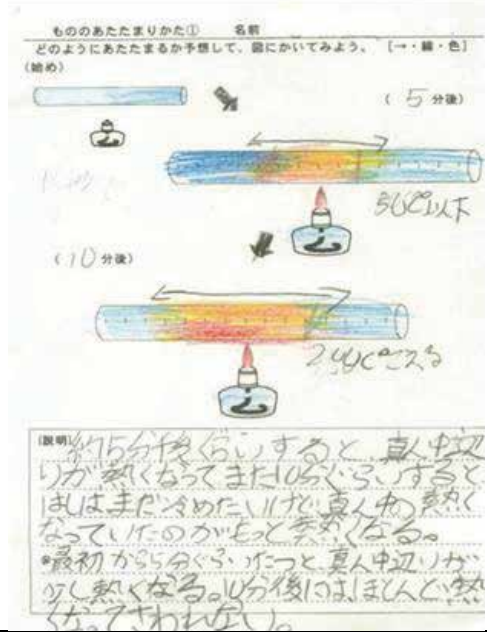
3.1 The first part of the lesson (One hour)

By showing the frying pan one uses to cook, the science teacher raised the children's level of interest and curiosity. He listened to the opinions of the children regarding predictions of the frying pan's surface temperature, and got the impression that children usually do not have a sense of what temperatures in excess of 100° C are like. It seemed that their most familiar experience with temperature was the use of an alcohol thermometer during a science lesson about boiling water. Worksheets used by Student A and Student B are shown in Figure 2. Student B is the student of the same gender as Student A, with the closest birthday in the class.

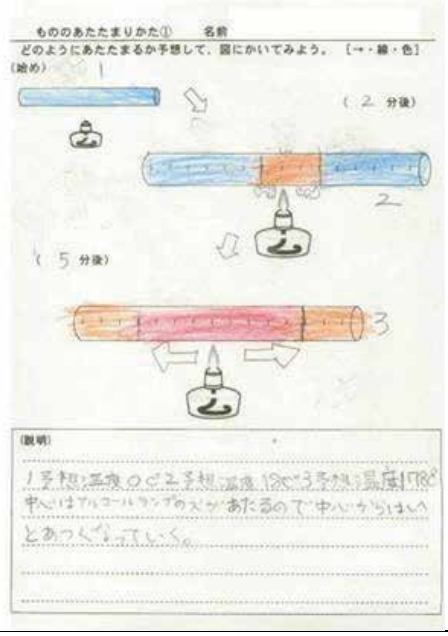
Student A was able to predict the way the metal rod would heat up while considering time and temperature. He represented the differences in temperature by using lines as scale marks, with colours showing the differences in temperature. Student B was able to make the same representation in the worksheet.

In the class, Student A predicted that the temperature would reach "around 200° C," giving the impression that this student is well-versed in scientific knowledge, through information attained from television and other media, or from books and other types of reference documents. When the science teacher introduced thermal tape, Student A even mentioned "thermography." The student seemed to have a rich array of experiences from everyday life

and to possess a powerful interest and curiosity regarding scientific phenomena. This student also used colours to indicate temperatures after the metal rod was heated for five or ten minutes, using arrows while making predictions not only envisioning the differences between the centre and rends but also envisioning specific temperatures that would differ at different levels of heating depending on the location on the metal rod, such as the top and bottom of the central part of the rod where it came into contact with the flames of the alcohol lamp.



Student A



Student B

Fig. 2. Worksheets (for prediction) during this part of the lesson by Student A and Student B (Student B is the student of the same gender as Student A with the closest birthday in the class)

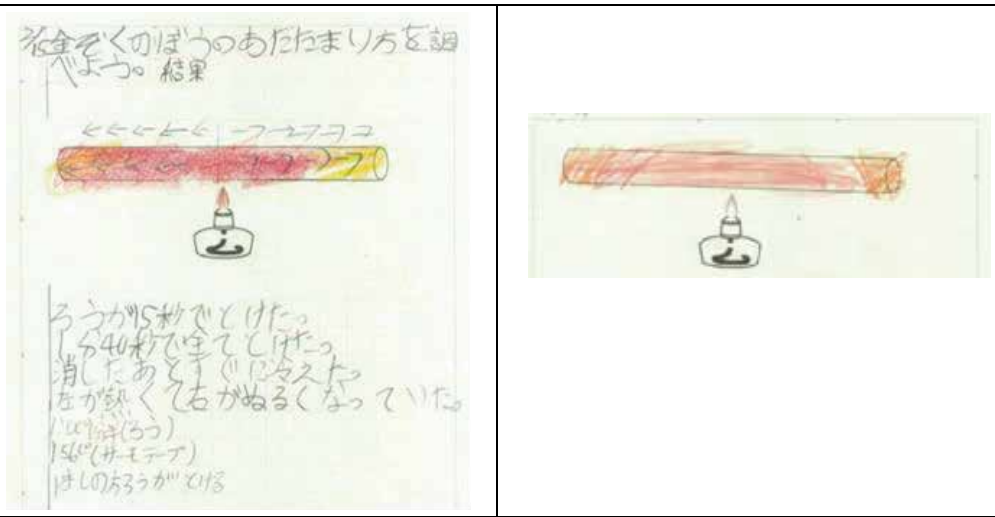
3.2 The second part of the lesson (Four hours)

The goal of the first hour of the second part of the lesson was to use wax to observe how metal heats up and understand the process of heat gradually spreading from the heated part. This activity was performed with the children split into groups, cooperating while carrying out the experiments, sharing responsibilities, and helping each other. Many of the children carefully observed how the wax melted, how the temperature changed, and the amount of time it took until the metal heated up, while using colour classification, arrows, and other methods to summarize experimental results and what they learned in their notes, which they then presented while verifying the opinions of their friends. Figure 3 shows worksheets in this lesson by Student A and Student B.

As shown in Figure 3, Student A used a stopwatch to measure the elapsed time and record the experimental results, classifying temperatures using colours while representing heating

using arrows. He realized that the temperatures were different at the left and right ends. Also, he observed how the metal rod cooled after the alcohol lamp was extinguished. Student B recorded the experimental results by representing heating through the use of colour classification. However, he did not record concrete results in detail, and did not sufficiently represent heating.

During the experiment preparation stage, all of the children gathered around the experiment desk, thinking about experimental methods, verifying procedures, and then proceeding with the lesson. Among the children, Student A always stood close by the teacher's side, mumbling ideas and thoughts while earnestly working on the lesson. The experiment of spreading wax on a metal rod and heating it with an alcohol lamp was conducted by groups of children who shared and swapped responsibilities throughout the experiment. Student A's group was the first one in the class to start working on the experiment. In addition, while verifying operations and measurement results, the group considered places where things were not going well, asking the teacher to take measurements with the radiation thermometer and otherwise proactively participating in the experiment and observations. Student A not only observed how the metal rod heated up, he also continuously observed how the rod cooled off. He was confident in his experimental findings that the metal rod heated up differently on the left and right sides, and in his notes, he meticulously summarized the results using colour classifications, arrows, and numerical values.

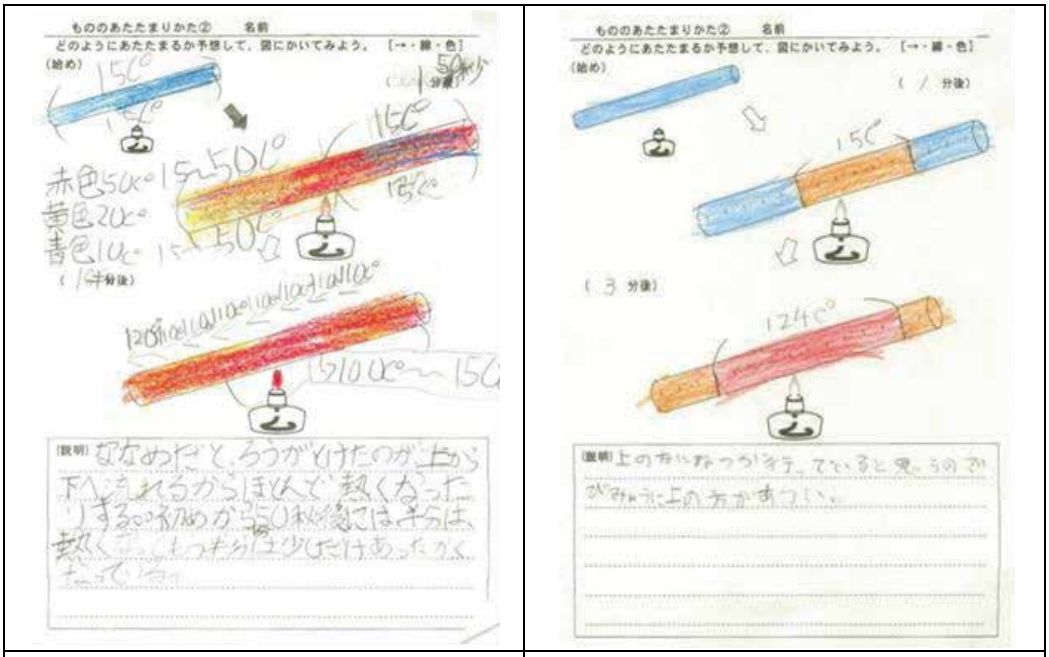


Student A	Student B

Fig. 3. Worksheets (for results) by Student A and Student B

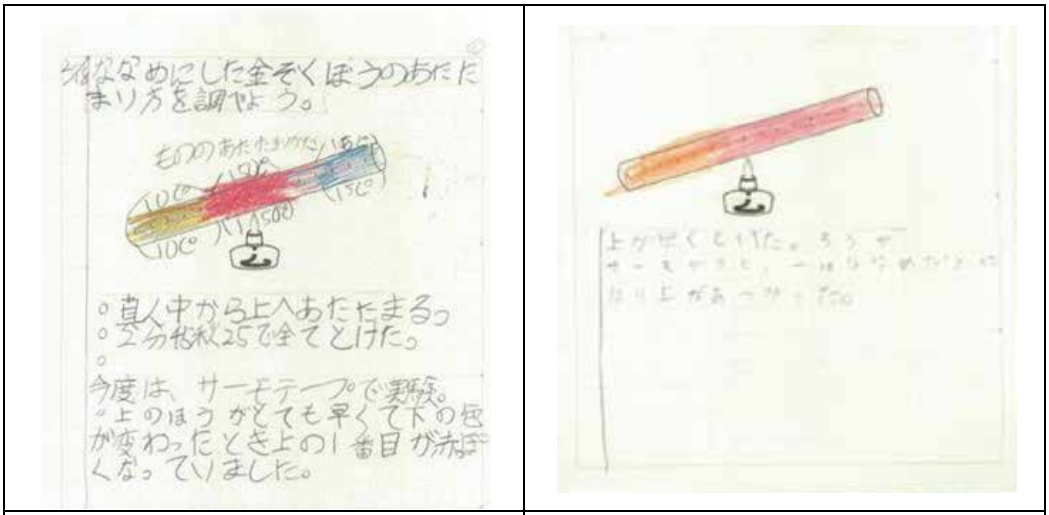
The goal of the second hour of the second part was to make students understand that even when the rod is at an angle, it will heat up gradually from the place where heat is applied. Many students predicted that as the slanted metal rod is heated, the flames will burn upward, so therefore heat will conduct more readily upward. The worksheets of Student A and Student B are shown in Figure 4 and Figure 5.

In the prediction, Student A took advantage of the results from the experiment during the previous class (1 minute and 50 seconds for full melting) in order to precisely determine the time it would take for the slanted metal rod to heat up, while using colour classification and arrows to represent predictions in detail. Student B made similar considerations as well.



Student A	Student B

Fig. 4. Worksheets (for prediction) by Student A and Student B



Student A	Student B

Fig. 5. Worksheets (for results) by Student A and Student B

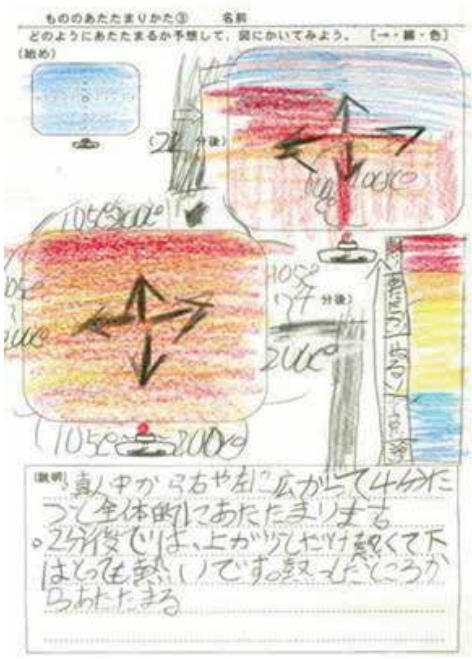
As in Figure 5, Student A used a stopwatch to measure the elapsed time during the experiment and represented the results by using colour classification. He asked the teacher to measure the metal rod's surface temperature and recorded the findings. He also realized that the temperature differed slightly between the top and bottom of the metal rod. Student B however only wrote that the wax melted on the top part of the metal rod and did not sufficiently represent how heating occurred by indicating information such as the order in which the wax melted and the time that it took to melt.

During the experiment's prediction stage, Student A predicted that the earlier temperature of 15° C for the entire metal rod would increase to around 50° C after 50 seconds, and then reach 150° C after 1 minute 30 seconds. Student A expressed these predictions with concrete, numerical values, while meticulously using arrows and colour classifications. During the experiment, Student A took turns applying wax with another student in the same group. Student A also actively participated in the experiment, affixing the metal rod to the stand while verifying the height of the alcohol lamp, positioning the alcohol lamp while verifying the position of the groove on the metal rod, and otherwise thinking carefully while performing the various procedures. Student A was able to use a stopwatch and radiation thermometer to observe how the metal rod heated from a variety of different positions and recorded these findings. During the presentations, Student A carefully listened to the other students' presentations, and presented the different experimental results of his own group. Student A always made an effort to reason independently while learning.

The goal of the third hour of the second part was to have students predict how a metal plate will heat up, discuss among themselves what methods and materials to use to investigate the heating, and consider experimental methods and what must be prepared. Figure 6 shows worksheets in this lesson by Student A and Student B.

Student A used complicated colour classifications and arrows to represent in detail how the metal plate would heat up, taking time and temperature into consideration. Student B was able to predict how the metal plate would heat up and took time into consideration. Although Student B seemed to represent temperature differences using colour classification, since there was no explanation, he did not sufficiently represent his prediction regarding the heating of the metal plate.

Student A was enthusiastic about this lesson's prediction activity, concentrating for a long time and summarizing predictions with a great level of detail. With respect to the heating of the metal plate, Student A was able to use detailed colour classifications, representing differences in the heating state by referring to temperatures with the following five levels: "hot," "warm," "lukewarm," "slightly cool," and "cool." In addition, Student A predicted that the temperature would be between 100 and 200° C. Regarding the time required for the heating as well, Student A came up with the predictions "after 2 minutes" and "after 4 minutes," recalling the previous metal rod experiments and how long it took the ends of the rod to heat up before. Student A consistently incorporated a variety of previously learned information. While the students were considering their own experimental methods and materials, Student A was also able to make proposals based on foresight regarding what will happen, such as "since it will heat up from the middle, we can place ice in the middle."



Student A

Student B

Fig. 6. Worksheets (for prediction) by Student A and Student B

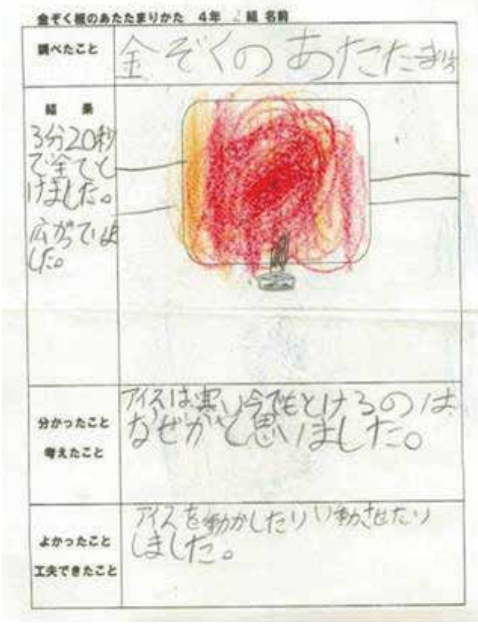
Furthermore, while listening to and considering the predictions of other students, Student A indicated the difference between the predictions of other students that the metal would heat up in a round pattern from the middle, and the predictions of students that it would heat up in a square pattern. Student A carefully listened to the opinions of other students, and while focusing on differences, enthusiastically described these differences. Student A's behaviour is evidence of a proactive attitude towards learning about science.

The goal of the fourth hour of the second part was to have groups of students consider methods and perform experiments regarding how a metal plate heats up and summarize what they discovered. Worksheets in this lesson by Student A and Student B are shown in Figure 7.

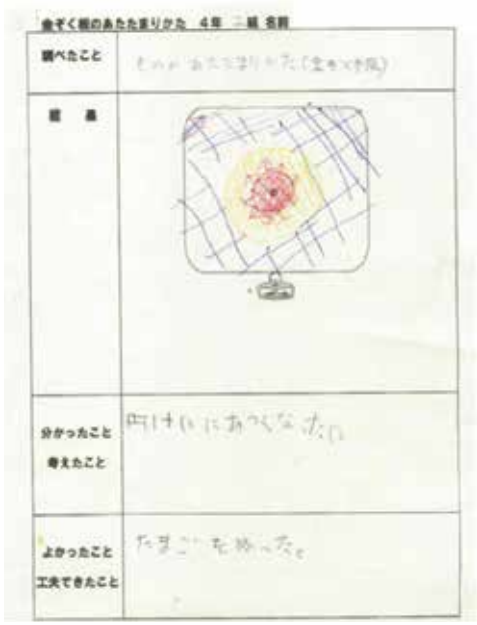
Student A used a stopwatch to measure elapsed time, representing this along with the results of the experiment, but did not sufficiently represent how the metal heated up. It is evident that this student came up with a strategy of moving objects to melt during the experiment. Student B represented experimental results with colour classifications and arrows, but did not sufficiently represent the passage of time or changes in the substance that melted.

Moreover, Student A understood the objectives of the experiment and thought with foresight regarding the properties of the materials to use in the experiment, experimental methods, and so on. Student A affixed the metal plate to a stand, and placed the alcohol lamp directly underneath the metal plate through a process of trial and error. Student A's group conducted its experiment using ice. Since the ice was brought by another student in

the same group, Student A just watched the other student decide where to place the ice and actually line up the ice. In spite of this, Student A helped by changing the positions of the pieces of ice while thinking of various different ideas for where to place them, while properly summarizing the results, such as how the place where the flames hit the metal is where the heating starts and how the heating spreads to the surrounding areas.



Student A



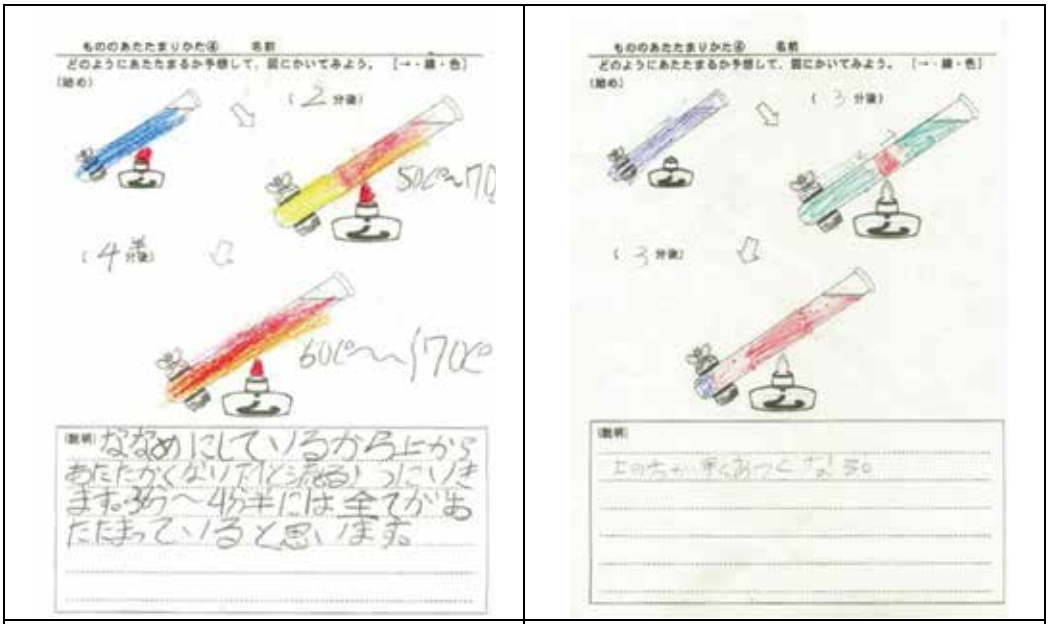
Student B

Fig. 7. Worksheets (for results) by Student A and Student B

3.3 The third part of the lesson (Three hours)

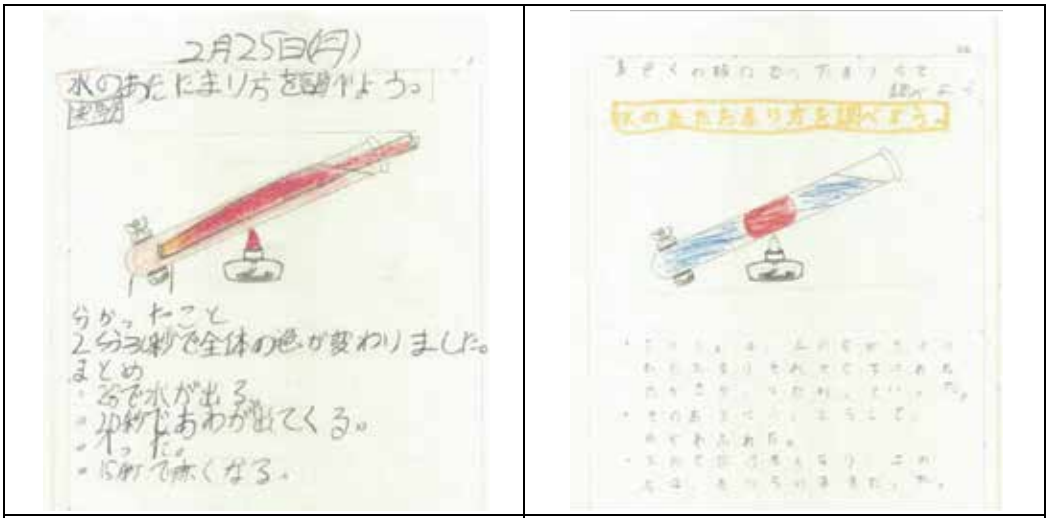
The goal of the first hour of this third part of the lesson was to have the students not only predict how the water in the test tube would heat up, but to also understand that the water gradually heats up starting at a location above where the heat is applied. Figure 8 and Figure 9 show worksheets in this lesson by Student A and Student B.

While considering the concrete times and temperatures involved in the heating of the test tube's water, Student A was able to represent predictions using easy-to-understand diagrams and sentences. He thought that the water would heat up more slowly than metal. Student B seemed to represent temperature differences using colour classification, but since there was no explanation, he did not sufficiently represent his prediction of how heating would occur. Figure 9 shows that Student A used a stopwatch to measure the time elapsed during the heating of the water in the test tube and represented the changing colour of the thermal tape in a concrete fashion. He also observed and recorded in detail how the water changed in the test tube. Student B used descriptions of changes in temperature that did not match descriptions of changes in the thermal tape's colour, and he did not sufficiently represent experimental results.



Student A	Student B

Fig. 8. Worksheets (for prediction) by Student A and Student B



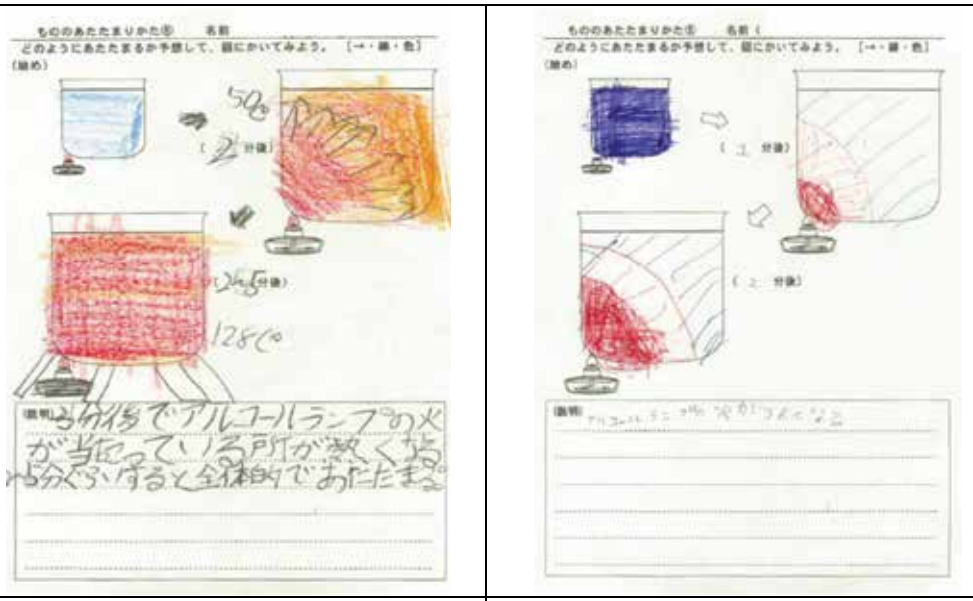
Student A	Student B

Fig. 9. Worksheets (for results) by Student A and Student B

When the students gathered around the experiment desk to verify the experimental methods during this lesson, Student A once again stood right next to the teacher and presented a variety of impressions and thoughts, evidence of a high level of motivation. After this, Student A voiced concerns about the test tube breaking, clarifications were made regarding the resistance of glass to heat, and the students were told that the test tubes would

not break. When predicting how the water in the test tube would heat up, Student A took advantage of his experiences learning about how metal heated up to concretely predict how long it would take for the water to heat up, and he also predicted the temperatures that would be reached. During the experiment, when the water overflowed out of the test tube, Student A quickly obtained a rag and continued observations. During observation, in addition to recording thermal tape temperature changes along with the elapsed time, Student A also carefully observed and recorded the boiling state of the water inside the test tube. Since Student A was able to closely observe changes during the experiment, he was able to successfully present his acquired knowledge and skill.

The goal of the second hour of this part was to have students predict how water in a beaker will heat up and consider and discuss methods for effectively investigating convection and heating in the water. In the predictions using a beaker to investigate how water heats up, when the flames of an alcohol lamp were applied to one side, many of the children predicted that the heating would spread in a round pattern, as with the metal plates. Worksheets of Student A and Student B are shown in Figure 10.



Student A	Student B

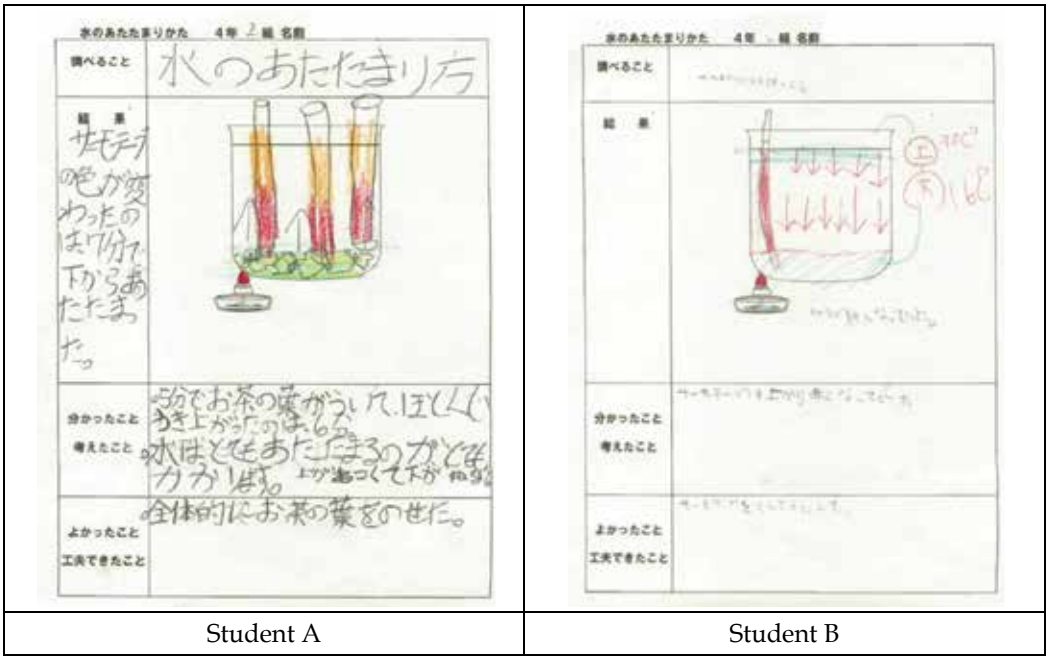
Fig. 10. Worksheets (for prediction) by Student A and Student B

Student A considered time and temperature while investigating how the water in the beaker heated up and used colour classification and arrows to clearly represent concrete predictions with diagrams and sentences. Although Student B seemed to represent temperature differences using colour classification, since there was no explanation, Student B did not sufficiently represent his prediction of how heating would occur.

When writing a prediction regarding how the water would heat up, Student A thought that the heat would be conducted in a round, circular shape, as was the case with the change of temperature on the metal plate. Student A made predictions that took time and temperature

into consideration, and explained that all the water would be warm after about five minutes. When the students presented their predictions, Student A asked a friend predicting that "the entire amount will heat up after about 30 seconds" "why will it heat up after about 30 seconds?" Student A seemed to feel that explaining the reasons for his own thinking accurately and in detail would earn him praise from many friends in the class.

The goal of the third hour of this part was to have students cooperate within groups, investigate how water in a beaker heats up, and understand that water heats up through a repeated process of convection. During the experiment, by using multiple pieces of thermal tape affixed to a glass rod, the students successfully observed how the water heated up from the top. The students added substances such as sawdust, which allowed them to also observe how convection works. The demonstration experiment using a 3 L beaker made this a lesson that left a strong impression on the children. The use of a beaker of this size makes it possible to leisurely observe the state of convection, as there is a large amount of water involved. Worksheets by Student A and Student B are shown in Figure 11.



Student A | Student B

Fig. 11. Worksheets (for results) by Student A and Student B

Student A concretely recorded how the water in the beaker heated up, considering time and temperature and using colour classifications and arrows. Further, he recorded the movements of the tea leaves and the changing colours of the thermal tape. He indicated that it would take some time to heat up the water, perhaps in comparison with the experiment on the heating up of metal. Student B recorded how the water in the beaker heated up in concrete terms, considering temperature and using colour classifications and arrows. He did not record observations regarding how the substance added to the beaker moved.

Even after the experiment started, Student A touched around the beaker in order to verify the heating with his senses, continued observations while verifying elapsed time, recorded

findings on the worksheet, and otherwise participated fully in the experiment. After about seven minutes after the start of the experiment, along with changes in the thermal tape and the water, Student A also observed that the tea leaves were moving, and verified that the water was starting to heat up at the bottom. During the experiment using the 3 L beaker, Student A considered ways of improving the experimental methods by matching the experimental instruments and predicting differences in heating speed and made enthusiastic observations such as "it will take twice as long." Student A realized that water takes longer to change temperature than metal, and summarized conclusions while making comparisons with the content of previous lessons.

3.4 The fourth period of the lesson (One hour)

The goal of this lesson was to have students predict how air will heat up in a room and to make them understand that air at the heated location will move upwards, causing convection cycles to repeat as the entire room warms up. In the experiment to investigate how air heats up, the entire science room was heated with a space heater, and the resulting changes in temperature were measured. Worksheets by Student A and Student B are shown in Figure 12.

Student A	Student B

Fig. 12. Worksheets (for prediction) by Student A and Student B

Student A considered time and temperature while investigating how the air in the classroom heated up and used colour classification and arrows to clearly represent concrete predictions with diagrams and sentences. Student B used colour classifications to represent how classroom air heated up. Since there was no concrete explanation, he did not sufficiently represent predictions of how air would heat up. After the experiments, Student A properly summarized the measurement results of his group and also recorded the results of other groups. Student B was able to record the results of his own group and other groups according to temperature measurement locations. He did not summarize temperature differentials in the recording of his own group's findings.

While recording predictions, Student A used the reason "because air is a gas" to explain why the room heated up from the top. Student A based a prediction that air would heat up

through convection on the previous experimental results regarding how water heats up. During the activity where the students presented their predictions, when another student stated the opinion that the room's temperature would increase to "between 18 and 62° C," Student A stated that the "room's air will not reach 62° C." During the experiment to measure room temperature, Student A stood on top of the experiment desk. While measuring the temperature of the ceiling, Student A recorded his findings on the worksheet and then compared those findings with those of other children. Not only did Student A accurately take the measurements that he was responsible for, he also did a good job cooperating while carrying out other shared responsibilities during the lesson.

3.5 The fifth period of the lesson (Two hours)

The goal of this period was to have students construct hot-air balloons, mobiles, pinwheels, and so on, that work due to air convection and to make the students understand that warm air becomes light and rises. All of the children selected and constructed an object from among the options (mobile, hot-air balloon, and pinwheel). Worksheets for designing the objects by Student A and Student B are shown in Figure 13.

Student A	Student B

Fig. 13. Worksheets (for designing the objects to make) by Student A and Student B

Student A drew two pictures of completed objects. He concretely represented everyday phenomena that could be used to investigate the characteristics of how objects heat up as well as other phenomena that he wanted to investigate further. Student B wrote about the strategy used to construct a mobile. He did not put forth any concrete examples of everyday phenomena showing the characteristics of heating that he wanted to investigate further.

Student A first selected and built a hot-air balloon. Not only did Student A start working quickly, he also finished the complete prediction diagram right away. Student A used scissors to remove the corners and taped the balloon together with cellophane tape while working very hard to construct it. Student A was interested in how the temperature of the hot-air balloon's plastic bag would rise, and immediately stuck a piece of thermal tape on the bag to try it out. In addition, Student A was the only student in the class to take on the challenge of constructing a different kind of object. When, through trial and error, Student A created a quality pinwheel within the lesson time, he looked very confident. Student A seemed to really enjoy the high level of freedom of this learning activity.

3.6 Self-evaluation and rubric assessment of the lesson

At the end of this unit's lessons, the students were asked in simple terms about the ten concrete evaluation goals, and three items were added regarding confidence, interest, and motivation regarding science in general, for a total of 13 items to be used for a self-evaluation review sheet. For each item, the students chose from "Did Well," "Did Somewhat Well," and "Could Not Do." During the point assignment part of the self-evaluation, "Did Well" items were assigned one point, "Did Somewhat Well" items were assigned two points, and "Could Not Do" items were assigned three points. The average score of self-evaluation points for each item was calculated for every student, and these averages in the class are presented along with Student A's self-evaluation scores in Figure 14. The rubric assessment of the lesson for Student A is summarized in Table 1 and Table 2.

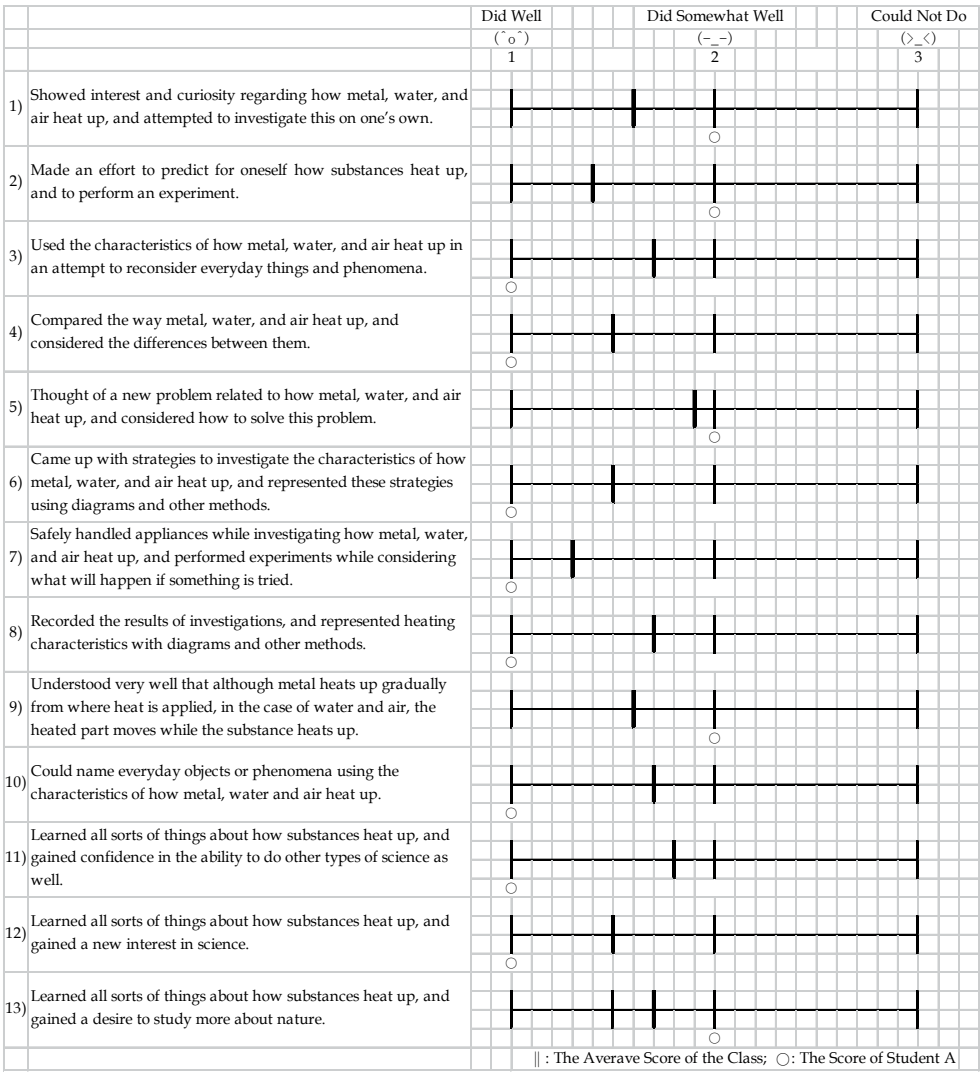


Fig. 14. The score of self-evaluation points about the lesson

Specific Evaluation Points	Evaluation Method/ Resources	Evaluation Benchmarks			Special Notes
		Fully Satisfactory	Basically Satisfactory	Needs Improvement	
Strand I: Interest, Motivation, and Attitude					
I. Shows interest and curiosity regarding how metal, water, and air heat up, and proactively attempts to investigate the differences between how these substances heat up.	Recording Analysis Behavioural Observation Remarks	Shows interest and curiosity regarding how metal, water, and air heat up, and attempts to investigate this on one's own, even outside the lesson.	Shows interest and curiosity regarding how metal, water, and air heat up, and attempts to investigate this on one's own.	Shows interest and curiosity regarding how metal, water, and air heat up, but does not attempt to investigate this on one's own.	
II. Performs experiments to investigate the characteristics of how substances heat up based on one's own predictions.	Recording Analysis Remarks	Makes an effort to clearly predict for oneself how substances heat up and to perform an experiment.	Makes an effort to predict how substances heat up, and to perform an experiment.	Attempts to perform an experiment without predicting how substances heat up.	Considers time and temperature and makes clear predictions while skilfully using diagrams.
III. Applies the characteristics of how objects heat up in an attempt to reconsider everyday things and phenomena.	Recording Analysis Behavioural Observation Works	Applies the characteristics of how metal, water, and air heat up in an attempt to reconsider everyday things and phenomena.	Applies the characteristics of how metal, water, and air heat up in an attempt to reconsider an everyday thing or phenomenon.	Does not apply the characteristics of how metal, water, and air heat up or attempt to reconsider everyday things or phenomena.	Was the only student in class to take on the challenge of constructing multiple objects, and succeeded in doing so.
Strand II: Thinking					
I. Compares the way metal, water, and air heat up, and can consider the differences between them.	Recording Analysis Remarks	Compares the way metal, water, and air heat up, and can consider the differences between them based on an attempt to organize multiple perspectives.	Compares the way metal, water, and air heat up, and can consider the differences between them.	Focuses on differences between the way metal, water, and air heat up, but cannot comprehend what the differences are.	
II. Applies the characteristics of how metal, water, and air heat up to think of new problems, as well as solutions to these problems.	Recording Analysis Behavioural Observation Works	Can think of a creative new problem regarding the characteristics of how metal, water, and air heat up and a concrete solution to this problem.	Can think of a new problem regarding the characteristics of how metal, water, and air heat up and a solution to this problem.	Cannot think of a new problem regarding the characteristics of how metal, water, and air heat up or a solution to this problem.	Was the first student in the class to affix thermal tape to a plastic hot-air balloon in order to investigate the temperature of the hot-air balloon when it rises.

Table 1. Rubric assessment of the lesson for Student A – Strand I and Strand II –

Specific Evaluation Points	Evaluation Method/ Resources	Evaluation Benchmarks			Special Notes
		Fully Satisfactory	Basically Satisfactory	Needs Improvement	
Strand III: Skills and Expression in Observation and Experiment					
I. Comes up with strategies to investigate the characteristics of how metal, water, and air heat up and can represent experimental devices and plans using diagrams and other methods.	Recording Analysis Behavioural Observation Remarks	Comes up with creative strategies to investigate the characteristics of how metal, water, and air heat up and can represent these strategies in concrete terms using diagrams and other methods.	Comes up with strategies to investigate the characteristics of how metal, water, and air heat up and can represent these strategies using diagrams and other methods.	Could not come up with strategies to investigate the characteristics of how metal, water, and air heat up or represent these strategies using diagrams and other methods.	
II. Can safely use heating appliances and the like, and can perform experiments with foresight regarding how metal, water and air heat up.	Behavioural Observation	Can perform experiments with foresight regarding how metal, water and air heat up, while coming up with strategies and safely handling equipment.	Can perform experiments with foresight regarding how metal, water and air heat up, while safely handling equipment.	Cannot safely handle equipment or perform experiments with foresight.	Correctly handled equipment while coming up with strategies regarding how to position the thermal tape and ice based on foresight. Also, asked the teacher about the danger of heating up a test tube.
III. Can investigate and record how metal, water and air heat up and can represent these characteristics using diagrams and other methods.	Recording Analysis Remarks	Can repeatedly investigate in order to record details and comes up with own strategies while representing characteristics using diagrams and other methods.	Can record results of investigations and represent characteristics using diagrams and other methods.	Cannot record results of investigations or represent characteristics using diagrams and other methods.	Considered time and temperature, and skilfully used colour classifications and arrows while representing experimental results.
Strand IV: Knowledge and Understanding					
I. Understands that although metal heats up gradually from where heat is applied, in the case of water and air, the heated part moves while the whole heats up.	Recording Analysis Remarks Test	Focuses on the properties of each substance while organizing and understanding differences between how metal, water, and air heat up.	Understands that although metal heats up gradually from where heat is applied, in the case of water and air, the heated part moves while the substance heats up.	Does not sufficiently understand the differences between how metal, water, and air heat up.	
II. Uses the characteristics of how metal, water, and air heat up to learn about everyday objects and phenomena.	Recording Analysis	Can name everyday objects and phenomena that match the characteristics of how metal, water, and air heat up.	Can name one everyday object or phenomenon that matches the characteristics of how metal, water, or air heats up.	Cannot recognize everyday objects or phenomena that match the characteristics of how metal, water, and air heat up.	

Table 2. Rubric assessment of the lesson for Student A – Strand III and Strand IV -

As shown in Figure 14, Table 1, and Table 2, it is evident that 2E Student A enjoyed the lesson very much, recognized his high competence and his own progress in science, and increased his self-efficacy and self-esteem through the lesson. He achieved more in all four strands than Student B did, and his score was much higher than the average for the class. The science teacher made special note of many aspects of Student A's learning that went beyond "Fully Satisfactory," as in Table 1 and Table 2.

4. Discussion

4.1 Student A's points of excellence throughout this lesson

Hannah & Shore (1995) showed that the metacognitive performance of 2E students resembled that of gifted students without disabilities more than that of learning-disabled students. When filling out the worksheets for predicting how substances would heat up, Student A considered temperature changes and how much time elapsed, while drawing complicated diagrams using colour classifications, arrows, and so on, and was able to neatly represent his detailed predictions. Student A carefully summarized observed changes, such as temperature differences between the top and bottom of the metal rod, how much the temperature changed, and so on, in detail. In addition, Student A made six predictions regarding how the metal plate or water would heat up, and each time, not only did Student A properly summarize his thoughts but when recording explanations, he was also able to describe his reasoning and expressed great confidence behind each prediction.

Student A verified the experimental methods and made new discoveries during the demonstration experiments, always standing right next to the teacher and listening while mumbling his own impressions and learning the lessons with extreme enthusiasm. Student A also eagerly participated in the group experiments and observations, proactively preparing and putting together each experiment's instruments and enjoying the process of learning.

During the construction activity, not only did Student A verify the properties of heated air by building a hot-air balloon, as soon as the hot-air balloon floated, Student A also built a pinwheel, making Student A the only student in the class to successfully construct two objects. Student A was also the first student to start affixing thermal tape to a hot-air balloon as part of an activity to verify air temperature and often thought of new problems while enthusiastically participating in activities.

4.2 Effects this lesson is thought to have had on Student A

It is necessary to change our present paradigm and go from a deficit to a growth paradigm in an inclusive education (Cline & Hegeman, 2001). This study focuses on nurturing the strengths of 2E children in science lessons. The innovation of using worksheets enabled the children to represent a variety of different ideas. The use of a variety of methods to meticulously and accurately record predictions, including those that are difficult to convey in presentations just using words, made it possible for Student A to skilfully summarize these predictions. Although Student A did not often make presentations or attempt to convey these ideas to other students, what Student A did think of when making predictions was recorded in an easy-to-understand fashion. In the self-evaluation review sheet as well, Student A scored high marks for items related to skills and expression.

Although in previous lessons, Student A was not enthusiastic during activities involving the recording of predictions or results in notes or worksheets, thanks to the use of coloured pencils to classify temperature and the summarizing of changes over time, Student A was able to concentrate on the work from the beginning to the end of the activity time.

The introduction of a variety of different experimental tools, such as glass rods with thermal tape applied, stopwatches for measuring the passage of time, and so on, inspired Student A to participate in the experiments and observations even more proactively. Student A's group spent less time preparing for the experiment than any other group, and by cooperating and sharing responsibilities with other group members, Student A was able to skilfully and accurately carry out the experiments.

4.3 Points for other teachers to keep in mind when implementing this lesson

The lessons of this unit were introduced with an activity that involved observing how a frying pan heats up. This gave the impression that it is important to enhance learning by taking advantage of the everyday experiences of children.

For children to be able to think for themselves of experimental material and methods and to come up with their own strategies, it is first necessary for the teacher to predict what will happen to a certain extent, and to research teaching materials while verifying safety. During this experiment regarding how a metal plate heats up, investigatory methods using the melting or hardening of egg whites, butter, ice, and so on were introduced. Although a variety of different substances will melt when heated, some substances also quickly start to burn, smoke, or emit a smell, and this is why sufficient prior research of teaching materials is necessary. The hot-air balloons used during the construction activity are made by sticking plastic bags together with cellophane tape or sealers, and unless they are as thin as approximately 0.01 ㎜, they will not float properly. If a thick plastic bag is used, since an extremely large balloon must be constructed, it will be necessary to find a place other than the science room for the activity. In addition, when a hair dryer was used to heat up the plastic bags, even after they expanded and grew very large, it was necessary to continue heating them up for two to five minutes before they would start floating.

Finally, when students were split into groups, it was evident that some consideration should be given to the configuration of group membership during observational experiments and other such activities. Besnoy (2006) proposes "Provide peer modelling." This approach permits 2E students to see how a fellow student might implement learning strategies. The inclusion of individual activities is effective, as was the case with the construction activity part of this unit's lessons. In addition, one student in the same group, who clashed several times with Student A during the lesson and who changed the comments for Student A on the mutual evaluation sheet from "Did Well" to "Poor" also filled in places where Student A worked hard and did well during the experiments. Student A, on the other hand, did not write very much. Vespi & Yewchuk (1992) note that while 2E students do not have extremely successful relationships with peers, these students are not rejected by peers and teachers in the same way that learning disabled students are. Although Student A did not write very much about the good points of fellow group members, through the exchange of review sheets, it is expected that the students will be able to realize their own ability to make improvements while building confidence at the same time.

5. Concluding remarks

Japan's special-needs education has added children with so-called "mild developmental disabilities" to the scope of programs, and although progress has been made in the detailed classification of disabilities as well as in theoretical, empirical, and practical certification, educational research involving finding the details of areas where these students excel has been lacking. It may be possible to closely tie research aimed at attesting to areas of excellence in children with learning difficulties with research aimed at compensating for weaknesses in gifted children. As Robinson (1999) stated, 2E students provide educators with an opportunity to examine school learning that addresses both strengths and needs. This is because some of the actions characteristic of children with learning difficulties actually overlap the actions characteristic of gifted children (e.g., Brody, 1997; Hartnett & Nelson, 2004; Leroux & Levitt-Perlman, 2000). For this reason, this research aimed at studying 2E children in science can serve as a seed that will grow into new educational research and practices to meet the diverse needs of children.

Suggestions for enriching the individual strengths and capabilities of students who either have trouble learning science or who show talent in science are summarized as proposals for lesson development below. These proposals are not just for students who tend towards 2E, but are also valid for regular students, including students who are gifted in science.

Proposal 1: When splitting students into groups for observations and experiments, base group configurations on predictions, methods, and so on, including the details and techniques involved in observations and experiments. Including individual activities is also effective.
Proposal 2: Include situations where children come up with their own methods and strategies, and choose their own tools during observations and experiments.
Proposal 3: Introduce situations where children use diagrams to represent their own thoughts and expressions.
Proposal 4: Increase the amount of time allowed for working and thinking.
Proposal 5: Include challenging problems.
Proposal 6: Include a construction activity in units when this is possible.
Proposal 7: Provide a variety of resources.
Proposal 8: Encourage and recognize diverse opinions.

Based on survey results regarding gifted styles in the area of science (Sumida, 2010), there is no significant difference between the ratios of students with and without LD/ADHD/HA in the gifted learning styles of science. In other words, when it comes to giftedness in science, the same opportunities are equally open both to students who have and do not have LD/ADHD/HA. This means that science lesson can help students realize their high potentials and provide in which they can take advantage of their abilities. Rather than including these proposals in every single lesson, it is advisable for teachers to consider incorporating the proposals where possible within a single unit, or within units where possible within a single semester, or within the learning activities of a single year. Finally, I would like to continue further researching into nurturing giftedness in science and into other areas. It is possible to achieve improvements in cross domains where children tend to stumble in terms of learning (in areas such as Japanese or arithmetic) and behaviour (in areas such as inattention, AD/HD, interpersonal relationships, and obsessiveness).

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10

The Quality of Teaching Determines Students' Achievement in Writing

Deilis Ivonne Pacheco Sanz and Jesús-Nicasio García-Sánchez
University of Leon
Spain

1. Introduction

Recent research confirms that it is of great interest and relevance to analyze the level of agreement between the beliefs, attitudes, sense of self-efficacy, learning approaches and self-regulation of the teaching staff and students' achievement in written composition. In most cases, these studies present examples of the practical relationship between the teacher and the students' achievement in the instrumental areas linked to the teaching of writing, such as in the area of reading and mathematics. These studies are significant inasmuch as they have produced valuable information with respect to the levels of education, participants, instruments employed, interventions, teaching or rollout programs carried out, as well as information related to the priorities, organization and development of the research. These interesting contributions lead us to consider which aspects are evaluated within the classroom; the variables which are used to relate the teachers' practices to the students' achievements; the results obtained; the theoretical and educational implications, the limitations and deficiencies of the studies and suggestions for future research. (Álvarez et al., 2011; Díez et al., 2009; Pacheco et al., 2009; Pacheco et al., 2007).

In the process of revising within a Spanish and international cultural setting what promoted the interaction between teachers' practice and writing achievement, we found studies that claim that teachers' practices must be educationally consistent – integrating education and evaluation - in order to obtain positive effects in the activities, processes and results of the of students' learning (Flórez & Monroy, 2008; Stokking et al., 2004).

Other studies have elaborated different categories explaining why the suggested practices are essential to students' success. Categories such as extra or additional classes and the use of active participation are examples of categories that help to improve student achievement. Both the authors claim promote the following activities: classes directed and dominated by discussion and work groups; discussions between teachers and students and, more importantly, among students; significant dialogues between students and teachers; active student participation during normal class sessions through questions and answers or discussing homework, break up groups, discussing together (teachers and students) the solutions to some problems, etc.; and, where categories and topics arise from the students, the teachers can provide answers (de la Fuente et al., 2008; Nkhoma, 2002).

With this in mind, and in accordance with the new approaches regarding the teacher-student relationship, different studies indicate that, at present, teachers may be able to make changes in the teacher–student continuum. This shift, will in turn lead students to behave more autonomously. The traditional type of interaction, which implies a strongly directive position for teachers, will cease to be effective in enhancing the progress or achievement of the students' autonomy. Additionally, this research emphasizes the terms *teacher centered instruction* - an authoritarian or traditional educational style which does not promote great transformations in the students – as opposed to *student centered learning,* where the education tends to be smooth, progressive and result in transformation (Valle et al., 2008; Flórez & Monroy, 2008; Al-Weher, 2004; Taylor et al., 2002; Nkhoma, 2002).

Regarding the type of practices teachers carry out in the teaching of writing and how they influence academic achievement, some studies reveal specific strategies directed at teachers which have proven effective in creating a great variety of learning situations and effective instruction, in the case of students with and without difficulties of learning (LD) and/or underachievement (UP), so that these students develop their linguistic as well as their writing competence (Rosino, 2009; Fidalgo et al., 2008; Villalobos, 2007; García, 2007; García & Rodriguez, 2007; García et al., 2006).

Teachers should be aware, through the studies that are currently available to them, of the key tools required for writing (processes, models, strategies, etc.), to be able to carry out the teaching of writing and thus help students acquire competence and fluidity at the lexical level, and progressively master the mechanisms of writing. Given that consolidating and becoming proficient in the orthographic system is a long process that demands a great deal of experience and practice, teachers must teach and encourage their students to self-regulate and control their word production. Thus, the common objective of teaching specific strategies is to assist students in becoming self-regulated learners, able to learn by themselves. One of these strategies, for example, is the revision process. Evidence shows that helping students increase the frequency and depth of their revision is a powerful strategy, allowing students the cognitive freedom to focus on the text and its correction (Rosino, 2009; Perez, 2001; Chanquoy, 2001).

In addition, many theories on writing promote the idea that writers' attitudes are formed or developed partly through the use of writing instruments and claim that technological instruments can make the writing process easier as well as increasing motivation for students with LD. These theories maintain that both students and teachers feel the effects of the new means of writing. In the case of the students, these new writing methods are favored, in terms of the quality of the product and the aspects of the students' achievement, which can describe their own behavior. Teachers also report students' greater desire to use these instruments, a greater motivation to begin new projects and to produce greater amounts of written work. The reasons for greater enjoyment include the presentation of high quality work, the speed at which the work can be produced and the ease with which a text can be organized and changed (Jiménez et al., 2003; Parr, 1994).

Other research has made interesting contributions to the principles that should be implemented both in order to prevent difficulties and to develop writing skills. Among these, we can emphasize the following : the provision of effective writing instruction; the preparation of instructions to detect each student's individual needs; early intervention to

provide additional aid; the expectation that every student will learn to write; identifying and managing the academic barriers to writing; and, the use and development of technological instruments that improve writing execution. The most interesting point, according to the authors, is to look into how to reduce the children's difficulties in written composition and how the school and teachers can help these children with learning difficulties to improve their writing (Graham, 2006; Graham et al., 2001).

According to research, the writing education that many students receive is inadequate because it focuses almost exclusively on the teaching of lower level writing skills, such as calligraphy and spelling, with few opportunities to actually write. Other students are in classes with an increased frequency of writing tasks , but only a short amount of time is devoted to teaching the necessary writing skills and strategies, as it is assumed that these abilities can be acquired through informal and secondary methods of study. Other children attend schools where practically no time is devoted to ensure writing skills are obtained or to the teaching of writing. It is highly improbable that children with learning disabilities acquire the necessary knowledge in programs such as these (de Caso et al., 2011; Pacheco, 2010; García et al., 2009; Troia, 2006).

Most researchers believe the teaching of writing for these students should focus as much on prevention as on intervention; it should respond to the specific needs of each student; it should maintain a healthy balance between meaning, process, and form; and it should make as much use of formal methods of study as of informal methods. Designing instruction for the teacher as well as for the educational level is in itself not an easy task. However, it requires a coherent, coordinated, and extensive effort. The writing problems experienced by children with learning difficulties are not transitory difficulties that are eliminated easily, immediately or without establishing precise and effective practices (Graham, 2006; Troia, 2006; Villalobos, 2006; Graham et al., 2002; Graham et al., 2001). Based on the considerations addressed within this framework, in this research we propose, as a fundamental objective, to study written composition teaching practices in relation to the achievement of the students with and without LD and/or under achievement. Teachers' practice is thought to be based on their beliefs, attributions, expectations and the sense of personal efficacy that they hold with respect to the teaching-learning process. This is also closely related to students' achievements and the factors or components that modulate them (the students' motivation, the role that the parents or the family environment play in this process and the teacher's use of strategies, procedures and instruments in the area of writing or, in other curricular areas). Thus, the hypothesis supposes that the teachers' beliefs exert a strong influence on the practice of written composition and are predictive of students' success in the classroom. It is believed that this relationship varies depending on students' level of education and on the type of student.

2. Methodology

Participants

Participants were selected from two types of origin, although interrelated. One group was the sample of teachers taken from a previous study. The other groups were the students (of these teachers) who were classified into three categories - with attention deficit disorder (ADD), and without hyperactivity (ADHD), with or without learning disabilities (LD).

The teaching staff

We evaluated 99 teachers from 30 private and state schools in the province of León, Spain, who teach Spanish language (the local first language) and are responsible for students with and without learning difficulties and/or low achievement, in the last year of infant education and the first three years of primary education.

The selection criterion for this sample was based on that used in previous studies the research team developed in these schools regarding different writing-related areas of interest - the influence of working memory and attention on students. The students addressed were both typically achieving and with learning difficulties, of different ages, with and without ADHD.

The teachers taught Spanish language to pupils in the second and third years of Primary Education, at 20 of the 30 private and state schools in the province of Leon, Spain. Of these teachers, 83.33% were women, 64.23% worked in state schools and 37.77% were employed by private schools. The average age of the teachers was 46.92 years, with a maximum age of 60 and a minimum of 27, which indicates both maturity and stability in the teaching career.

The average years of experience in this career was 23.43 years, which indicates significant educational experience. 18.84 of those years specifically devoted to language teaching. This means that they were experts in the instructional aspects related to teaching written composition. Only 12.4% had a bachelor's degree in philology or education and the remainder had a teaching degree in another specialist area. None of them had one in special education.

The students

The sample of students was selected in a similar fashion to the selection of the teachers. They were chosen following several strict criteria with the purpose of being able to match the sample with the needs and goals of this research project.

The first criterion was that the students selected receive classes from the teachers in the sample. This criterion was applied with the concurrent selection of the teachers, that is to say, the students and professors were selected simultaneously. The study was carried out independently by people different from those in the research Team on Excellence in Psycho-Educational Intervention in Developmental and Learning Difficulties directed by second author. This was done as if they were independent studies; with the aim of ensuring there was no interference in the results. This ensured the teacher's knowledge of the research objectives did not interfere, and there would be no bias resulting from the knowledge of the true object of this study.

The second criterion was to include students from the three categories, that is to say, students with LD, students without LD and/or students with ADHD. The latter group was recruited from the Association of Parents of People with ADHD in the province of Leon (ALENHI, Leon Association of People with Attention Deficit Disorder with and without Hyperactivity). In addition, discrepancies between achievement and IQ of the students with writing LD were found in the intelligence measures, but that was not the case for students without LD or with ADHD, which was relevant to the selection of the samples.

The third criterion required the sample to be representative of the spectrum of the educational levels for the teachers studied. The aim was to relate the achievement in written composition to the data collected from the sample of teachers. However, before the third year of Primary Education there is a limited production or level of written composition. This study addressed from the third year of Primary Education on. That is to say, we only included students of second (third and fourth years) and third cycle (fifth and sixth year) of Primary Education in the sample.

After applying the three criteria, a sample of 111 students of 3rd to 6th year of Primary Education was extracted (78 males and 33 females). Of these, 35 students had LD, 36 did not present LD and 40 had ADHD. Their ages ranged from 9 to 12 years. The average of age of the sample of the second cycle was 10 years old and the average of age of the third cycle was 11 years old. (For more details see Table 1).

Student typology	Students	PE-2nd	PE-3rd	Total Level
	Male	14	20	34
	Female	3	3	6
ADHD Students	Total Level	17	23	40
	Average age	10	10.5	
	Min-Max	9-11	9-12	
	Male		20	19
	Female		16	16
LD Students	Total per Level		36	35
	Average age		11	
	Min-Max		10-12	
	Male		25	25
	Female		11	11
Students without LD	Total per Level		36	36
	Average age		10.5	
	Min-Max		10-11	
Total Level		17	95	111

Table 1. Distribution of the sample of students by type, gender, age and cycle of Primary Education.

Instruments

The instruments employed were concerned with measuring the teachers' variables, that is to say, with the role of practice in the teaching of the written composition, and with the measures of the students' variables.

Evaluation of the teaching staff

The development of the instrument which is the object of this study began by first reviewing the Academic Search Elite databases, which are available at the Central Library of the University of León. Moreover, it was essential to study and review the legislation, educational programs and guides that establish the syllabi for both infant and primary education. This permitted the collection of information about the evaluation criteria in the area of Spanish language in each of the educational stages studied, and in particular the empirical data related to the focus of this research study.

These theoretical bases allowed the researchers to proceed to the collection, translation and, where appropriate, modification of the instruments used, as well as developing new tools to assess the areas and components that affect teachers' practice in the teaching of writing. Once created, they were subjected to validation (reliability, validity, norms, etc.) by the research team.

In this way, we obtained the instrument that evaluates the Role of Teachers Practice in Writing (PRAES), together with its corresponding questionnaires: the first focuses on opinion (PRAESPO), the second on the theoretical approach (PRAESPE) and the third refers to the classroom activity - what teachers actually do (PRAESPA) – and, finally, the focus of the last questionnaire was on self-efficiency (PRAESAE) (Pacheco et al., 2007).

Overview of the psychological meanings assessed

The PRAES is shaped both by the identity of the teacher, and by the four sections or questionnaires related to the components and factors that affect practice. (For details, see Table 2). The names of each questionnaire, presented in the order in which they are used in the PRAES protocol are as follows:

1. Practice-Opinion (PRAESPO), refers to the teachers' views regarding the role of the teacher in their teaching writing practice. It considers the following components and indicators: (i) The personal student component (motivation, planning and review), (ii) the practice component, (iii) the family component and (iv) teachers' training. This questionnaire was prepared by the research team.
2. The Practice Approach Questionnaire (PRAESPE) evaluates teachers' theoretical orientation in relation to the formal and the natural learning process of writing. This instrument was adapted from the Writing Orientation Scale (Graham et al., 2001).
3. The Classroom Practice Questionnaire (PRAESPA) measures the skills, instructional procedures, activities and materials used by teachers when teaching writing, and the type of text or the actual texts they use. This instrument was partially developed by the team and partly adapted and translated from Graham et al., (2001), based on his Teacher Writing Practices Scale.
4. The Teacher Writing Practices Scale Practice (PRAESAE) helps to better understand the type of factors that create both personal and general difficulties for teachers in their teaching, thus determining their self beliefs in the process of teaching writing. This instrument differentiates between self-efficacy and general efficacy. It was developed by the research team, based on the Teacher Efficacy Scale for Writing, adapted according to the directives and guidelines for constructing self-efficacy scales (Graham et al., 2001; Bandura, 2005).

Aspects Evaluated	Instrument	Tasks	Parameters
The role of practice	PRAES	Four Questionnaires	Rating
Opinions about the factors that affect the teaching of writing	PRAESPO	Likert type Questionnaire	Rating
Theoretical Approach (natural vs. formal)	PRAESPE	Likert type Questionnaire	Rating
Classroom Activities	PRAESPA	Likert type Questionnaire	Rating
Teachers' self-efficacy regarding the teaching of writing (personal and general)	PRAESPAE	Likert type Questionnaire	Rating

Table 2. Aspects evaluated in teachers and instruments used in research

Student evaluation

The instruments used to measure the student variables were of two types. Firstly, we used measures to monitor the level of students' general achievement and their level of intelligence and, secondly, instruments to measure specific achievement in written composition.

General measures

In order to measure intelligence, we used the Cattell assessment, with the purpose of selecting the suitable participants and, in particular, to establish the aptitude achievement discrepancy criterion (LD) or no discrepancy (under achievement), as well as to observe whether students had intellectual limitations (whether they had LD or ADHD or not). In addition, measures of general achievement were obtained through scale (from 1 to 4) and appreciation instruments filled out by the teachers regarding each of the students. For this type of instruments, several protocols were developed that covered all education levels (Infant Education, Primary Education, and Compulsory Secondary Education). These instruments were constructed specifically by the research team based on the guidelines of the Curricular Designs Base, the Ministerial Decrees and the Council of Education of the Region of Castile and Leon. They were elaborated through meticulous analysis, and were adapted to the objectives of the research team. This analysis was carried out with the goal of teachers evaluating the students' general achievement in language and mathematics.

The purpose of the application of these appreciation scales was to obtain an approximate measure. Although they were based on the teachers' opinion and therefore were subjective measurements, they do come from an expert on the student whom they teach. It fundamentally concerns the students' general achievement in language and mathematics, to be able to compare it with her/his level of intelligence, measured by the Cattell assessment, and to be able to state whether there is a discrepancy between aptitude or capacity and achievement (see Table 3).

	Students: General measures		
Evaluated Aspects	Instruments	Tasks	Parameters
Overall Intelligence	IC Cattell	Four intelligence subtests	Total score, CI total and Centil
Overall Student Performance	Teacher Rating Scales	Questionnaire / Appreciative Scale of performance in language and math	Ratings and qualitative observations
	Students: Specific Measures		
Writing Product	Editorial Writing	Editorial writing and comparison-contrast	Objective and subjective indicators
Text-based Measures	Editorial Writing	Editorial writing and comparison-contrast	Objective and subjective indicators
Reader-based Measures	Editorial Writing	Editorial writing and comparison-contrast	Objective and subjective indicators
Productivity and consistency	EPPyFPE (García, Marbán, & de Caso, 2001)	Editorial writing	Indicators

Table 3. Aspects evaluated and instruments used in research on the students.

Specific measures

We measured specific achievement in written composition through two types of tasks. The first task entailed writing a free format text that served to establish the students' level of writing. It also helped establish whether there was a discrepancy between aptitude and achievement in writing, using the scales developed by the research team (García, 2001; García and Marbán, 2003). The scales corresponded with "the other measures of coherence" (relevance, connectors, paragraphs and argument thread) and, with several parameter measures (content and, functional words and determiners) that were previously applied by García and Marbán (2003). The measures of productivity and coherence were obtained from the written compositions of the participants in the planning tasks. Productivity is the amount of text developed by a student in each of the tasks. This productivity was verified by analyzing the words in the content, functional and determining words' parameters. A text is considered coherent when it presents information in an organized way, so that different receivers can perceive it as a unit. The coherence of the text was measured by means of relevance indicators to demonstrate theme continuity, and observe the ability to connect the ideas to construct proposals, to construct well-delimited paragraphs, to organize the sequence of these paragraphs to establish the thread of the argument throughout the text. When it was a narrative, the coherence analysis was carried out by means of a structure analysis, adjusted to include the indicators of a framework (time, space and characters) and of episode (initial event, response execution and consequence). In addition, for the tasks entailing converting matrices into propositions, the total scores of integration of the information were obtained (García and Marbán, 2003).

The second task consisted of several texts of comparison-contrasts, where reader and text-based measures were taken. The parameters obtained from these tasks, were those that were used to relate the students' achievement in written composition to the role of the teachers' practices in the teaching of writing.

Text-based measures

The text-based measures evaluate information generation or productivity and the organization of the information, or the coherence and structuring of the information. For example, in the case of information generation, aspects such as the title, the number of paragraphs, the number of textual units, the number of verbs in personal form, the number of content words and, functional words and determiners are tallied. As for the organization of the information, objective elements relative to referential coherence (indicating referential and lexical coherence) and to the relational coherence (meta-structural and discursive indicators) were measured, as well as "other measures of coherence". As regards the aspects related to the structuring of the information, objective measures concerning the textual typology were used (comparison-contrasts) were measured as well as the number of punctuation marks (commas, periods, question marks, inverted commas, vignettes, etc.).

Reader-based measures

These concern a qualitative evaluation or judgment considering the specific criteria for the comparison-contrast type text. It involves making a global evaluation, as far as structure, coherence and quality are concerned, as indicated in detail in Table 4.

Type of measures	Evaluated Appearance	Parameters
Text Based	Productivity	Number of paragraphs Number of sentences Number of verbs Number of words (determinants, content, functional, and totals)
	Consistency	Number of cohesive ties: anaphoric, lexical, meta, structural, connective, argumentative, reformulative Referential consistency: anaphoric and lexical ties Relational consistency: metastructural, connective, argumentative and reformulative ties Total consistency: relational and referential coherence Density of consistency: number of ties for every 100 words
	Structure	Number of main parts of a text, introduction, main body and conclusion
Reader based	Structure	Rating (1-4)
	Consistency	Rating (1-4)
	Quality	Rating (1-6)

Table 4. Aspects used to evaluate the text produced (translated Garcia & Fidalgo, 2006, pp. 185)

Procedure

The study presented here, which is a descriptive study, consisted of two comparative and related samples, chosen simultaneously from 30 schools. The samples were selected to complement each other. In fact, the research team was carrying out a series of studies in the province of León which required samples of students from three different categories which are matched for general characteristics: a group of students with LD, another group without LD and a group of students with ADHD.

The sample of the teachers was selected on the basis of the criterion explained above. They were teachers who were responsible for students with and without learning difficulties and/or low achievement in infant and early primary education. The next step was the fieldwork itself. It consisted, firstly, of establishing telephone contact with the school principals to obtain permission to visit and carry out the protocol with the language teachers of the selected school years in each of these schools. Two researchers then visited the schools on the agreed dates and times and asked teachers to complete the protocols. The sample selection was performed directly by the two researchers and not by other means, to ensure the reliability and validity of the instruments in the collection of information. Data collection was conducted over a period of five months.

The procedure followed for the data collection from students can be summarized in the following steps. Firstly, general measures of sample selection were applied. Different members of the research team, with an approximate duration of 10 to 20 minutes, carried out an IQ measurement using the Cattell assessment in small groups. After the Cattell assessment, students were asked to carry out different written composition tasks. Small groups of students carried out individual free text exercises (García, Marbán, and de Caso, 2001), to determine their level of achievement in writing. Several comparison-contrast texts were written to obtain the indicators and the measures of the product of the writing (text and reader-based measures). These measures were used to relate the students' achievement in writing to the role of the teachers' practice, which constitutes the object of this study. Our basis for this sample came from an initial sample of more than 350 students from previous studies carried out by the research team, of which only 111 students were selected for this study. Simultaneously, the teachers were asked to complete evaluation scales regarding the each student's general achievement . This task took some time and once finished the forms were collected.

Along with the application of these instruments and tasks, a further set of tests and questionnaires were applied. These were related to attention, working memory, and the study of the online processes used in written composition. They were measured by means of a writing log, but they are not included in this study, as they are part of an overarching project including different studies with broader goals than those presented in this article. Once all the assessments were carried out in the 30 schools, the members of the research team analyzed all the texts. Members of the team, who had received specific training over several meetings, including the study of the correction dossier and the systematic supervision of the written texts, carried out their meticulous correction. The texts were corrected twice and anonymously with the purpose of reaching an agreement between coders. The approximate time dedicated to the correction of texts for each student was of two hours, including the codification and computerization of the data. The correction was

carried out after eliminating the data concerning the students' identity, their typology, age, school, and gender, etc. Therefore, the evaluators were blind to the origin, level, etc. of students. In addition, corrections were systematically balanced to ensure that all the correctors marked texts belonging the three student categories and from all participants levels of education. The data from the corrections of the general measures and of the specific measures of the written composition, along with the data provided by teachers, were codified and computerized in Excel matrices by the team members. These Excel matrices were then integrated into a single SPSS matrix by the research director who also carried out the different statistical analyses (univariate and multivariate analysis) and the interpretation of the results.

3. Results

After the creation of a single matrix on SPSS (v. 13.0) with the variables generated for the data regarding teachers and students, the following types of analysis were carried out: multivariate analyses of variance (MANOVAS) using the SPSS Model Lineal General module (MLG) and multiple linear regression analyses (ARL).

General Linear model

The multivariate contrasts in the student based measures based on their typology (ADHD, LD versus without LD), indicate highly significant statistically results with a large size effect [$F (84, 28) = 3.52$; $p = .001$; $\eta^2 = .914$].

For the execution of these multivariate analyses of the three student typologies (ADHD, with and without LD) and, as dependent variables, the different measures obtained for the students and the teachers were taken as intersubject factors. The purpose of this was to highlight the differences between the teachers as regards the role of practice in the teaching of writing. We also sought to show the differences according to student typology and to try to extract some pattern to help understand the relationship between the teachers' writing teaching practice and the students' achievement.

The tests concerning the intersubject/intergroup effects also indicated statistically significant results in most of the dependent variables related to students and to teachers. The size effects, in general, were large. When the grouping variable (intersubject factor or fixed factor) belonging to a specific group was taken (with ADHD, with and without LD), statistically significant differences were observed, both in the writing tasks and in comparison–contrast texts. In the comparison-contrast texts significant differences were observed for the variables of information generation, organization of ideas, structure, reader-based quality measures, etc. For example, for organization of ideas in relational coherence ($p = .001$; $\eta^2 = .217$); or for reader-based measurement as concerns structure ($p = .001$; $\eta^2 = .213$); and for reader-based evaluation (order-quality) ($p = .001$; $\eta^2 = .284$). Also, in the writing task, statistically significant differences were observed for idea generation and total productivity ($p = .001$; $\eta^2 = .268$); in the reader based evaluation (order and structure) ($p = .001$; $\eta^2 = .486$); and in quality ($p = .001$; $\eta^2 = .383$).

As concerns what teachers actually did (see Table 5), it was interesting to observe that it differed according to the students taught, in motivation (close to statistical significance), in natural teaching approach, and in self-efficacy (very close to statistical significance). The tests of the intersubject effects indicated statistical significance for the opinion variables,

motivation subcomponent (p = .073; ŋ ² =, 091); approach, natural learning subcomponent (p = .002; ŋ ² =, 205); and, close to statistical significance for general self-efficacy (p = .058; ŋ ² =, 098).

Measure/group	ADHD (N = 40)		DA (N = 35)		SDA (N = 36)				
Variables	M	α	M	A	M	α	F	p	ŋ²
Opinion: Reasons	29.59	3.84	28.18	4.96	31.32	3.72	2.74	.073	.091
Opinion: Planning and revision	24.12	2.08	24.91	2.22	26.16	1.97	1.18	.314	.041
Opinion: Practice	30.59	4.34	31.64	3.23	33.00	2.47	2.30	.109	.077
Opinion: Family	15.41	2.47	14.09	2.91	15.26	1.55	1.83	.170	.062
Formal Education Approach	39.88	8.08	37.64	7.65	41.21	6.90	1.18	.315	.041
Natural Learning Approach	34.59	7.06	27.91	4.63	30.26	4.86	7.08	.002	.205
Classroom: Skills	24.29	3.72	23.05	3.33	22.95	2.97	.907	.410	.032
General Self-efficacy	33.05	10.06	38.31	4.79	37.00	4.92	3.00	.058	.098

Table 5. Statistically significant results: multivariate analysis of variance in the teachers' measures (PRAES) between groups of students with ADHD, DA and without DA

When the contrasts between the significant variables obtained in the tests of the intersubject effects (between the groups) were collated post hoc, we found statistically significant differences in many of them (see Table 6). For example, there were significant differences among the post contrasts and between the group with LD and the group without LD. The same was noted for the ADHD group, that showed significant differences compared to the group without LD. However, no significant differences were noted between the groups of students with LD and those with ADHD. This pattern was observed in the variables that refer to the writing task in total productivity (LD as opposed to without LD, p = .001; without LD as opposed to ADHD, p =, 047) and for organization of ideas, referential coherence (with as opposed to without LD, p =,051). Other patterns noted are also of interest, for example, the significant differences between the three groups, as is the case with the reader-based structure measures (with LD as opposed to without LD, p = .001; LD compared with ADHD, p = .056; and without LD compared with ADHD, p =,001).

Also, we would also like to highlight the results concerning the teachers – the statistical significance related to the motivation variable (p = .073), natural teaching approach (p =.002) and general self-efficacy (p = .058).

The post hoc contrasts indicated different patterns between the students with and without LD and ADHD with regard to the teacher related variables. There were likewise differences between the group with LD and those without LD. The ADHD group is significantly different from the group without LD, but this is not so between the LD and ADHD groups. This pattern is observed in the natural teaching approach variable (LD as opposed to ADHD, p = .002; and without LD as opposed to ADHD, p =, 072). The non-significant variables related to the PRAES include those which correspond to: Opinion and the subcomponents of practice (p = .109), family (p = .170) and teacher training (p = .650); the formal approach (p = .315); the actual classroom behaviors and the subcomponents of abilities (p = .410), materials (p = .874), procedures (p = .271), texts(p = .278) activities (p = . 454); and personal self-efficacy (p = .913). These variables, to some extent, predict teachers' behaviors in the teaching of written composition (see Figure 1).

	Essay (p)		
Variable	LD vs. WLD	LD vs. ADHD	WLD vs. ADHD
Total Productivity	.001	n. s.	.047
Organization of ideas: consistency referential	.051	n. s.	n. s.
Organization of ideas: total coherence	.049	n. s.	n. s.
Other aspects: overall coherence	.041	n. s.	n. s.
Reader based evaluation: amount, structure	.001	.056	.001
Reader based evaluation: summary, consistent	.001	n. s.	.001
Reader based evaluation: amount, quality	.001	n. s.	.002
Reader based evaluation: order, structure	.001	n. s.	.001
Reader based evaluation: order, coherence	.001	n. s.	.001
Reader based evaluation: order, quality	.001	n. s.	.001
	Comparison-contrast (p)		
Productivity total	n. s.	n. s.	.075
Relational Consistency	.029	n. s.	.002
Total Consistency	n. s.	n. s.	.052
Other aspects: overall coherence	n. s.	.039	.001
Reader based evaluation: amount, structure	.005	n. s.	.055
Reader based evaluation, summary: consistent	.005	n. s.	.001
Reader based evaluation, amount: quality	.003	n. s.	.002
Reader based evaluation, order: structure	.008	n. s.	.005
Reader based evaluation, order: coherence	n. s.	n. s.	.027
Reader based evaluation, amount: quality	.001	n. s.	.001

Table 6. Post-hoc significant contrasts in the multivariate analyses, both for the students' writing tasks (by type) and for the teachers' actions (by type of students)

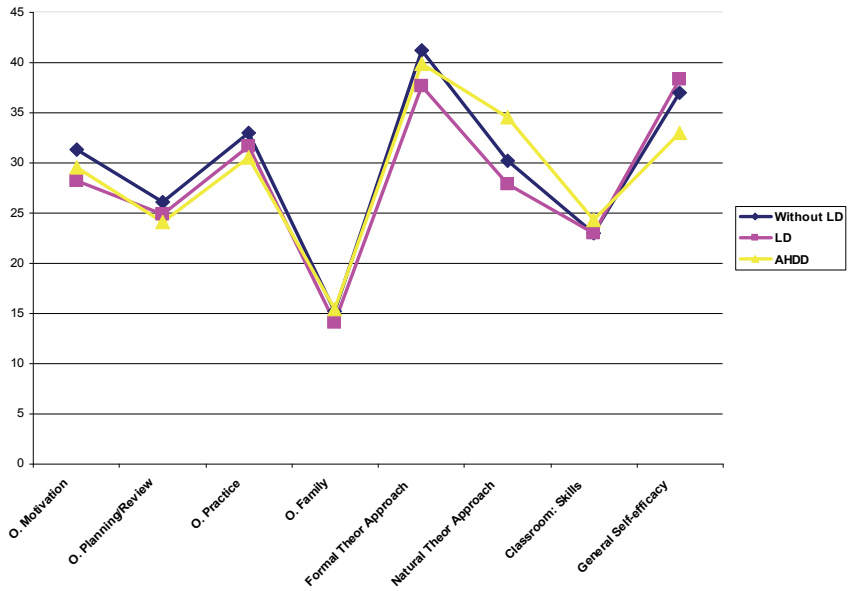

Fig. 1. Statistically significant differences in the teachers' variables, depending on student typology.

3.1 Multiple linear regression analysis

Prediction of student typology

If we considering the total writing measures (product totals from reader and text-based measures) and the measures of the PRAES (scale and the subscale totals) as predicting variables, and the type of student as the predicted variable, we obtain statistically significant results. When the measures are taken only from writing, statistically significant results in the prediction of the type of students were also obtained. However, when only the PRAES results are considered, they do produce statistically significant results in the prediction of the type of student. In any case, this is interesting, as it does not support the idea of there existing differences in the teachers' practices based on student typology. When the type of student is taken as a dependent variable (ADHD, LD, without LD) or as a variable predicted by the set of the total measures of the written product (students' achievement), in the hierarchic multiple regression step-by-step analysis, we obtained one model with a statistically significant regression coefficient (R^2 corrected =.496). The variables in the model that reached statistical significance are, among others: writing, reader based evaluation concerning order and structure [β = .711; t = 7.557; p = .001] and other aspects of total coherence [β = -.283; t = -2.447; p = .018]; those from the PRAES as regards classroom practice and the procedure subcomponent [β = -.237; t = -2.645; p = .011] and for the opinion and the motivation subcomponent [β = .182; t = 2.167; p =.035]. The remaining variables were excluded from the model, as they did not reach statistical significance.

Prediction of the written product

When the writing variables (the product totals from the reader and text-based measures) are taken as predicted variables and the PRAES variables as predicting, many produce statistically significant results, albeit of a low level. However, this is interesting, as they indicate a tendency, and given the nature of the different measures this points towards results which are very relevant from a theoretical point of view.

The fact that some total measures from the PRAES predict some totals for the writing product is very interesting, given that there is some relationship between the two. For example, the factors that are involved in the prediction of total productivity include the factors attributed to the family and the formal teaching approach, as are those used by teachers who will mainly employ these in students without LD. Other variables regarding teaching staff that predict some measure of achievement in writing are the procedures used (in several variables), the role assigned to the family, the materials used (in several variables), the natural teaching approach (more used with the group of students without LD and those with ADHD), personal self-efficacy, the formal teaching approach, teacher training, motivation, classroom practices, the use of plans and revision.

Of the 27 regression analyses extracted to predict writing based on PRAES, 23 were found to have statistical significance. The variables from the PRAES that are predictive regarding writing concentrate on the family subcomponent, classroom activities with the subcomponents of procedures and materials, in addition to the formal theoretical approach, the natural learning approach, personal self-efficacy, teacher training, motivation and the aspects of planning and revision. In addition, the attempt to predict writing achievement based on total productivity and the number of words parameter from the PRAES was

carried out and a corrected R^2 of .067 was obtained. This is significant, although it only generates a regression model or equation with the predicting variables of PRAES for opinion with the family subcomponent [β = .276; t = 2.817; p = .006] and for approach, with the subcomponent of formal approach [β = .217; t = 2.213; p = .029]. It does not generate any other significant variables, which we have therefore excluded from the model.

In summary, regression analysis provides statistically significant data for predicting all the writing variables within PRAES, which presents interesting data regarding predictive validity. It also indicates the great predictive potential of the instruments applied, as they allow us to observe variables that are not always of the same nature.

4. Discussion and conclusions

The objective of the present study was to consider the teachers' self-regulation in the teaching of written composition in relation to the achievement of students with and without LD and/or under achievement. It was expected that the results of this study would show that the teachers' beliefs both affect and have a strong influence in their classroom practices concerning written composition and also that this predicts students' success. According to the results obtained it is possible to affirm that, broadly speaking, the objective was achieved. As for the hypotheses, they were only proven for some measures but not for others. For example, data was obtained which supports the differences between the students based on the PRAES assessment. The potential of the PRAES to predict writing achievement was also demonstrated. However, data was collected which does not necessarily corroborate the prediction of the typology of students based the PRAES. This may be due to the nature of the measures or perhaps because there is no actual predictive potential. As far as the sample is concerned, as well as being representative, relevant and of a broad spectrum (compared with the samples in other empirical studies), it also allows us to describe the students' achievement according to the type of practice employed by teachers.

As regards the instruments used, given the revision of empirical and theoretical studies published in recent years, we can confirm that the PRAES and the applied writing measures (general and specific) used to evaluate both general achievement and specific aspects of written composition display not only acceptable validity and reliability but, also, appropriate sensitivity to the detection of differences based on the type of student and according to the prediction between variables. It is important to highlight that we know of no published studies that jointly employ the four PRAES components (Opinion, Approach, Classroom Behavior, Self-efficacy) to evaluate teachers, as well as the instruments applied to evaluate and to measure students' general and specific achievement in written composition, and that link both teacher and student measures. This justifies and affords relevance to the present study. As concerns the statistical analysis and its contribution to the study, when taking the intersubject factors – the three typologies of students (ADHD, LD, without LD) – as dependent variables, the different measures obtained for students and teachers verify the differences among the teachers regarding the role of their practice in teaching written composition, based on the differences according to the students' typology.

The results obtained are of high statistical significance in most of the dependent variables regarding students and teachers, with large effect sizes, in general. As regards the students, when belonging to one group type is taken as a grouping variable (with ADHD, with and

without LD), statistically significant differences are observed, both for the writing tasks as for the comparison-contrast texts. In comparison-contrast texts, significant differences were observed regarding the variables of information generation, organization of ideas, structure or reader-based quality. Examples include the organization of ideas in relational coherence, reader-based evaluation concerning structure, and reader-based evaluation for order and quality. Also, in the writing task statistically significant differences were found regarding idea generation and total productivity, in reader-based evaluation for order, structure and quality. As far as teachers are concerned, it is interesting to observe that they behave differently based on the students they have, as regards motivation, general or natural teaching approach and self-efficacy. The tests of intersubject effects indicated statistical significance for the opinion variables, in the subcomponents of motivation; approach, natural learning; and general self-efficacy.

When trying to extract some pattern that would help understand the relationship between what teachers actually do when they teach writing and students' achievement, a very interesting observation was made. A relationship was noted underlining the fact that some total measures of the PRAES predicted some totals of the writing product. Other variables concerning the teachers that helped to predict some measures in writing achievement were the procedures used, the role assigned to the family, the materials employed, the natural teaching approach, personal self-efficacy, the formal approach, teacher training, motivation, the practice and the use of plans and revisions. Of these, those that most significantly predict writing variables are: the family, the activities carried out in the classroom along with the procedures and the materials used, as well as the use the formal theoretical approach.

When the type of students (ADHD, with and without LD) was taken as an independent or a predicted variable from the set of total measures of the writing product we found variables included in the model related to writing: writing a draft, reader-based evaluation, order and structure and other aspects of total coherence. We also noted variables related to the PRAES: practice in the classroom in the procedure subcomponent; opinion and the motivation subcomponent. The remaining variables were excluded from the model, as they did not reach statistical significance. When we attempted to predict writing achievement through total productivity in the 'number of words' parameter, a regression model or equation was obtained with the following PRAES predicting variables: opinion, the family subcomponent, and the formal approach. No other variable was found to be significant. These factors are, at least indirectly, based on the type of teachers' practice in the area of Spanish language. There were no significant differences in relation to the theoretical concepts and strategies applied in the teaching of writing in the different school years from Infant to Primary. There were, nevertheless, differences based on age, which is an indicator of some type of adjustment according to the students' stage of development. According to the results obtained, all teachers seem to act in a homogenous way as far as the theoretical conceptions that direct their behavior are concerned - or in other respects, which indicates poor self-regulation of their practice. In addition, it appears that their practice of teaching writing does not substantially differ between students with and without learning difficulties and/or low levels of achievement.

It is clear that this study presents evident limitations concerning the use of PRAES, and it should be complemented with direct observation of the teachers' behavior as well as direct

observation of students' achievement in the classroom. It also seems reasonable to carry out this type of analysis in other areas and to observe whether there is any general pattern or specific patterns related to the practices in each area.

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Correspondence should be addressed to Departamento de Psicología, Sociología y Filosofía. Área Psicología Evolutiva y de la Educación. Campus de Vegazana s/n, 24071 – León, Spain. Phone: +34-987291041 (university); +34-987222118 (home); +34-652817871 (cell); Fax: +34-987291035 (university). E-mail: jn.garcia@unileon.es.

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11

Diagnosis of Teachers' Practice in the Teaching of Written Composition

Deilis Ivonne Pacheco Sanz and Jesús-Nicasio García-Sánchez
University of Leon
Spain

1. Introduction

When considering the role of teachers in education an estimation and simplification could be made, indicating that their activity depends on factors that revolve around four key areas: students, time, space, and the characteristics of the institution. The enjoyment or discontent of their students, the number of students and the duration of the classes, the space available for physical activity and the support from other teachers and the institution, positively or negatively impact their availability to teach in a general sense and the self-regulation of their practice. We could say that understanding how a teachers' effectiveness influences overcoming the obstacles which are part of the process of education depends on many factors, including, among others, those described above, as well as other aspects, some of which will be studied in this article (Pacheco et al., 2009; Pacheco et al., 2008; Martin & Hodges, 2003).

The knowledge on the effectiveness of teaching specific lessons, such as developing writing skills is somewhat limited for teachers. However, many of these barriers, and the effectiveness of teachers in handling them would seem to be a logical obstruction to achieving other objectives and outcomes in their classroom. In this way, *belief in the self-efficacy or individuals' the set of beliefs about their own ability to achieve certain results* is a variable that needs to be considered in the study of teachers' practices (Bandura, 2005).

Beliefs concerning efficacy influence people's thoughts, both to stimulate and to disparage (optimism or pessimism) several aspects: the courses of action they choose to pursue, the challenges and goals that they set for themselves, their commitment to them, the amount of effort they invest in certain endeavors, the results they expect to achieve for their efforts, the magnitude of their perseverance against obstacles, the resistance to adversity, the levels of stress and pressure experienced when faced with challenging environment, and the achievements that they accomplish. The different areas of activity, performance, strategies, beliefs in the effectiveness for learning and developing their skills as teachers are some of the conditions associated with social cognitive theory. This theory presents some variation regarding the different domains of functioning (Álvarez et al., 2011; Pacheco et al., 2009; Bandura, 2005).

In addition, teachers' perceptions motivation to implement new ideas and teaching methods can generate changes in their conceptions of the teaching-learning process (de Caso &

García, 2006; García & de Caso, 2004, 2006a). Teachers may modify the preconceived ideas they have about any particular subject when faced with the need for a change of approach that is generated in society or in education. Training courses on new approaches can encourage them to talk about new ideas in cooperative groups and to relate theory to practice (Bazarra et al., 2004). In the case of adopting the constructivist approach and implementing its practice in the classroom, for example, by encouraging them to abandon the "spoon feeding" style of teaching in favor of a self-centered learning style and to discourage teacher-centered learning for student-centered learning, or choosing a democratic over an authoritarian style, placing greater emphasis on real and everyday life experiences rather than on approaches based on memorization and discarding traditional methods of evaluation for new methods that allow students to explain what they know or have learnt in different ways (Al-Weher, 2004; Flowers & Monroy, 2008).

With regard to educational research, the majority of teachers believed that the scientific method is present in the curriculum but is not employed in practice, which indicates the true situation for research (Sierra et al., 2009). This knowledge may allow them to suggest improvements in the areas of training in educational research. Some examples would be to research: how children learn, how students are motivated and which materials are necessary to make learning concepts more interesting for the students, the teacher-student interaction, whether real life examples stimulate students to study specific concepts, why students have problems with certain concepts or skills in certain areas, etc. According to the studies reviewed, the implications derived in terms of what teachers think and believe allow us to conclude that these teachers should be better prepared as regards the *what, where and how* of research in education (Al-Weher, 2004; Sierra et al., 2009).

When teachers are asked or inquire about what they think teaching is some of the studies reviewed showed that this provides them with an arena to talk about their beliefs and values in relation to their practices. More specifically, they are provided with ways to think about how they self-regulate, perceive their successes in teaching and also to contemplate ways to help them develop a sense of satisfaction as concerns their practice. The definitions, specifications and consistency of their answers can help obtain and identify the key patterns or categories that characterize their experiences of their actions. Interest, commitment, authentic communication, spontaneity, teacher-student dialogue and moments of learning, define and describe the moments in which the teachers perceive that learning occurs both for themselves and for students. The moments in which learning takes place, are considered to be within the classroom and not in their personal lives (Pacheco et al., 2008; Prieto et al., 2008; Tardy & Snyder, 2004).

When a teacher with a sense of satisfaction is in a teaching situation and feels involved other than merely mechanically, the teaching is productive. The importance of the sense of acting gives them a sense of wisdom about what they do and why they do it (Tardy & Snyder, 2004). According to researchers this suggests that education must provide opportunities for teachers to refine or improve their perceptions or self-regulation in their practice, thus encouraging reflection, exploration and articulation of their work. This also permits a good approach from the theoretical point of view; it can illuminate the understanding of language teaching from the teachers' perspective. When this occurs, the teacher is motivated in the workplace, enjoys what s/he is doing and therefore encourages her/his students. Such progress in learning is important both for students and for teachers because it provides the

sensitivity to achieve effective education that helps students develop as people and, if the ultimate goal of education is to inspire the desire to learn rather being a simple information transfer, this enables teachers to adapt or transform their practice (Pacheco et al., 2006; Prieto et al., 2008; Liew et al., 2008; Tardy & Snyder, 2004).

Regarding the assessment of students' cognitive skills, we found that the misgivings concerning the quality of teacher assessment are not unusual in themselves, as teachers are not necessarily competent assessors. Certainly they do not consider the many ways in which human judgments are subject to unintentional distortions, similar to the halo effect, or the effects of order and the transfer of rules. There is also a chance that the assessment trend becomes "slack" and generates specific complications: the tasks assigned to students which involve students choosing the topics or issues may diminish the quality of assessments for these students. Moreover, according to research, teachers should register, tally their assessments and communicate the results with the help of students, family, colleagues, the school administration and government advisors (Flores & Monroy, 2008; Stokking et al., 2004).

In this way, when inquiring about the quality of assessment practices, the research shows that firstly, there is no unique theoretical model to assess the cognitive abilities of students and, secondly, the requirements for research in skills development and for the goals that teachers set for their students depend on the notion of discipline, the willingness to investigate and report, and the expectations of how the pupils may be able to learn. The contribution of the research studies review opens an avenue for further research concerning the quality of the teachers' practice and the development of their applied skills in teaching across various or in specific disciplines (Flores & Monroy, 2008; Stokking et al., 2004).

As for writing, the review of empirical studies has demonstrated the use of techniques, strategies and instruments to encourage both teachers in the practice of the profession and future teachers to reflect on the self-regulation of their professional practice. In this sense, when investigating writing in the educational process (processes, models, strategies, etc.) noted that these are key tools that teachers must know about to be able to carry out the teaching of writing and help students acquire competence and fluency at a lexical level, gradually becoming skilled in the mechanisms of writing. Since the consolidation and mastery of the spelling system is a lengthy process, requiring a great deal of experience and practice, teachers should teach and encourage their students to employ self-regulation and to control written production. Hence the common goal of teaching strategies is to help students become self-learners, able to learn by themselves (de Caso et al., 2011; Pacheco, 2010; Rosino, 2009).

When we explore the role and importance of the different strategies used in developing teachers' reflective skills through instruments such as questionnaires and interviews, as well as examining the influence of their approaches, their thoughts, their stance and observations on writing (Pacheco et al., 2007; Bain et al., 2002). In this regard, in reviewing the empirical studies at an international level, as there is a lack of information on the Spanish case, we have seen the development, validation and implementation of instruments that measure the role of the teachers' practice in the classroom, and this has permitted the collection of relevant data on the topic, such as the scale of writing orientation, *Writing Orientation Scale*

(Graham et al., 2002), which analyzes and assesses the teachers' beliefs regarding the formal and informal methods for teaching writing. The scale of teacher effectiveness in writing, *Teacher Efficacy Scale for Writing* (Graham et al., 2001) describes personal and general self-efficiency. The scale of teachers' writing practices, *Teacher Writing Practices Scale* (Graham et al., 2000) provides information on the skills involved in writing and the instruction methods used by teachers in the classroom. These questionnaires are useful for assessing both teachers' theoretical orientation in relation to the writing teaching-learning process, as well as the procedures and activities that are generally followed in the teaching of writing, i.e. the type of practices that are developed in class from three different dimensions, (i) the thoughts concerning the effects of this type of instruction, (ii) the correction of writing and (iii) the natural methods of learning.

The data obtained in the review of studies show that the teachers' beliefs exert a strong influence on their practices and the success of their students in the classroom. In the area of language, for example, some theories suggest that these practices are shaped by the theoretical concepts or beliefs that teachers have on reading and writing instruction. If we correlate the efficacy and beliefs in their teaching of writing, the results are consistent with the statement that those teachers with a greater humanistic and a less controlling approach have a high sense of teaching efficacy. The authors of these studies believe that the effectiveness of teachers is an important element for effective teaching of writing. Therefore, knowledge of the theoretical approaches and guidelines on the instruction of teachers is significant in understanding the processes of teaching and learning (Graham, 2006; Troia, 2006; Troia & Maddox, 2004).

These considerations justify the objective of this study, as it seeks to study and evaluate the processes and components of writing from the teachers' point of view (the student's motivation, the role of parents or family in this process, the use of strategies, procedures and instruments used by the teacher in teaching writing) and, also, teachers' theoretical orientation (beliefs, attributions and expectations, their sense of personal effectiveness and self-regulation) about the teaching-learning process of writing. This objective is consistent with the line of research undertaken by the Team of Excellence for Research Intervention Psychological Difficulties in Learning and Development [IPDDA], led by Dr. JN Garcia-Sanchez at the University of León in 1994. The line of research has focused on studying the factors, determinants and processes of writing. Furthermore, research studies have covered the following areas: the evaluation and implementation of analytical tools for writing, their evolution and development, as their involvement and optimization; the improvement of planning in writing for pupils with learning difficulties, and also on improving reflectivity in writing; the development of the motivation to write; the study of assessment-related morphological awareness, in working memory or attention; the improvement of metacognition in writing, self-knowledge and self-improvement in processes for reviewing the written message. In this respect, when we consider writing as a recursive process with significant cognitive demands concerning attention, operational memory and we also consider writing as rewriting, requiring significant planning and the use of effective instructional strategies, the teacher's role and what they do or the approach they take are relevant and essential in this evolution (García & de Caso, 2007; García & Fidalgo, 2008a, 2008b; García & Rodriguez, 2007; Fidalgo et al., 2008; Pacheco et al., 2009; García, 2007).

2. Methodology

2.1 Participants

We evaluated 137 teachers from 30 state and private schools in the province of León, Spain (see Table 1), who teach in Spanish language (the native language) and are responsible for students with and without learning difficulties and/or low achievement, in the last year of infant education and the first three years of primary education.

The selection criterion for this sample was based on that used in previous studies that the research team has developed in these schools regarding different writing-related areas of interest concerned with the role of working memory and attention on students, both typically achieving and those with learning difficulties of different ages as well as those with and without ADHD.

Of the 137 participants, 63.5% were women, 64.23% worked in state schools and 37.77% in private schools. The average age of teachers was 46.92 years, with a maximum of 67 and a minimum of 23 years, indicating maturity and stability in the years of teaching. The average work experience in the field was 23.43 years, indicating a great degree of teaching experience, with 18.84 years in the area of language, which suggests that they are very familiar with the instructional aspects related to the teaching of writing. Only 17 teachers (12.4%) had a teaching or philology degree and the rest have master's degree in various fields, but none in special education.

Educational level	Gender		No answer	Total teachers
	FEMALE	MALE		
The third stage of Infant Education	7	0	1	8 (5.83%)
The first stage of Primary Education	24	6	5	35 (25.54%)
The second stage of Primary Education	27	9	8	44 (32.11%)
The third stage of Primary Education	29	10	11	50 (36.49%)
TOTAL TEACHERS	87 (63.5%)	25 (18.24%)	25 (18.24%)	137

Table 1. Distribution of the sample of teachers by gender and educational stage.

2.2 Instruments

The development of the instrument which is the object of this study began by first reviewing the Academic Search Elite databases, which are available at the Central Library of the University of León. Moreover, it was essential to study and review the Royal Decrees, educational programs and guides which establish the syllabi for both infant and primary education. This allows us to collect information about the evaluation criteria in the area of Spanish language in each of the educational stages studied.

These theoretical bases allowed the researchers to proceed with the collection, translation and modification of the instruments, where appropriate, as well as developing new tools to assess the areas and components that affect the teachers' practice in writing instruction. Once created, they were subjected to validation (reliability, validity, norms, etc.) by the research team.

In this way, we obtained the instrument that evaluates The Role of Teachers Practice in Writing [PRAES], with its corresponding questionnaires: the first focusing on Practice-Opinion [PRAESPO]; the second on the theoretical The Practical approach [PRAESPE]; the third refers to the activity in the classroom, what teachers actually do The Classroom practice [PRAESPA]; and, finally the focus of the last one was on self-efficiency [PRAESAE] (Pacheco et al., 2007).

2.3 Overview of the psychological meanings assessed

The PRAES is shaped both by the identity of the teacher, and by the four sections or questionnaires related to the components and factors which affect practice (for details, see Table 2). The names for each questionnaire, according to the order of presentation within the PRAES protocol are:

PRAESPO, this refers to the teachers' views regarding the role of the teacher in their practice in writing instruction considering the following components and indicators: the personal student (motivation, planning and review), the practice component , the family component and teachers' training.

PRAESPE, which evaluates teachers' the theoretical orientation in relation to formal teaching and the natural learning process of writing. This instrument was adapted from the Writing Orientation Scale The scale (Graham et al., 2001).

PRAESPA, measures the skills, instructional procedures, activities and materials used by teachers in teaching instruction, and the type of text or the actual texts they use. This instrument was partially built and developed by the team and partly adapted and translated from The Teacher Writing Practices Scale Practice-Teaching (PRAESAE) instrument (Graham et al., 2001). It helps to better understand the type of factors that create both personal and general difficulties for teachers in their teaching, thus determining their self beliefs in the process of teaching writing. This instrument differentiates between self-efficacy and general efficacy. This instrument was developed by the research team, from the Teacher Efficacy Scale for Writing (Graham et al., 2001), adapted according to directives and guidelines for constructing self-efficacy scales (Bandura, 2005).

2.4 Procedure

The design and plan of the sample consisted of verifying the time taken to apply this protocol in schools in the province of León, as a pilot in order to eliminate the problems and difficulties and adjust it to the research needs. The sample selected on the basis of the criteria explained above, in terms of the participants were teachers who were responsible for students with and without learning disabilities and/or low achievement in infant and early primary education. The next step was the field work itself. It consisted, firstly, of establishing telephone contact with the head teachers of schools to obtain permission to visit

TEST IN THE STUDY	COMPLETE NAME	COMPONENT	MEASURE
PRAESPO	Practice - opinion	Practical opinion: personal Component of the student:: Motivation	Positive direction (address): 2,4,5,6,7,9,10,11,13,17,18,19,20 7: In complete disagreement 1: In complete agreement Negative direction (address): 1,3,8,12,14,15,16,21,22 1: In complete disagreement 7: In complete agreement
		Practical opinion: personal Component of the student: Planning and review	
		Practical opinion: Practice component.	
		Practical opinion: Family component	
		Practical opinion: Teacher training.	
PRAESPE	Practice - approach	Practice - Formal education approach:	1: Very in disagreement 6: Very in agreement
		Practice - Natural learning approach:	
PRAESPA	Practice - classroom	Practice - Classroom: Skills	1: Never 2: Several times a year 3: Monthly 4: Weekly 5: Several times a week 6: Every day 7: Several times a day
		Practice - Classroom: Materials	
		Practice - Classroom: Procedures	
		Practice - Classroom: Texts	
		Practice - Classroom: Activities	
PRAESAE	Practice - teaching	Personal self-efficacy	1: No self-efficacy 2 3: Little self-efficacy 4 5: Some self-efficacy 6 7: Moderate self-efficacy 8 9: High self-efficacy
		General self-efficacy	

Table 2. Description of the tests in the study of the Role of Teachers Practice

and carry out the protocol with the Spanish language teachers, according to the school years selected in each of these schools. Then, two researchers visited the schools on the agreed

dates and times for teachers to complete the protocols. The collection of the sample was performed directly by the two researchers in order to ensure the reliability and validity of the instruments in the collection of information. Data collection was conducted over a period of five months. It is necessary to highlight the effort exerted both in the use of persuasion and communication techniques to synchronize more effectively with the agents under study and to develop their awareness regarding research, as well as the physical effort and the costs of work.

Once the field work was completed and all the protocols were collected, a total of 137, the codification and computerization of the data in an Excel data matrix were carried out. This matrix was transformed into a SPSS version 13.0 matrix which is available in the ULE for conducting statistical analysis. Then the preparation of tables, graphs and other data used for the presentation of results and to provide empirical evidence was carried out, including the interpretation of the data and the identification and extraction of conclusions. Furthermore, the limitations and prospects for future study were determined.

3. Results

The analysis and findings set out below focus on four specific points, (i) an analysis of the psychometric properties of PRAES, including its internal consistency reliability and validity of both the content and construct, (ii) an analysis of the descriptive data which highlight the averages of the measures and variables, (iii) a linear regression analysis (linear regression models), and (iv) a multivariate analysis of variance (general linear models).

3.1 Psychometric properties of the instrument

Reliability

The reliability is calculated by the internal consistency of scales. When calculating the internal consistency reliability of the four instruments, the Cronbach α is 793, which represents an acceptable reliability. When calculating the reliability for each of the four instruments, the results are variable, being generally adequate except for PRAESPE with a Cronbach α of .581, which is rather low, with regard to the rest of the scales α Cronbach; for the PRAESPO = 861; for the PRAESPA = 788 and, for the PRAESAE = 843.

Validity

To study the validity of the PRAES instrument, two types of analysis were carried out: content or apparent validity and construct validity.

Content validity of PRAES

From the revision of the international theoretical and empirical studies published in recent years, we can reasonably assert that the apparent or content validity of the PRAES is acceptable. In this review, we summarize the findings, the empirical evidence and the theoretical conceptualizations, in the four major components that relate to the role of the teachers' practice in teaching writing.

The first component, the PRAESPO is concerned with the way teachers relate to the multiple components of teaching writing, such as motivation, planning and review, family, and the

teacher's practice and training. This type of instrument, based on obtaining the opinion of teachers, has been used previously, in part, by Graham et al., (2001).

The second component, PRAESPE, refers to the theoretical approach followed by teachers at the schools involved in the study, which can be dichotomized into two major clusters along a continuum. At one extreme is formal education and at the other we find natural learning. It is understood that the different teachers are located along the continuum, with some elements of both approaches. This type of component has been studied previously in several studies by Graham et al., (2001).

Moreover, the component related to the specific practice undertaken by the teacher in the classroom in the teaching of writing, PRAESPA has to do with elements that include the deployment of skills, the use of specific procedures, the performance of the various activities, the use the appropriate materials or the use of diverse textual genres. Some of these aspects have been measured and studied by Graham et al., (2001).

Finally, we look at the self-perception component of efficacy which the teacher holds regarding their performance as a writing instructor/teacher, the PRAESAE. This component refers to the self-perception of the teacher, is related by Bandura (2005), and we followed his guidelines in the construction of that component.

Construct validity of PRAES

We obtained the estimate of the construct validity using a factor analysis of the principal components with a normalized varimax rotation.

The analysis allowed the extraction of five factors or principal components that only partially conform to the structure of the test following the validity of content which was developed from a review of international theoretical and empirical studies. In general, the factors extracted from the analysis did not coincide exactly with the four components of PRAES, although we can say that they were largely close, indicating at least partially an acceptable construct validity.

Firstly, we obtained a factor which has been labeled as general because it includes the saturation of the factorial weights of the total number of PRAES scales. The general factor explains 33.20% of the total variance predicted and is saturated by the weight factor for the PRAESPO, the subtotal of motivation (-.738) and the family subtotal (-.882), plus the PRAESPA with the texts subtotal (.765) and the activity subtotal (.813), as well as the personal self-efficacy subtotal (.569) and the general self efficacy subtotal (.479), although in the latter case, as can be seen, the totals are of a lesser magnitude.

Secondly, we obtained a factor which can be called theoretical approach which includes self-saturation of the factor weights of the total number of scales in the PRAESAE. This factor explains 22.49% of the total variance and is saturated by the factor weights corresponding to the PRAESPE, the formal education subtotal (.929) and the natural learning subtotal (-.582) with the PA PRAES with its skills sub-totals (.905) and the materials subtotals (.446), plus the personal self-efficacy totals (.657) and general self-efficacy totals (.580). These lower factorial weights contribute less to this factor's configuration. Thirdly, we obtained a factor we have called opinion, since it includes the saturation factor of the total weights of the various PRAESPO scales. This factor explains

16.22% of total variance and is saturated by the factor weights for the PRAESPO, the practice subtotal (.875) and the teacher training subtotal (.896), plus the PRAESPE natural learning subtotal (.640).

A further factor, called activities was obtained which includes the saturation factor of the total weights of the various PRAESPA scales. This factor explains 8.80% of total variance and is saturated by the factor weights corresponding to the PRAESPA, the procedures subtotal (.978) and the materials subtotal (.649), plus the PRAESPO motivation subtotal (.442). The latter with less weight and therefore make a smaller-scale contribution this factor. In fifth place, there is the review-planning factor, so called because it includes saturation of the weights of the total factors in one of the PRAESPO scales. This factor explains 7.23% of total variance and is saturated by the factor weights of the PRAESPO, the planning and review subtotal (.939), plus the PRAESAE general self-efficacy subtotal (-.408).

Descriptive data

In this section we give an overview of the descriptive results. We present the averages of the measures and variables in Table 3. This table contains data on the number of participants, the minimum and maximum scores obtained for each variable and the respective averages and standard deviations, as well as the highest scores for each of the variables.

As shown in Table 3 and Figure 1, the data generally showed a positive result for each of the variables included in the instruments. For example, in the motivation sub-component of PRAESPO the average score was 29.65, which exceeded the median potential in this variable, and a maximum score of 35 as obtained. Furthermore, the average years of teaching experience was 23.43, which indicates great teaching experience, with 18.84 of those years teaching Spanish language, which suggests the teachers were highly knowledgeable regarding instructional aspects, which is probably related to the teaching of writing.

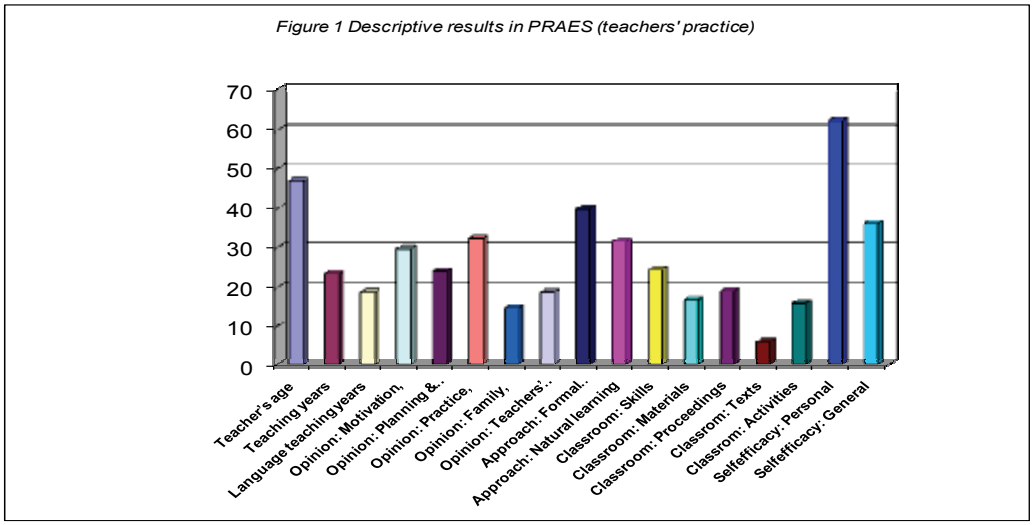

Fig. 1. Descriptive results in PRAES (teachers´ practice)

VARIABLES	COMPONENTS	N	Min.	Max.	Average	Standard deviation	Maximum possible score
AGE OF THE TEACHER		98	23	67	46.92	11.20	
YEARS OF TEACHING		111	1	43	23.43	11.75	
SCHOOL YEAR TAUGHT		137	-1	6	3.4	1.96	
YEARS TEACHING SPANISH LANGUAGE		113	1	43	18.84	12.77	
OPINION	Opinion, motivation subcomponent.	132	12	35	29.65	3.96	35
	Opinion, planning and review subcomponent.	136	4	28	24	3.37	28
	Opinion, practice subcomponent.	135	10	41	32.54	4.52	42
	Opinion, family subcomponent.	136	4	21	14.91	2.78	21
	Opinion, teacher training subcomponent.	129	6	26	18.76	3.30	28
APPROACH	Natural learning approach subcomponent.	124	13	54	39.99	7.76	54
	Natural learning approach subcomponent.	124	19	48	31.67	6.57	54
CLASSROOM	Classroom, skills subcomponent.	125	14	33	24.46	4.12	35
	Classroom, materials subcomponent.	94	7	30	16.89	4.99	42
	Classroom, procedure subcomponent.	132	9	28	19.12	4.08	28
	Classroom, texts subcomponent.	109	2	12	6.02	2.12	77
	Classroom, activities subcomponent.	120	6	28	16.03	5.18	28
SELF-EFFICACY	Personal self-efficacy subcomponent.	119	35	90	62.37	9.82	90
	General self-efficacy subcomponent.	115	24	50	36.34	5.57	54

Table 3. Description of the statistics of the general variables and instruments

Multiple linear regression analysis

The aim is to predict the dependent variable (predicted variable) from the rest of the predictor variables. The total of the four scales are taken as predictors and each of the predicted variables is taken in turn, including the identification of other variables, such as the way in which the teacher teaches. When the educational year taught is taken as a dependent variable or as a variable predicted from the PRAES set of measures and their subscales in the hierarchical multiple regression analysis model with a single statistically significant regression coefficient (adjusted $R^2 = .313$) is obtained, step by step. One single variable was included in the model, from the PRAESPA – the procedure sub-component [$\beta = .613$, t=-2452, $p = .034$]. The rest of the variables were excluded from the model, as they did not achieve statistical significance. Moreover, when attempting to predict the teacher's formal theoretical approach, an adjusted R^2 of .616 was obtained, which is very high although it only generates one model or regression equation with the predictor variable PRAESPA in the skills subcomponent [$\beta = 807$ t = 4315, $p = .002$]. There were no other significant variables, which meant they were consequently excluded from the model. Similarly, the theoretical prediction of natural teaching can be realized with two regression equations. The first model gives an adjusted R^2 of .331, with a significant variable found in personal self-efficacy [$\beta = - .626$, t=-2540, $p = .029$], and in the second model, an adjusted R^2. 556 was obtained, the texts subcomponent being significant in addition to the personal self-efficacy subcomponent of the PRAESPA [$\beta = .774$, t= 2465, $p = .036$]. As a result, we excluded the remaining variables in the step by step multiple regression analysis. In summary, regression analysis provides statistically significant data for predicting each of the PRAES variables from the other variables, which is very interesting as regards its predictive validity. Furthermore, it indicates the great predictive potential of PRAES, as it allows us to obtain knowledge about variables that are not always of the same in nature as the rest. For example, the PRAES includes an opinion subcomponent concerning self-efficacy another that outlines the type of behaviors or activities performed by teachers in the classroom and a third concerning the theoretical approach followed by teachers in writing instruction. This different character, which provides such high regression coefficients, is a good indicator, which supports the integrity of the PRAES.

Multivariate analysis of variance (general linear models)

It is important to highlight that the analysis to distinguish the role or influence of the different grouping variables (teachers' gender, years of teaching experience, education centre, and the school year taught), does show statistical significance in the multivariate contrasts. Each of the PRAES variables used as an inter-subject factor were not statistically significant in the multivariate contrasts, except in the case of the teacher's natural theoretical approach. This variable, when grouped into three clusters, with a multivariate variance contrast is statistically significant and also shows a large effect size [$\lambda = 001$ F (2.18) =46,465, $p = .021$, $n^2 = 998$]. This is similar to the personal self-efficacy variable when it is grouped into three clusters and shows a large effect size [$\lambda = 001$, F (1, 10) = 1169.051, $p = .023$, $n^2 = 1$]. The tests of the inter-subject effects of personal self-efficacy and natural theoretical approach indicate there are some significant variables (see Table 4).

As regards the natural theoretical teaching approach, the evidence of the inter-subject effects indicate statistical significance for variables of the formal theoretical approach ($p = .053$, n^2

= .480), for the PRAESPA and its skills subcomponent (p = .024, n = ² 564). The same natural theoretical approach without clusters, was as expected (p = .001, n ² = .938), just as the personal self-efficacy variable (p = .024, n ² = .565), as shown in Figure 2.

SIGNIFICANT VARIABLES		λ	F(2,18)	p	η²
		0.001	46.465	0.021	0.998
	Theoretical formal approach			0.053	0.480
Theoretical natural approach	PRAESPA: Skills Subcomponent			0.024	0.564
	Theoretical natural approach			0.001	0.938
	Personal self-efficacy			0.024	0.565
		Λ	F (1.10)	p	η²
		0.001	1169.051	0.023	1
	PRAESPO: Family Subcomponent			0.038	0.365
Personal self-efficacy	PRAESPA: Materials Subcomponent			0.092	0.258
	PRAESPA: Texts Subcomponent			0.001	0.779
	Personal self-efficacy			0.002	0.626

Table 4. Results of the multivariate variance analysis of the statistically significant variables of the PRAES in three conglomerates

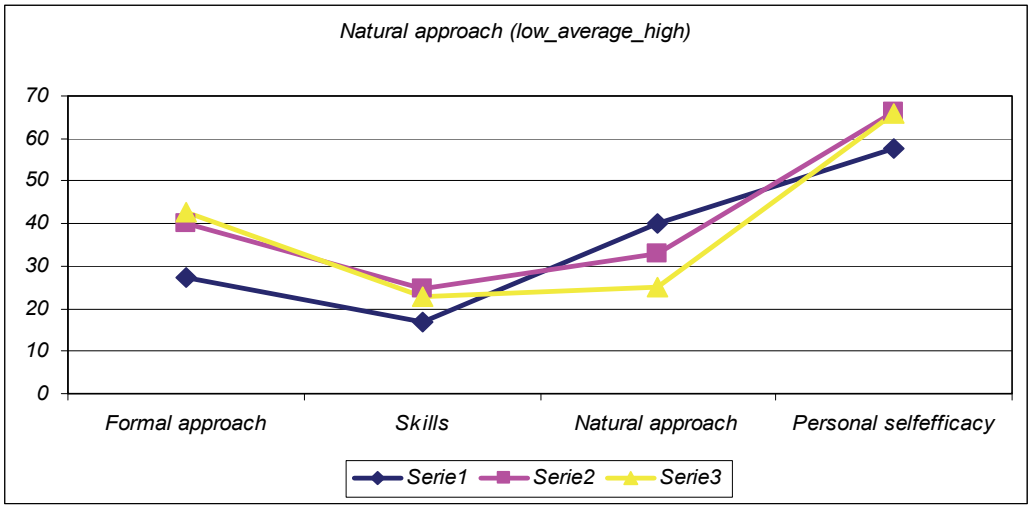

Fig. 2. Natural approach (low_average_high)

The tests concerning the post hoc contrasts, however, generally do show significant differences between the clusters of this variable. In terms of personal self-efficacy, the test for the inter-subject effects indicates statistical significance for PRAESPO variables, with the

family subcomponent (p = .038, n ² = .365). For the PRAESPA materials subcomponent (p = .092, n = ². 258), although in this case, the texts subcomponent also comes close to statistical significance (p = .001, n ² = .779), and as does personal self-efficacy (p = .002, n^2=.626). See Figure 3.

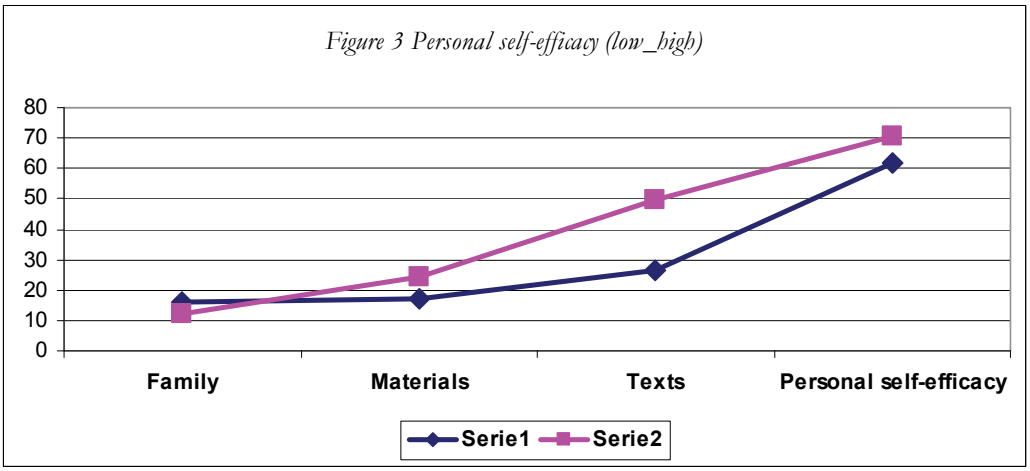

Fig. 3. Personal self-efficacy (low_high)

4. Discussion and conclusions

The aim of this study was to consider the type of practice carried out by language teachers in the area of teaching writing. Specifically, we wanted to look at the components that influence their practice and the theoretical tendencies that teachers hold about the teaching-learning process of writing, as well as their beliefs about their ability or their self-efficacy. Moreover, the study aimed to consider their views on the factors that affect the self-regulation of the teachers' practice in teaching writing.

Given this objective, it is expected that the type of practices that teachers develop in class are determined by and due to certain factors such as: the theoretical concepts they hold about how students learn, their thoughts regarding the effects of this type of instruction, the correction of writing and the different teaching methods (formal, natural, etc.). According to the results obtained and, in general, we can assert that the goal have been met because the project has investigated the role of practice, implemented appropriate tools, as well as used a representative sample of a range of levels of education. However, the hypothesis was only partially confirmed. We can say that the PRAES instrument adequately met the requirements in terms of reliability and validity, allowing for the extraction of data relevant to the study regarding the role of practice. But, the hypothesis was not fulfilled as regards the role of the differential data obtained from teachers, depending on the educational level of students, as no statistically significant differences were obtained, indicating flexibility in the teachers opinion, their theoretical approach, what they say they do or believe about their ability to teach writing, according to the characteristics of students (in this case, the student's progress was taken to be reflected by the year in which they were enrolled).

The fact that the teachers state that they do the same, believe the same, maintain the same theoretical framework for teaching writing, with the same feelings of ability, regardless of the students' level may have several causes. It may be simply an observation of what is actually expected, which contradicts our hypothesis, and that teachers apply these patterns without considering the characteristics of students. This may be because their training is not specific or because practice in writing instruction is scarce, except in the initial levels, where the mechanical aspects are predominant, which all indicates a lack of self-regulation their practice. But it is possible that, by using such general measures rather than more direct measures of the teachers' actions, which consequently reflects the teachers' social desirability, including their own ideology, beliefs and theories, their views, all of which were very generic.

If the actual teaching of writing to different levels was addressed it may produce might greater differences as it is not possible to teach students of different educational levels in the same way. In this sense, the PRAES would measure the beliefs and wishes more generally than the role of the actual practice. This instrument, which was applied at the margins of the teachers' direct activity, thus reflects components of "trait" rather than "state". What would have happened if teachers had been directly observed in the classroom in their writing instruction with their students from different educational levels? It is expected that they would have demonstrated different strategies, but this possibility must be explored in another study. As for the sample, as well as being representative, relevant and of a broad-spectrum (as compared with the samples from other empirical studies), allows for the description of the kind of practice carried out by these teachers, and the gaining of valuable data, although these are, as previously indicated, partly limited.

Concerning the instrument applied, given the review of theoretical and empirical studies published in recent years, one can reasonably assert that the PRAES presents adequate validity and acceptable reliability. However, the questionnaire is the instrument most used in research conducted in this area.

Furthermore, we can ensure that the construction of PRAES demonstrated the selective and representative collection of elements that refer to the opinion or approach components, on the specific behavior carried out by the teachers in the classroom in the teaching of writing composition and the self-efficacy component, as indicated above. It should be emphasized that no published study is known to have researched the four components together. This justifies and affords relevance to this research.

Regarding the statistical analysis and as a contribution to this research study, five factors or components were obtained that, although only partially conform to the structure of the test, do have some overlap with the four components of the PRAES. Firstly, there is an overlap between the general factor, in which the teachers' both personal and general self-efficacy interact with motivation, the family and the classroom activities in the teaching of writing. Secondly, is the factor of self-efficacy and theoretical approach, since the following are interrelated, the natural and formal theoretical approach of the teacher interacts, the skills they develop and the materials used in teaching writing, identifying their personal and general self-efficacy. In addition, the third factor, opinion, interrelates the nature of the theoretical approach to teacher training and the practice developed in the teaching of

writing. Similarly, the fourth factorial component of activities in which motivation interacts with the procedures and a material used in the teaching of writing also overlaps with the above. And finally, the planning and review factor, which relates general to self-efficacy with planning and revision practices followed by the teacher in the teaching of writing.

In summary, we can say that these factors allow us to infer the nature of the practice developed by teachers in the area of language. No remarkable facts concerning significant differences in relation to the theoretical concept and strategies applied in the teaching of writing at different stages of infant and primary education were discovered and, therefore, we find low levels of self-regulation of the teachers' practice.

In addition, the curriculum guidelines as described by the royal decrees do not seem to affect this practice, since, according to the results obtained, all teachers appear to act uniformly in terms of the theoretical concepts that guide them. This also indicates that there is no difference in the treatment of learning and teaching of writing in students with and without learning difficulties and/or low performance. When compared with other empirical studies that address the same area we discovered some important contributions of this research study. First, it is the first study of its kind in Spain. Secondly, it is the first to address the four components combined into a single instrument (Opinion, Approach, Classroom behaviors and Self-Efficacy). The other research studies in this field have studied only one or two aspects. Moreover, the sample or study population is fairly representative, in terms of breadth and of educational levels covered because, as noted, the empirical studies reviewed have either poor samples or are focused on the first levels of education. It is important to note the limitations of the study. Among these, we include the lack of data about the performance of these teachers' students in order to establish meaningful relationships between what the teacher teaches and what/how children learn. This issue is to be addressed in a second empirical study. Furthermore, the study was based on questionnaires, and these instruments have certain limitations. It is well known that from the psychological point of view, the acquiescence effect is produced, i.e., the tendency to respond positively to everything that is asked. Although this variable was controlled by introducing different directions in the elements of the instrument it should be monitored more effectively.

Another limitation, also mentioned by other authors, is the lack of direct observation of the teachers' behavior in the classroom to actually verify what they say they do. Overcoming this limitation will require the implementation of further studies. It would be pertinent to verify whether there are differences in teaching methods from other areas. This would be of great interest to detect if they apply the same strategies, both with and without students with learning difficulties, as in the different educational levels.

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Correspondence should be addressed to Departamento de Psicología, Sociología y Filosofía. Área Psicología Evolutiva y de la Educación. Campus de Vegazana s/n, 24071 – León, Spain. Phone: +34-987291041 (university); +34-987222118 (home); +34-652817871 (cell); Fax: +34-987291035 (university). E-mail: jn.garcia@unileon.es.

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Part 3

Neurodevelopmental Disorders

12

Motor Skill Performance of Children with Sensor Impairments

Danijela Ilić-Stošović and Snežana Nikolić
University in Belgrade, Faculty of Special Education and Rehabilitation
Republic of Serbia

1. Introduction

According to ICD – 10 (1993) there are two big groups of specific developmental disabilities: learning disabilities and motor disabilities. The first includes a group of disorders which characterize problems in school achievement, especially in reading and math. The second includes a group of disorders in motor coordination, balance, lateralization, which cannot be explained by general problems in intellectual development or any other specific neurological disorder. The etiology of these disorders is unknown, but there is a hypothesis that they are the consequence of interaction between biological factors and the influence of social environment, as much as interaction between those two factors and quality of educational processes.

Motor skills play a crucial role in the social and emotional functioning of a child and may impact quality of life and well being (Poulsen, Ziviani, Johnson & Cuskelly, 2008; Skinner & Piek, 2001; Sleeuwenhoek, Boter & Vermeer, 1995; Verrips et al., 1999, as cited in Houwen et al., 2009b).

Williams et al. (2008) found that preschool children with poorer motor skill performance were less active than children with better-developed motor skills. They concluded that the relationship between motor skill performance and physical activity could be important to the health of children, particularly in obesity prevention.

The results of research (Šarenac, 1999; Nikolić et al., 2000; Urošević, 2001) conducted with early childhood age children in regular primary school show that 10-15% of children with poor motor skills have low school success. These children need support to overcome developmental and learning difficulties.

Barnet et al. (2009) assessed children's proficiency in object control (kick, catch, throw) and locomotor (hop, side gallop, vertical jump) skills with the aim of investigating whether skill proficiency predicts subsequent physical activity. The research results indicate that object control proficient children were more likely to become active adolescents. According to these authors motor skill development should be a key strategy in childhood interventions aiming to promote long-term physical activity.

With the aim of further understanding control impairments seen in children with developmental coordination disorder (DCD) and the effect of these impairments on motor

performance in these children, Grovea and Lazarusb (2007) assessed 30 children with and without DCD. It was found that children with DCD had greater difficulty maintaining postural control when visual and somatosensory feedback were compromised in sensory conflict environments ($p = .031$). Group differences in postural control were independent of age. It was pointed out that their results demonstrated that impaired ability to utilize vestibular feedback while re-weighting somatosensory and visual feedback for orientation may be responsible, in part, for the postural control impairments observed in some children with DCD.

Coordination, balance, body position sense and motor sequential organization are not in themselves prerequisites to academic success. The effectiveness of gross motor output plays a role in personality development. Youngsters who are not able to compete in team sports will generally lack a sense of ”motor mastery” and may suffer from diminished self-esteem, social rejection and general feelings of inadequacy. Gross motor disabilities may be the outward indicators of central nervous system dysfunction. A history of difficulty catching a ball, general awkwardness, poor balance and trouble learning to ride a bicycle, to hop and to skip may lead one to suspect a gross motor lag (Abroms, 1980, as cited in Nikolić & Ilić-Stošović, 2009).

The detection of motor skill disorders then is an important indicator of delayed or lower quality motor maturity. Prompt inclusion of these children into treatment programmes prevents mild disorders from developing marked difficulties in school (Nikolić & Ilić-Stošović, 2009).

The problem becomes more complex when considering the terms of sensory impairment influence on the motor skill performances.

Childhood hearing impairment is a significant public health problem which is associated with long-term academic and communicative difficulties (Davis, 1997, as cited in Rajendran & Roy, 2011). Children with hearing impairments have a higher risk for deficits in balance and gross motor skills compared with children who are developing typically. As balance is a fundamental ability for the motor development of children, a valid and reliable assessment to identify weaknesses in balance is crucial (De Kegel et al., 2010).

Research results related to motor skill performances of children with hearing impairments are very different. Cushing et al. (2008) found that large differences existed in the balance ability of children with sensorineural hearing loss requiring cochlear implantation compared with age-matched controls (children with normal hearing). Implant activation, however, conferred a slight advantage in accomplishing balance-related tasks. An et al. (2009) examined the relation between age and single-limb standing balance in children with and without deafness, and concluded that the postural stability of profoundly deaf children improves as a result of adaptive sensory compensation, both visual and somatosensory. In addition, it appears that postural control is more highly dependent upon visual input than on somatosensory input. Gayle and Pohlman (1990) measured the dynamic, static and rotary balance of deaf and hearing children. Significant differences were noted between groups for dynamic balance and rotary balance. Although not significant, there was a difference of 57.8% in a number of trials for successful completion of static balance in favour of the hearing children. In the present study, overall balance in deaf children was significantly inferior to the balance in hearing children. The authors highlight that knowledge of these

differences may aid those working with deaf children in physical education. Horak et al. (1988) examined vestibular status and motor proficiency of 30 hearing-impaired and 15 motor-impaired learning-disabled children to determine whether vestibular loss can account for deficits in motor co-ordination. Reduced or absent vestibular function in 20 hearing-impaired children did not affect development of motor proficiency, except in specific balance activities. However, sensory organization deficits in the learning-disabled group and in three of the hearing-impaired children were associated with widespread deficits in motor proficiency. A few studies related to motor skill performances of persons with hearing impairment indicate that, with the exception of balance impairment, there are no significant differences in this area between persons with hearing impairment and those who can hear (Garet & Levin E, 1970). But, the research conducted by Vujasinović (1997), states that the children with hearing impairment show the delaying in motor development. Depending on age, this delaying varies from 8 months (at the age of four), to two years and nine months at the age of eleven. The delaying in motor development in relation to the chronological age increases with the age itself. Narančić (1997) examined practognostic organization of children with hearing impairment and showed that, generally speaking, their abilities to master the psychomotor performance in the service voluntarily given model were not reported. Butterfield (1986) evaluated and summarized the gross motor development of 132 hearing-impaired children between the ages of 3 and 14 year. Delays were noted in catching, kicking, jumping and hopping. It was determined that gross motor skill performance was not related to etiology of deafness or to the sex of the subjects. Rine et al. (2000) also found evidence of delayed gross motor development regardless of age, but only children less than 5 years[1] of age had developmental balance deficits on initial testing. Both gross motor and balance development scores were lower on repeated testing. Kohen-Raz and Masalha (1988) found significant correlations between the basic arithmetic and motor skills, within the hearing as well as within the hearing-impaired groups; these remained significant even within the small subgroups of the latter. Thannhauser et al. (2001), examined psychomotor efficacy of children with hearing disorders. It was found that children with impaired hearing reach worse psychomotor efficacy in the range of hand movement co-ordination and precision. Psychomotor efficacy examined at particular age undergoes development and sex was not a differentiating factor, and compared environments were not univocally found to influence the development of the examined features. In a study aimed at examining motor performance in deaf elementary school children and its association with sports participation, Hartman et al. (2011) found that the deaf children had significantly more borderline and definite motor problems than the normative sample: 62% (manual dexterity), 52% (ball skills) and 45% (balance skills).

As routine screening for children with hearing impairment does not include assessment of balance and motor deficits, physical therapy services are not included in the educational programme, unless obvious neurological or orthopaedic disorders are diagnosed. However, teachers and parents of these children often report incoordination, clumsiness and balance deficits which may hinder the child's optimal performance (Butterfield, as cited in Rajendran & Roy, 2011). Moreover, many paediatric health care providers are often too busy or inadequately trained in conducting elaborate developmental screening tests during the

[1] In this study gross motor development was examined in 24 to 83 - month-old children with sensorineural hearing impairment.

regular clinics. These tests are performed only when the child presents with an obvious deficit (Omondi et al., 2007 as cited in Rajendran & Roy, 2011).

From the other side vision plays an important role in motor skill performance as vision guides and controls the acquisition, differentiation and automatization of motor skills (Brambring, as cited in Houwen et al., 2009). Functions of visions in motor skill acquisition are (a) incentive function - to motivate children to move, (b) spatial function - to provide information about distance and direction of movements and objects, (c) protective function - to anticipate dangerous situations, and (d) controlling/feedback function - to detect errors and correct the ongoing movement by online regulation of the movement. Furthermore, vision enables children to imitate movements made by others (Brambring, 2006, as cited in Houwen et al., 2009b, pp. 465). The objective of Taylor Kulp's (1999) study was to examine the relationship between visual motor integration skill and academic performance in kindergarten through to third grade. The children's regular classroom teachers rated the children with respect to reading, math and writing ability. Second and third grade children were also rated on spelling ability. They found that performance on a visual analysis and visual motor integration task is significantly related to academic performance in 7, 8 (reading, writing and math achievement ratings) and 9 year olds (writing, spelling and math achievement ratings). Performance on the visual motor integration was found to be significantly related to teachers' ratings of the children's reading, math, writing and spelling ability.

The visual control is necessary for all targeted movements in the function of their correction. The children with visual impairment at the earliest age have badly expressed and incoordinated movements of hands, they are passive and show a low curiosity for the objects in their surroundings. As we could read, there are a lot of studies that are related to the motor skill performances of children and adolescents with visual impairment. Jablan (2003), examined the motor skill development quality of elementary-school age children with severely visually impairment. It was found that 55.8% of children had harmonious development of motor functions. The most difficulties were found within melokinetic praxia and the coordination of bi-manual activities. Houwen et al. (2009a) examined the physical activity levels of children with and without visual impairments. It was further investigated whether the degree of visual impairments was associated with activity level, whether body composition was associated with activity level and whether interrelationships existed between activity level and motor skill performance. All participated children (96) were ages 6 to 12 years and attended mainstream schools. It was found that total activity was significantly higher in children without visual impairment than in children with visual impairment. Participation in moderate to vigorous physical activity was significantly higher in children without visual impairments versus children with visual impairments. Light activity was positively associated with locomotor scores; total activity and moderate to vigorous physical activity were positively associated with object control scores. For children without visual impairments, total activity and time spent in moderate to vigorous physical activity were positively associated with locomotor scores and time spent in sedentary activity was inversely associated with object control scores. The authors concluded that the results of their research emphasize the importance of promoting an active lifestyle in children. Special attention has to be paid to children with lower visual acuities and children with higher body mass index. From the other side, the research conducted by Norris, Spaulding and Brodie (1957) (as cited in Garet & Levin, 1970) indicates that the development

of the children with severe visual impairment is approximately equal to the development of the children who can see, except for the tasks requiring specific experience. The skills in fine motor coordination and the success in mastering spatial relations were found out to develop spontaneously in the visually impaired children who had adequate opportunities for rough motor activities and who were allowed to freely research their environment, although usually in a later age than in children without visual impairment. A similar conclusion can be found at Warren (1994) who indicated that variables linked to impaired vision, such as environmental opportunities and barriers for movement, rather than vision impairment per se, have an impact on the motor skill performance of persons with visual impairment. Houwen et al. (2009) reviewed 39 studies, 26 of which examined the effects of child, environmental and/or task variable (sell) on motor skill performance, 13 of which reported suggestions by experts about variables related to performance. In this review study weak evidence was found for three relationships: (a) between the degree of visual impairment and the performance on dynamic balance and manual dexterity (Gipsman, 1981; Houwen et al., 2008; Leonard, 1969; Pereira, 1990; Reimer et al., 1999; Ribard et al., 1987; Wyver & Livesey, 2003 as cited in Houwen et al., 2009b); (b) between amblyopia/strabismus and fine motor skills (Caputo et al., 2007; Hrisos et al., 2006; Weber et al., 2008, as cited in Houwen et al., 2009b); (c) between movement interventions and motor skill performance (Aki et al., 2007; Dye, 1983; Jospeh, 1984; Lieberman, Stuart et al., 2006; Palazesi, 1986; Poncillia et al., 2005, as cited in Houwe et al., 2009b). In addition, weak evidence was found to refute a relationship between gender and static balance (Leonard, 1969; Pereira, 1990; Ribadi et al., 1987, as cited in Houwen et al., 2009b).

As it could be seen through reviews of previous studies, motor functioning of children with sensory impairments can be very variable.

Every limitation or poor motor skill performances, in their own way disturbed the process of integration in school and threatens effectiveness of participation in educational activities. Poor motor skill may lead to poor performance in physical activities, which may reduce a child's sense of competence. This may lead to withdrawal of movement activities that would, in turn, lead to limited opportunities to practice motor skills and participate socially (Skinner & Piek, as cited in Houwen et al., 2009b).

2. Method

The aim of this research is to establish the prevalence, form and the quality of motor skill performance in children with sensor impairment. The research results will focus on two groups of school aged children: children with visual impairment and children with hearing impairment. First, the findings on variables associated with prevalence, form, level of motor disorders and quality of motor skill performances are analyzed in each group of children. "*Motor skill performance* is a broad term which is defined as the observable act of movement and task characteristics (Hutzler, 2007; Newell, 1986; Shumway-Cook & Wollacott, 2001; Warren, 1994; WHO, 2001, as cited in Houwen et al., 2009b). *Motor skills* are acts or tasks dependent on practice and experience for their execution (Payne & Isaacs, 2002, as cited in Houwen et al., 2009b). In the purest sense, the term motor refers to underlying biological and mechanical factors that influence movement (or observable action), however, the terms movement and motor are frequently use interchangeably (Gabbard, 2007; Sherill 2004, as cited in Houven et al., 2009b, pp. 467)".

The quality of motor skill performance, in this research, is analyzed in three areas of motor functioning: neuromaturation, coordination and balance. The study provides data on interaction between: (1) motor skill performance and visual or hearing impairment (between groups and single analysis). Findings are compared with the aim of establishing if there is strong evidence for or against the effect of visual or hearing impairment on motor skill performance; (2) motor skill performance of children with visual impairment, as much as motor skill performance of children with hearing impairment, with the aim of establishing if there is a similarity or some kind of pathway which can help professionals in creating rehabilitation programmes, as much as programmes for adaptive physical education; (3) motor skill performance and common child variables, such are gender and age. Gender differences in motor skill performance for children and adolescents in general may exist because of differences in body composition during growth and maturation, and social influences regarding physical activity. Generally, the magnitude of differences in motor performance between boys and girls is low to moderate during childhood, and girls are low to moderate during childhood, but this changes quite markedly after puberty when boys tend to outperform girls (Thomas & French, 1985, as cited in Houwen et al., 2009b); (4) the previous findings of the authors Nikolić, Ilić-Stošović (2009) that are related to motor skill performance of children with typical development are examined in all three groups with the aim of establishing differences or a similarity in prevalence and structure of motor skill performance.

Why did we decide to do such a study? Sensor integration is essential for obtaining a complete experience of phenomena and activities that surround us. It is basic for mostly learning situations. Sensor integration, thus integration of auditive and visual information, is basic for creating, defining and interpretation of terms. Disabilities in this area may influence development of all academic skills, and also other skills, especially motor skill. From the other side, integration of perception and motor activities primarily is related to visual-motor coordination and audio-motor integration. Visual-motor integration implies ability of visual and motor coordination. Difficulties in this area, potentially, can disturb all areas of a child's life: social, academic, sports and practical. The child, because of lack of visual control of motor activity, organises its movement in space and time inadequately. Audio-motor integration includes compliance of motor activities with verbal and non-verbal stimulus, such as melody, rhythm etc.. Spurious capacitance response in this area can be directly reflected in the development of academic skills (Gligorović et al., 2010). The situation becomes more complicated if a child is born with sensor impairment, or during early development copes with sensor impairment. What than happens with motor skill development and performance? Is it possible, although both with sensor, but one group with visual and the other with hearing impairment, that there are some similarities? This was a question that we tried to answer through our research.

The truth is that there are a lot of studies that are related to motor skill performance of children with visual impairment and a lot of articles with the studies that are related to balance disorders and motor outcomes of children with hearing impairment. Also, many of those studies compared the motor skill performance of children with visual or hearing impairment and children with typical development. But there are only a small number of studies that examined motor skill performances (not only balance) in children with hearing impairment, in spite of some evidences (see in Vujasinović, 1997; Narančić, 1997; Butterfield, 1986; Rine et al., 2000; Kohen-Raz & Masalha, 1988; Hartman et al., 2011) that children with

hearing impairment have some delays in motor development and lower results in motor skill performances scores in relation to children without any impairment. It was challenging to compare the motor skill performance of the two, considering the type of sensor impairment and different groups of children, although there are not a lot of studies that compared variables, such are neuromaturation, lateralization or coordination between those two groups of children with sensory impairment.

In that way this research can contribute in enabling differentiated diagnostic criteria for establishing the level and the quality of motor skill performance, prevalence and of the form of the manifestation of motor skill performance disorders in pupils with sensory impairment. The main idea was to point to the importance of including assessment of motor skill performance in routine screening of children with sensor impairment. Second, the results of this research can give implications for therapeutic approaches related to improvement of motor skill performance. Third, the results of this research can contribute in creating sports activities for children with sensor impairment.

2.1 Sample characteristics

The 73 pupils were children with different degrees of hearing impairment (HI) and 83 were children with different degrees of visual impairment (VI). The group of children with visual impairments consisted of two subgroups: children with blindness whose range of vision ranges from 0.02 to a complete absence of quantitative and qualitative vision, and children with low vision, whose range of vision ranges from 0.3 to 0.05. The sample is a balanced representation of the children with blindness (41.94%) and low vision (48.38%). The group of children with hearing impairments consisted of children whose level of hearing loss ranged from 45-59dB (ASA) or 56-70 dB (ISO) of them 17.73%, then 25.32% of children with hearing impairments whose level of hearing loss ranged from 60-70 dB (ASA) or 71-90 dB (ISO) and 56.95% of children with very hard hearing impairments (80 dB and more (ASA) ili 91 dB and more (ISO))[2].

According to psychological documentation, all children were of average intelligence. All children were between 7 and 14 years of age. The distribution of the total sample according to gender is equal (boys 53.2% and girls 46.8%) and does not show a statistically significant difference (Pearson's R: Value ,022; Approx. T (b), 268; Approx. Sig. ,789(c)).

All children attended schools for education children with visual/or hearing impairment (special schools) in Belgrade, Republic of Serbia.

2.2 Material

The main criterion for the selection of test materials was that the methods used had to be appropriate for testing children of middle childhood age (psychological/pedagogical periodization of children's development) and to evaluate the most important functions for this period of life: neuromaturational maturity (a symptom of synkinesia, diadochokinesia

[2] This paper shows an empiric segment of the macro-project "Phenomenology of Developmental Disturbances and Disorders", which was realized at the Faculty for Special Education and Rehabilitation, University of Belgrade, and approved by the Ministry of Science and Technology of Republic of Serbia (number of license: MNTR 1611).

and motor impersistence, as much as symptom of dyslateralisation); balance; and coordination (general motor skills and visuomotor coordination). Levin M.D. (1980) tests were used for evaluation of neuromaturation and Bruininks-Oseretsky Test of Motor Proficiency (Bruininks 1978) and the ACADIA test (Atkinson, Johnston, Lindsay, 1972) were used to evaluate coordination and balance. The tasks were selected on the basis of chronological age of the children, because they have been widely used in similar research and because they have standardized methods for interpreting the results. The outcome of Dügers et al.'s (1999) study, with the primary objective to research the relationship between motor abilities and demographic characteristics, such as age and sex, in healthy children aged 4-11 years, revealed that the Bruininks-Oseretsky test can be useful to investigate unexplored aspects of motor development. This was one more reason to choose this test for our research.

Every child was tested individually in separate rooms, without other children present, but with presence of two researchers and a class teacher. The testing did not start until the child was relaxed and ready to cooperate. Tasks were explained verbally to the child. In the situation where the child couldn't understand verbal directions, the researchers demonstrated the desired response. We took into account that, regarding the children with hearing impairment, we had to say the tasks clearly, simply, in short sentences, and for the pupils of higher classes we had prepared the tasks written in big Cyrillic letters. In some cases, if a task was not clear, we used demonstration as well. Children with visual impairment perceive verbal demands well, and constructing the protocol we took into account its adaptability for this category (the imitation tasks were omitted, as well as those which first require the reception of visual information and then motoric performance). Small help of the researchers was given, mainly for balance and coordination tasks.

3. Results

3.1 Quality and the effect of type of sensor impairment on motor skill performance

3.1.1 The prevalence and distribution of symptoms of delayed neuromaturation

The neuromaturation tasks were scored as either some symptom of neuromaturational delaying is present or not. The video recording made it possible for both researchers to score the tests independently in order to obtain a reliable score. After having done so, both researchers agreed on every test. An alpha level of .05 was used for all statistical tests.

Neuromaturational evaluation implies the detection of symptoms of synkinesia, diadochokinesia and motoric impersistence.

Synkinesis is involuntary movements and it is associated with voluntary motor activity. Some authors considered it a secondary event and interhemispheric interaction in the functional organization of motor acts (Zaytseva, Sami Walid, Berdichevskaia, 2009). Execution of useless movement during performance of motor activity and/or sleep may represent an expression of the slow maturation of structures responsible for achieving basic levels of inhibitory control, which is reflected in the performance of complex tasks. In assessing the synkinesis, the child is expected to lay hands on the table and … lift each finger independently one after the other, first on one and on the other hand. Assessments forced open the possibility of occurrence of isolated fingers and synkinesis at the same or in

a different hand.. In assessing diadochokinesis, the child is given an order to relax one arm next to the body and the other bent at the elbow near the body, and then to perform rapid, alternating movements of supination and pronation.. This assessed the presence of second hand synkinesis and separation of the shoulder and elbow forces on active hands.

Motor impersistence is examined by requesting for the child to stand upright, arms outstretched in front of him, fingers outstretched, mouth open, eyes closed for 30 seconds. Assessments are based on the possibility of maintaining a given position, without vocalization, moving the fingers, tongue and other body parts. Inhibitory control mechanisms are used to control interference, modulation or interruption of ongoing activities, which are basically a series of other cognitive functions and abilities such as attention, working memory, understanding, planning, regulation of motivation and emotion (Brocki, Bohlin, 2004; Eisenberg, Smith, Sadovsky, Spinrad, 2004), theory of mind and social competence (Carlson, Moses, 2001). Inhibition of motor activity usually matures about 6-7 years, unlike the inhibition of linguistic, conceptual and mnestic stimuli showing a longer development trend (Welsh, 2002). Inhibitory control deficit, which is one of the basic mechanisms of executive functions, is a very important factor in the weak achievement in all tested parameters of sensomotor skills and abilities that are prerequisite for the development of academic skills.

These indicators of possible delay in the development of the central nervous system are normally present in children before they start to attend school. Related to our sample, there are 26.9% of the children with symptoms of synkinesis, 26.3% with symptoms of diadochokinesia in 23.1% of the children with signs of motoric impersistence.

Comparing children with hearing impairment and children with visual impairment, we can see that symptoms of synkinesis were noticed in 31.5% of children with HI and in 22.9% of children with VI. Symptoms of diadochokinesia were noticed in 13.7% children with HI and in 37.3% children with VI. Symptoms of motoric impersistence were noticed in 26% of children with HI and in 20.5% children with VI. (Figure 1). In relation to the type of sensory impairment, the results indicate an equal distribution of the symptom of synkinesia (Pearson's R: Value -,097; Approx. T (b) -1,208; Approx. Sig. , 229(c)), and of motoric impersistence (Pearson's R: Value -, 066; Approx. T (b) -, 817; Approx. Sig. , 415(c)), but the prevalence of diadochokinesia is statistically significantly and increased in the children with visual impairment (Pearson's R: Value, 268; Approx. T (b) 3,454; Approx. Sig., 001(c)). The reason for such increasing of symptoms of diadochokinesis in children with visual impairment can be found in the lack of opportunities for movement experience, lack of effects of graphomotor experience (writing), which has important influence on neurological development of muscles that control fine motor movements. It is believed that children with visual impairment often have fewer opportunities to interact with the environment, which may lead to limited movement experience. Furthermore, it is generally assumed that those with a greater amount of task-specific experience perform better (Houwen et al., 2009)

Additional research is needed in this area. Issues that need to be addressed include association of level of hearing/visual impairment with delaying in neuromaturnational development. Also, it is important to research how school programmes, environment and special or mainstream education influence development of this motor skill performance.

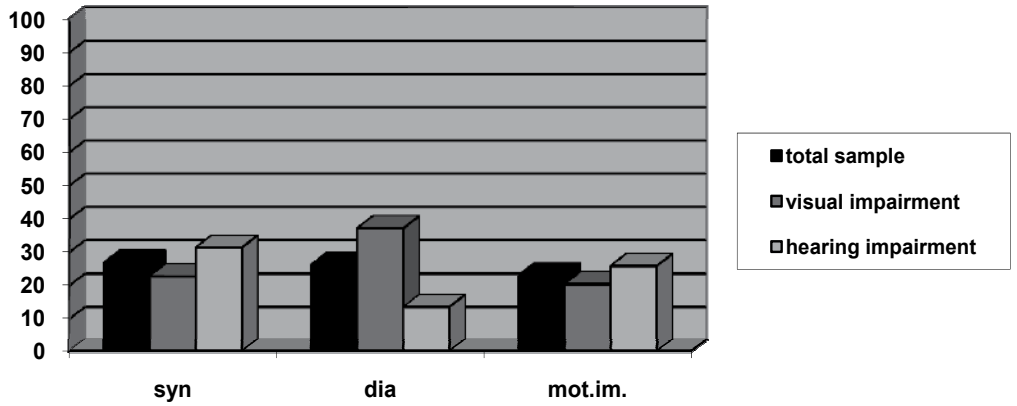

Fig. 1. The prevalence and distribution of symptoms of delayed neuromaturation in the total sample and in pupils with visual and hearing impairment.

Nikolić & Ilić-Stošović (2009) examined prevalence, form, level and quality of motor skill disorders in 1,165 children, aged between 7.5 and 11 years, with no detected impairment and with average intelligence scores. It was found that the symptom of synkinesis was present with 38.45%, diadochokinesia was present with 33.39% and the symptom of motor impersistence was present with 26.18%. In correlation with the results of our research we can conclude that there are no differences in prevalence and distribution of symptoms of delayed neuromaturation between groups of children with and without sensor impairment. Given that our sample included children older than the survey sample Nikolic & Ilić-Stošović, we can say that age does not significantly improves motor skill performances in chilren with sensor impairment.. Additional research is needed in this area. First of all, it is important to examine prevalence and distribution of neuromaturnational delaying in children and adolescents with typical development, between 11.5 and 14 years. Then, we will be able to state that there are no differences in neuromaturnal development between children with and without sensor impairment.

In addition, in order to explain why is so important to examine neuromaturation in children with sensor impairment, we will cite Kohen-Raz and Masalha (1988) who found significant correlations between the basic arithmetic and motor skills, within the hearing as well as within the hearing-impaired groups. The hearing-impaired performed as well on arithmetic tasks and on the tests of synkinetic control as their normal peers who were four years younger, while on static balance they were even inferior to the latter. Raz and Masalha (1988) concluded that as these results cannot be accounted for by low intelligence and neurological disturbances, or by direct or indirect effects of deficient language development, the assumption is supported that some type of neurological immaturity, unrelated to hearing loss, interferes with the acquisition of numerical skills in deaf children.

3.1.2 The prevalence and distribution of dyslateralization

The process of the maturation of the domination of extremities in the manipulative field is usually connected with the age between 6 and 8. Any ambivalence of the movements from

this period represents delaying in maturity of structures and functions determining lateralization of the movements.

Harmonious lateralization implies identical dominant eye, arm and leg lateralization. There are, in our research 51, 9% of children with harmonious lateralization. With total disharmony between the domination of arm, leg, eye and ear were 3.8% of our participants. There are 44.2% of children, in our sample, that are described as "with symptoms of dyslateralization". This means that those children were found to have disharmony between the domination of arm and the domination of eye, or between the usable and the spontaneous lateralization of upper extremities.

Comparing the group of children with HI and the group of children with VI, it was found that the category of children with sensory impairment does not indicate any significant influence on this variable (Pearson's R: Value ,133; Approx. T(b) 1,662; Approx. Sig. ,099(c)). In the sample of pupils with visual impairments, we noticed the presence of dislateralization in 7.2%, disharmonious lateralization in 44.6% and harmonious lateralization in 48.2%. In the sample of the pupils with hearing impairments, we noticed the presence of disharmonious lateralization in 43.8% of the pupils and harmonious lateralization in 56.16%.

The results of Nikolić and Ilić-Stošović's (2009) study are equal to ours. More studies are needed for strong evidence of whether sensor impairments have influence to the process of lateralization. From our study we can conclude that the type of sensor impairment does not influence to process of lateralization.

3.1.3 The prevalence and distribution of balance dysfunction

The stage of balance development begins in the period of middle childhood and this stage is characterized by the stabilization of head in spatial strategy, even if there are more requirements for the balance, and it is the result of predomination of dynamic and vestibular contributions to the balance control, unlike earlier stages, when visual contributions are dominant in balance control (Assiante, 1998).

Apart from the close association between balance skills and young children's motor performance, a dysfunction in postural control may be used as an indication of various types of developmental deficits. Children with disabilities, ranging from mild to severe ones, have a poor performance on balance tests (see: Cinelli & De Paepe, 1984; Gagnon, Friedman, Swaine, & Forget, 2004; 2001; Visscher, Houwen, Scherder, Moolenaar, & Hartman, 2007; Wright, Galea, & Barr, 2005, as cited in Venetsanou & Kambas, 2011). Physical therapists and occupational therapists have historically placed high priority on the treatment of patients with postural control problems because this control appears to be an integral part of all motor abilities (Westcott et al., 1997, as cited in Venetsanou & Kambas, 2011). Additionally, the examination of postural stability and motor control is essential to the vestibular evaluation of infants and children as bilateral vestibular failure may manifest itself as deterioration or delay in motor milestones (Snashall, 2007, as cited in Venetsanou & Kambas, 2011).

Damage to the vestibular system causes gaze and balance impairments (Rine, 2009, as cited in Rajendran & Roy, 2011). To determine the incidence of static and dynamic balance dysfunction in a group of children with profound sensorineural hearing loss receiving a

cochlear implant and to assess the impact of cochlear implant activation on equilibrium, Cushing et al. (2008) tested 41 children (ages 4-17 years) with cochlear implants and 14 children with normal hearing served as controls. All participants performed a standardized test of static and dynamic balance function (Bruininks-Oseretsky Test of Motor Proficiency 2 (BOT2), balance subset). Children with implants performed the BOT2 under the two randomized conditions. The group that had undergone implantation, however, performed significantly more poorly (12 (6) points; 95% CI, 10-14) than either the control group or the published test mean (P = .004). Children with implants performed better with their implants on than with their implants off (mean (SD) difference, 1.3 (2.7) points; 95% CI, 0.3-2.3; P = .01).

The balance was estimated through tasks of the Bruinincks-Oseretsky Test of Motor Proficiency. All tasks were appropriate to the age of the child. We estimated static and dynamic balance. In the results of our research in the area of balance in the pupils with visual and hearing impairments, we found good balance in 50.6% of the pupils, the absence of the balance was found in 27.6% and the difficulties in maintaining balance were recognized in 21.8% of the pupils. (Figure 2).

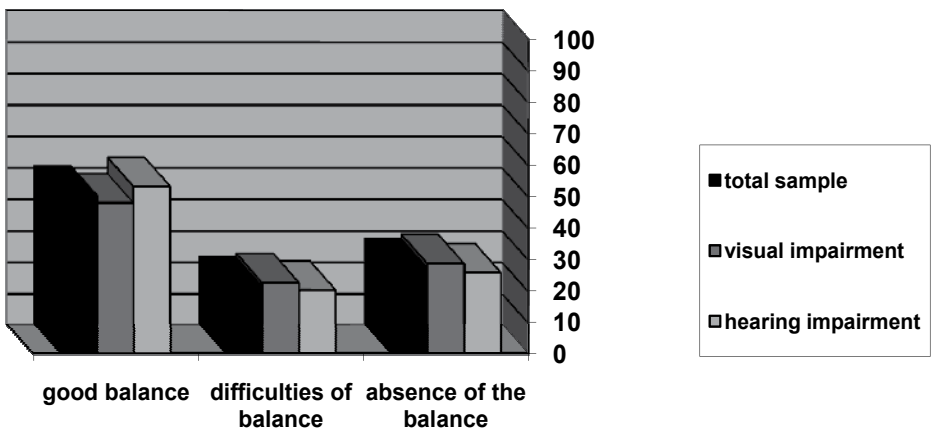

Fig. 2. The prevalence and distribution of balance dysfunction in pupils with visual and hearing impairments.

Opposite to our hypothetic view, but very close to different results of previous research, we did not notice any significant presence of balance dysfunction in the pupils with hearing impairment. The frequency of balance dysfunction has an equal distribution in both examined groups. The absence of balance was noticed in 26% children with HI and 28.9% children with VI. The difficulties in balance were noticed in 20.5% children with HI and 22.9% children with VI. Good balance was noticed in 53.4% children with HI and in 48.2% children with VI. The influence of the category of impairment is not statistically significant (Pearson's R: Value ,047; Approx. T(b) ,590; Approx. Sig. ,556(c)).

Potter and Newman Silverman (1984) also found that balance skills were not significantly related to the level of vestibular response. No significant sex differences were found in the vestibular or balance status of the deaf children. They concluded that the differences in the

characteristics of vestibular function and static balance skills in the deaf children compared with hearing children are important to therapists working with the deaf. Therapists should consider that these differences exist when they identify those deaf children with learning or other sensory-motor problems. Crowe and Horak (1988) investigated the relationship of vestibular function to motor proficiency, including balance, in children with hearing impairments. The test results of this study indicated that the children with hearing impairments and normal peripheral vestibular function exhibited normal motor proficiency, including balance. The children with hearing impairments and loss of peripheral vestibular sensitivity also demonstrated normal motor proficiency, except for balance ability. The children with hearing impairments and sensory organization deficits, however, exhibited motor deficits in many areas. The results of this study indicate that motor proficiency in children with hearing impairments depends on vestibular function. So, while children with hearing impairment can compensate for vestibular deficit through the visual and kinaesthetic system to maintain static balance with eyes open or closed (Potter & Silverman, 1984, as cited in Rajendran & Roy, 2011), and it appears that postural control is more highly dependent upon visual input than on somatosensory (An et al., 2009), we can conclude that children with visual impairment have less opportunity for compensation, besides an absence of damage of the vestibular system. From the other side, many studies (Johnson-Kramer et al., 1992; Johnson/Kramer, Sherwood, French & Canabal, 1992; Ribadi, Rider & Toole, 1987; Gipsman, 1981, as cited in Houwen et al. 2009) underscore the role of vision in static and dynamic balance, but also showed that subjects who are blind adapt to their condition.

O`Reilly et al. (2010) examined prevalence of vestibular and balance disorders in children, and concluded that the prevalence of balance disorders in children was low. Children diagnosed with these disorders typically did not present with chief complaints related to balance. Significant associations existed between sensorineural hearing loss, syncope and headache in children diagnosed with balance disorders. Nikolić and Ilić-Stošović (2009) did not examine associations between balance dysfunction and the presence of some other health problems in children, but, in their study, conducted on prevalence and distribution of motor skill disorders in children with typical development, the percentage of children with balance dysfunction is equal (30.12%) with the percentage we found in our research.

3.1.4 The prevalence and distribution of dyscoordination

Coordination involves rhythmically organized sequential and/or simultaneous use of both sides of the body, which can be divided into two categories - uterus coordination and coordination of upper and lower extremities. Both types of coordination are dependent on the quality of interhemispheric communication (Kennerley, Diedrichsen, Hazeltine, Semjen, Ivry, 2002; Brakke, Fragaszy, Simpson, Hoy, Cummins-Sebree, 2007; Muetzel, Collins, Mueller, Schiessel, Lim, Luciana, 2008). Significant developmental changes in the field of coordination arise from 4 - 10 years (Otte, Van Mier, 2006). Coordination of motor activity is the product of a complex system of interaction of perceptual, motor and cognitive skills (especially executive functions, in charge of motivation, planning and control activities), and the significant correlation with all parameters estimated abilities that are prerequisites of adopting academic skills, is expected. Coordination can also be divided into static and dynamic. This division of coordination is often used.

The evaluation of the coordination of movements is made on the basis of the evaluation of coordination during the performing of alternating movements, coordination while walking and visuo-motor coordination. General motoric skills of upper extremities, of lower extremities and of the whole body was evaluated through the kicking of a puck to the finish line, jumping over a rope, synchronized jumping and clapping hands, special requirements of walking manner etc.

There are, in our research, 24.4% of children with sensor impairment that had the representation of totally inappropriate coordination. The representation of the coordination with mistakes was found at 27.6% of children, whereas good coordination is represented with 48.1%.

The type of impairment indicated a significant influence on the ability of coordination (Pearson's R: Value ,309; Approx. T(b) 4,038; Approx. Sig. ,000(c)). Comparing the two groups of children it was found that there is, in the group of children with VI, 65.07% of children with the coordination disturbance, while in the group of children with HI, this phenomenon was noticed in 36.99%. Good coordination is present with 34.93% in the sample of children with VI, while in the sample of the children with HI, it was present with 63.01%. (Figure 3).

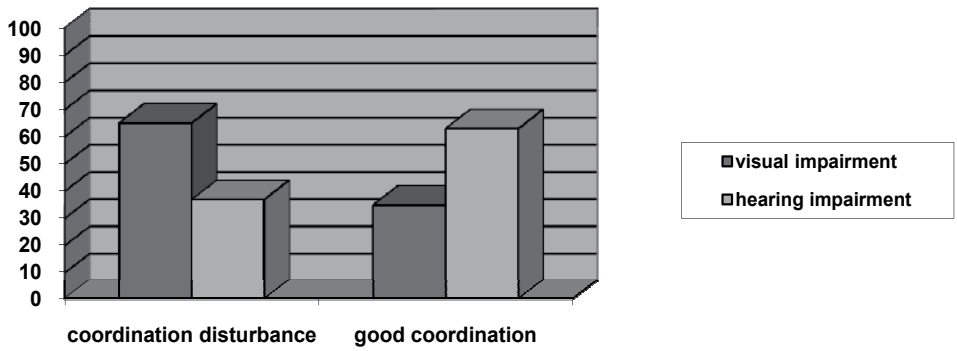

Fig. 3. The prevalence and distribution of dyscoordination in pupils with visual and hearing impairments.

Comparing our research results with the study conducted by Nikolić and Ilić-Stošović (2009) addressed to coordination skill in children with typical development, we can conclude that children with sensor impairment have more problems in solving the tasks what require good coordination skill than children with typical development. In the sample of children with typical development, the representation of totally inappropriate coordination was 7.72%, the representation of the coordination with mistakes was 27.72%, whereas good coordination was represented with 64.54%.

In relation to single aspects of motor skill performance, it is interesting to notice that the disorders in coordination occur in the greatest number - some 52% of the children in the sample. The symptoms of disorders in lateralisation and balance occur in a slightly smaller percentage. The symptoms of delayed neuromaturation mostly occur among the children age 7, and regarding the total number of the disorders, they are represented with 25.4%. The

age of the children, i.e. the class they attend, contributes to the reduction of the symptoms of neuromaturation delaying.

3.2 Relationship between age, type of sensor impairment and motor skill performance

As sighted children grow older, their motor skill performance improves because of maturation, experience, age and heredity (Gallahue & Ozmun, 2002, as cited in Houwen et al., 2009).

The research that has been conducted on differences in motor skill between various age groups of children with visual impairment gave insufficient evidence to establish this relationship. In a few studies (Bouchard & Tetreault, 2000; Pereira, 1992; Gipsman, 1981, as cited in Houwen et al.) the influence of age on motor skill performances of children with visual impairment was not found. From the other side, in a few studies the clear effect of age was found on tasks that examined manual dexterity performance (Reimer et al., 1999, as cited in Houwen et al., 2009), and on a novel motor task (dart throwing) in children and adolescents who were totally blind (Joseph, 1984, as cited in Houwen et al., 2009).

When we discuss the relationship between age and balance, it is important that the child imitates the adult pattern of postural control by the age of 7-10 years. According to the sensory systems' perspective, young children depend on the visual system to maintain balance. As they grow older, there is a progressive domination of the somato-sensory system and the vestibular system (Weisz, 1938; Forssberg H & Nashner, 1982; Foundriat et al., 1993, as cited in Rajendran & Roy, 2011).

An et al. (2009) found that the age-related changes in single-limb standing balance of the profoundly deaf children were notably affected by sensory conditions, in contrast with those of the normal hearing children, which were not influenced by sensory conditions. In standing on a firm surface with eyes open and standing on a foam surface with eyes open, where visual information was enabled, the mean time of maintaining single-limb standing for the profound deaf children significantly increased with age, and even reached levels similar to those of the normal hearing children. However, in the condition of standing on a firm surface with eyes closed and covered, where visual input was removed, the deficit of single-limb standing balance in the profoundly deaf children persisted. In the condition of standing on a foam surface with eyes closed and covered revealed no significant age-related changes in the profoundly deaf children. From the other side, Siegel et al. (1991) compared balance skills of hearing-impaired children with those of hearing children, in order to determine whether a deficit in balance exists in hearing-impaired children and to ascertain whether this deficit is age-related. Balance was measured by the use of the Balance subtest of the Bruininks-Oseretsky Test of Motor Proficiency, and the age of the participants was similar to participants in our research (from 4.5 to 14.5). The results showed that for each age group, the mean score for the hearing-impaired children was lower than the standard score. Both older groups had significantly higher scores than the youngest group, but the mean scores of the older groups were not significantly different. No difference between the subjects' balance scores and the Balance subtest standard scores was found among the age groups, suggesting that the balance deficit was not age-related.

The purpose of Butterfield and Ersing (1986) study was to examine the influence of age, sex, etiology and degree of hearing loss on the static and dynamic balance performance of

hearing impaired children and youth, ages 3 to 14 years. The subjects were individually assessed on Items 2 and 7 of Subtest 2 of the Short Form of the Bruininks-Oseretsky Test of Motor Proficiency. Performance on both tasks improved with chronological age. The sex of the child as well as extent of hearing loss did not affect performance in either task.

There is a usual opinion that the process of the differentiation of the tonus and the appearance of frequent movements on the edges of upper and lower extremities occur toward the end of the sixth year (Bojanin, 1985). The presence of synkinesis and diadochokinesia indicates the immaturity and insufficient differentiation of the basic tonus of muscular structures performing the movements. Some researchers, however, (Golubović Š., 1999) consider this a physiological phenomenon in this period of life, judging by the number of the children showing the immaturity of the muscular tonus in the area of wrist and hand, related to the maturation of cortical structures. Results of our research confirm that same trend is present in children with sensor impairment. According to our research, the symptoms of delayed maturation occurs in 25.43% of the children in the total sample. The greatest representation of all the elements of insufficient maturation appears among the children age 7 to 8 years, but they persist in a certain number of children age 13 to 14 years. Such tonus/neurological organization can disturb the efficacy in school requirements, particularly regarding graphomotor expression. As reported in a study conducted by Nikolić and Ilić-Stošović (2009), the influence of age on the development of this neuromaturation symptom, in children with typical development, was obvious. Most cases occurred in the 2nd-class pupils (32.84%), there was a slight decrease in the 3rd class (29.85%) and the fewest cases occurred among the 4th-class pupils (16.54%). The presence of motoric impersistance decreases with age. The effect of age was statistically significant, $F(26,909) = 16.74$, $p = .000$.

In our research the greatest number of children with synkinesia symptoms was noticed in the 1st class[3] (72.7%), 2nd - 42.85%, decreasing with the higher class. That leads to 20.4% of pupils with synkinesia symptoms in 7th-8th class.

The symptom of diadochokinesia is mostly present at age 7 (54.5 %) and 8 years (42.8%), while the lowest frequency was noticed among the children between 13 and 14 years (9.09%).

The inability to control the mobility of the body or impersistance appears in the children with delaying in neuromaturation and attention deficits. The influence of the age on the development of this neuromaturation symptom is obvious. Most cases were noticed among the children of 7 years old (54.5%), they slightly decrease at the age of 8 (35.71%), and the fewest cases were noticed among the children between 13 and 14 years (25%). The presence of motoric impersistance decreases with the age, but the effect of age was not statistically significant (Pearson's R: Value ,130; Approx. T (b) 1,624; Approx. Sig. ,106(c)). (Table 1.)

With the limitation of a lack of more studies addressing the relationship between age and neuromaturation symptoms in children with sensory impairment, we can conclude that

[3] First class in the Serbian education system correlates with children aged 7 years, Second class - 8 year old children, Third class – 9 year old children, Fourth class – 10 year old children, Fifth class – 11 year old children, Sixth class – 12 year old children, Seventh class – 13 year old children, Eighth class – 14 year old children.

there are no differences in the relationship between age and neuromaturation symptoms in children with sensor impairment compared with children without impairment.

We noticed extremely bad findings of balance capability at the age of 13 and at the age of 14 (50%). Bad results are, also, noticed at the age of 10 (38%), when the children were required to keep balance standing on one foot or standing on the toes, but with closed eyes.

Nikolić and Ilić-Stošović (2009) in their study, also, established that in children with typical development, keeping balance while kneeling, with the arms raised sideways and the eyes closed, was impracticable for a certain number of the 2nd-class pupils (compatible with age of 8) (6.97%). Extremely poor balance capability was noticed in children age 9 years (61.13%) and in children age 10 to 11 years (59.14%) (children were required to keep balance standing on one foot or standing on the toes, but with their closed eyes). The effect of age was statistically significant (F (104, 638) = 61.117, p= .000.).

As we can see in Table 1. in our research, the relationship between age and motor skill performance in children with sensor impairment is confirmed following motor skill performances: synkinesis, diadochokinesia and balance. (Table 1.).

Correlation between age and symptoms of delayed neuromaturation - Synkinesis		Value	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson'sell R	,213	2,704	,008
Correlation between age and symptoms of delayed neuromaturation - Diadochokinesis		Value	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson'sell R	,323.	4,239	, 000
Correlation between age and symptoms of delayed neuromaturation - Motor impersistence		Value	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	,130	1,624	,106
Correlation between age and dyslateralyzation		Value	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	, 017	083	., 834
Correlation between age and balance dysfunction		Value	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	-,356	-4,727	,000
Correlation between age and dyscoordination		Value	Approx. T[b]	Approx. Sig.
Interval by Interval	Pearson's R	-,028	-,352	,725

Table 1. Correlation analysis between age and motor skill performance of children with sensor impairment.

3.3 Relationship between gender type of sensor impairment and motor skill performance

Thomas and French (1985) analyzed 64 studies that reported gender differences on motor performance during childhood and adolescence. As cited in this study (there were 15,518 female and 15,926 male participants, aged 3 to 20 years), age was regressed on effect size, and the relation was significant for 12 of 20 tasks (e.g., balance, catching, grip strength, shuttle run, throw velocity, tapping). Several types of age-related curves were found; the curve for a throwing task was the most distinctive. Five of the tasks followed a typical curve

of gender differences across age. For 8 tasks, gender differences were not related to age, and effect sizes were small.

The results of Nikolić and Ilić-Stošović's (2009) study confirmed that the effect of a gender was statistically significant in the presence of neuromaturation symptoms. Girls had significantly better scores on evaluation of three symptoms of neuromaturation than boys. How can we explain such a difference in our results and the results of Nikolić and Ilić-Stošović's (2009) studies? It is necessary to do more research to give the answers to the question: why is that so? It is obvious that sensor impairment, in its own structure, influences development, functioning, experience of children affected with it, and somehow equalizes development of fine motor structure, between girls and boys. So, it is necessary to examine what is the issue, besides existing similarity in prevalention and distribution of neuromaturation symptoms overall and according the age between groups of children with sensor impairment and without, influences this difference according to gender.

Venetsanou and Kambas (2011) examined the effect of age and gender on balance skills in preschool children. Gender was found to have a statistically significant effect on the total balance score. Regarding individual items, the girls outperformed the boys on standing on the preferred leg on the floor, standing on the preferred leg on a balance beam, standing on the preferred leg on a balance beam – eyes closed, walking forward heel-to-toe on a walking line, walking forward heel-to-toe on a balance beam while the boys had statistically significant higher scores on walking forward on a balance beam.

There are not a lot of studies related to gender differences and motor skill performance of children with sensor impairment. Most research addressed the relationship between gender and balance skill, but there are not many studies related to the relationship between gender and some other motor skill performances. Leonardo (1969, as cited in Houwen et al., 2009), found no differences in static balance between boys and girl with blindness, but found higher median dynamic balance scores for boys than girls with blindness. Similar results found in Pereira (1990, as cited in Houwen et al., 2009), examine static and dynamic balance in children with visual impairment aged 6-13. No relationship was found between gender and this motor skill performance. Ribadi et al. (1987, as cited in Houwen et al., 2009) examined dynamic and static balance in adolescents who were congenitally blind aged 14-17, and did not find a relationship between gender and balance. Joseph (1984, as cited in Houwe et al., 2009) found a relationship between gender and success on dart throwing tasks in children who were totally blind. Boys performed significantly better than girls.

Potter and Newman Silverman (1984) examined balance skill in children with hearing impairment and no significant sex differences were found in the vestibular or balance status of the deaf children. Butterfield and Ersing (1986), also, found no relationship between gender and performance on dynamic and static balance tasks in children ages 3-14 years, with hearing impairment.

The effect of a gender, in our research, was not statistically significant in the presence of neuromaturation symptoms. The girls did not have significantly better scores on evaluation of three symptoms of neuromaturation than the boys among the pupils with sensory impairments. There are the same results related to gender and neuromaturation symptoms in a group of children with hearing impairment, as much as in a group of children with visual impairment.

The gender of the pupils with sensory impairment does not indicate any significant influence on lateralization of the variable sampled (Pearson's R: Value ,017; Approx. T (b), 083; Approx. Sig., 834(c)).

The results of our research indicate that the effect of gender to balance dysfunction was not statistically significant (Pearson's R: Value-,058; Approx. T(b) -,719; Approx. Sig. ,473(c)).

The effect of gender to distribution of dyscoordination was not statistically significant (Pearson's R: Value-,084; Approx. T(b) -1,040 Approx. Sig , 300(c)).

4. Conclusion

The aim of this research was to establish prevalence, form and the quality of motor skill performance in children with sensor impairment. The research results were focused on two groups of school aged children: children with visual impairment and children with hearing impairment. The findings on variables associated with prevalence, form, level of motor disorders and quality of motor skill performances was analyzed in each group of children. The quality of motor skill performances, in this research, was analyzed in three areas of motor functioning: neuromaturation, coordination and balance. The study provides data on interaction between: (1) motor skill performance and visual or hearing impairment (between groups and single analysis); (2) motor skill performance of children with visual impairment, as much as motor skill performance of children with hearing impairment, with the aim of establishing if there similarities or some kind of pathway which can help professionals in creating rehabilitation programmes, as much as programmes for adaptive physical education; (3) motor skill performance and common child variables, such as gender and age; (4) previous findings of the authors Nikolić and Ilić-Stošović (2009) that are related to motor skill performance of children with typical development with the aim of establishing differences or a similarity in prevalence and structure of motor skill performance in all three examined groups.

There are the same laws in the development of motor skills in the children with visual and hearing impairments as those in the development of the children without these impairments. But nevertheless, it is possible to notice constant deviations in some areas. Garet and Levin (1970) refer to the research of Norris, Spaulding and Brodie (1957), which indicates that the development of the children with severe visual impairment is approximately equal to the development of sighted children, except for the tasks requiring the ground of specific experience. According to these authors, the delayed mastering appears most expressively in some types of motor reactions. When talking about the manifestation of neuromaturation symptoms, the results of this research coincide with the results of Nikolić and Ilić-Stošović (2009), in the research of the neuromaturation of the children without sensory impairments: in the sample of the children with sensory impairments, the presence of the malfunction of neuromaturation was noticed in 25.49% of the total sample, and in the sample of the pupils attending mainstream schools, it was 25.74%. In relation to the type of sensory impairment, the results indicate an equal distribution of the symptom of synkinesia and of the motor impersistence, but the prevalence of the appearance of diadochokinesia is statistically significantly greater in the children with visual impairment. Almost the same frequencies also appear in the comparative analyses of balance situation i.e. of the appearance of balance dysfunction: in

the sample of the children with sensory impairments, the presence of balance dysfunction was noticed in 49.4% of the total sample, and in the sample of the children attending mainstream schools, it was 48%. Opposite to our hypothetic view and to previous research, we did not find any significant presence of balance disorders in the pupils with hearing impairment. Children with visual impairment have the problem of maintaining balance because of the lack of visual information, which are very important for maintaining the position of the body. The feature that is characteristic is the frequency of the phenomenon of dyscoordination, and that in the category of visually impaired children (65.07%), which is significantly greater also in relation to the pupils with a typical developmental course (37.3%, and to the sample of the pupils with hearing impairment (36.99%). Regarding the immense influence and the active role of visual information in movement control, the correction of errors and the entire coordination, such a result is not surprising. When we discuss the relationship between motor skill performance in children with and without sensor impairment, an important difference between these two groups of children can be seen in the relationship between gender and distribution of symptoms of delayed neuromaturation. Opposite to the research results of Nikolić and Ilić-Stošović (2009), that confirmed a relationship between gender and symptoms of delayed neuromaturation in children with typical development, it was not found in our research. The answer for this difference can be found in the relationship between experience and motor development. Although, all children in our sample attended special schools because of their increased need for individual and adaptive education, it is possible that lack of experience needed for development of neuromaturation (e.g. specific game) brought equalization in this area of motor skill performances between boys and girls. Additional research is needed in this area. Issues that need to be addressed include the association of education model (inclusive vs. special) and development of motor skill performance.

Assuming all presented studies related to the relationship between age and balance skill, age is a very important factor in balance skill for children with and without sensor impairment, but only if we consider type and difficultness of tasks. If we accept the opinion that it appears that postural control is more highly dependent upon visual input than on somatosensory (An et al., 2009), than we can conclude that we did not find strong evidence for a relationship between age and balance skill, but we did find a strong relationship between visual input and this motor performance skill. It is necessary, for further research to examine how different task demands (with and without visual input) influence balance skill in children with typical development. It is also necessary to examine how children with sensor impairment develop their motor skill performance and how the specifics in that development influence to scores measured at balance skill testing. Houwen et al. (2009) state that motor skill performance may be a function of age and experience.

A significant representation of isolated motor disturbances in the pupils with sensory impairments must concern and require the earliest possible intervention. The therapy approach to the disorders in motor development implies above all a properly established diagnosis, on the basis of which the kind and the form of the treatment to be applied will be determined. A timely treatment within the re-education, directed to the delaying in neuromaturation, disharmonic lateralization, balance and coordination disorders, may give favourable results. Also, it is very important to improve motor skill performance of children with sensory impairments, because it might contribute positively to their sports participation.

The construction and the application of screening protocol which contain the evaluation of neuromaturation maturity (symptom of synkinesia, diadochokinesia and motoric impersistence), the evaluation of lateralization, balance, coordination (general motoric skills), enabled differentiated diagnostic criteria for establishing the level and the quality of motoric functioning, as well as of the prevalence and the form of the manifestation of motoric disorders in the pupils with sensory impairment.

Interventions for motor deficits in children with hearing impairments must consider vestibular function as well as motor performance (Crowe & Horak, 1988).

However, this research has some limitations. First, in this research, correlation between type of hearing impairment (conductive or perceptual), as much as level of hearing loss, was not considered in the aim of establishing a relationship between motor skill performance. Second, correlation between congenital and other type of hearing loss or visual impairment was not considered in the aim of establishing a relationship between prevalence and distribution of motor skill performance. In that way, further research should consider this. Next, opportunities for movement experience of both groups of children with sensor impairment are very important factors that influence quality of motor skill performance. Restricted opportunities for movement and deprivation of practice have been shown to interfere with children's abilities to perform motor skills at adequate level (Gallahue & Ozmun, 2002, as cited in Houwen et al., 2009). In literature it is expressed that an adequate environment that reinforces positive environmental interactions is important for stimulating motor skill practice in children with visual impairment (Schneekloth, 1989, as cited in Houwen et al., 2009). There is no reason to believe that there is an opposite rule for children with hearing impairment. So, stronger evidence for a correlation between motor skill performance in children with sensor impairment could be found if further research considers it. Lastly, we examined only motor skill performance in children with sensor impairment educated in special schools. So, when we discuss our results, we must consider that our participants had such a level of sensor impairment what needed education in special circumstances. It might be possible that distribution and prevalence of symptoms of delayed motor skill performance would be different if we correlated motor skill performance in children with sensor impairment educated in mainstream schools and children educated in special schools. Unfortunately, this was not possible as, in the period that we did our research, inclusive education was not an option in the Republic of Serbia.

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13

Could Motor Development Be an Emergent Property of Vestibular Stimulation and Primary Reflex Inhibition? A Tentative Approach to Sensorimotor Therapy

Mats Niklasson
Department of Psychology, Karlstad University, Karlstad
Sweden

1. Introduction

It was through the concern to meet the needs of the intelligent but under achieving child that the 'modern' field of learning disabilities was born. That said, we must keep in mind that it also started with a deep concern for the mentally retarded and a hopeful vision and conviction that fulfillment of the human potential was possible. The aim of this chapter is to provide tentative arguments in favor of a complementary view of the learning disabled child's ability to mature and to learn. My approach is based upon the necessity and importance of the body as a fundamental tool in the learning process but I will start with a historical overview of learning disabilities in general. To enable the reader to get a better understanding of the coherence between the different concepts which I wish to unite, I will give brief historical backgrounds as I proceed. These historical backgrounds also serve the purpose of showing that whilst my conclusion might be new, its different parts have long been in front of our eyes awaiting discovery. Through knowledge of history we are also better prepared for the future. However, the history of science has shown so many times before that a synthesis between different disciplines is needed in order for further progress to occur.

2. Historical overview

2.1 The wild boy of Aveyron

The written history of learning disabilities may be said to have started (Strauss & Lehtinen, 1947) in 1799 with the physician and educator Jean-Marc Gastard Itard (1775-1838). Living in France, Itard discovered the 'wild boy' Victor. Although diagnosed as an 'idiot' and incurable by the father of scientific psychiatry, Philippe Pinel (Flugel, 1933), Itard was convinced that the boy could be educated into 'an acceptable human being'. As a man of his time, Itard was shaped by the spirit of the French Revolution and the philosophy of an inherent limitless possibility of human development. Being a physician for the deaf he used the same sensory training for Victor as he used for speech training with his patients. Although Victor's social behavior improved, his intelligence and ability to comprehend remained below expectation. Itard felt his experiment was a failure but published the

training and the teaching in a book, 'The wild boy of Aveyron' (1801; 1806; 1932). All of the teaching and training carried out has become of great significance (Flugel, 1933) because it was the first systematic attempt to train someone 'feeble-minded'. His work was successfully continued by one of his medical students, Edouard Séguin (1812-1880). Influenced by the utopian socialist Count de Saint-Simon, Séguin believed that educating the mentally disabled was a step toward a better society (www.newworld encyclopedia.org). By 1828, a special institute for the education of the mentally disabled had already been established in Paris and in 1842 Séguin became its director. Like his teacher, Séguin rejected the notion (Anastasi & Urbina, 2007) that mental retardation was incurable and practiced sense training and muscle training for the benefit of his patients. At the time (Strauss & Lehtinen, 1947), his work was in line with medical science which proposed specific training of those senses which were impaired as a way to improve the function of the nervous system. In 1846 Séguin wrote "you can't teach a child to read and write until its sensory system is mature" (Holle, 1990) and still today (Anastasi & Urbina, 2007), the methods used for training mentally disabled children in sensory discrimination and motor control have their origin in Séguin's work and in no small way Maria Montessori's work was also influenced by him.

2.2 Simon and Binet

By the mid 19th century (Strauss & Lehtinen, 1947), the first institutes created according to the French model were established in USA and in Great Britain. However, by the end of the century, due to effective laws regulating the compulsory education of children, educators in the US were troubled with a new problem. For a couple of months each year (Ravitch, 2000), 95 % of the children aged five to thirteen attended school. Among these children were those who showed various degrees of retarded intellectual development with a decreased ability to understand and to learn but who still were too able to be institutionalized. As a consequence of the need to separate the mentally deficient student from the normal, Binet and Simon developed an intelligence test. The first scale presented in 1905 (Anastasi & Urbina, 2007), included sensory and perceptual skills but as Binet held reasoning, judgment and comprehension as essential for intelligence, the test stressed the verbal content. However useful, the test, or more correctly the concepts used failed to fully distinguish mentally deficient children from the mentally retarded. Binet and Simon wrote in 1914 as cited in Strauss and Lehtinen (1947);

"….the division, which we have ourselves suggested, of all the abnormal into three groups: (1) the mentally defective; (2) the ill-balanced; (3) a mixed type which includes those who are both mentally defective and ill- balanced. The simply defective do not present any well defined anomaly of character, but they do not profit, or profit very little from ordinary school teaching. The ill-balanced, who might also be called the "undisciplined," are abnormal chiefly in character. They are distinguished by their unruliness, their talkativeness, their lack of attention, and sometimes their wickedness"(p. 12).

It is interesting to compare these lines to current descriptions of children with various difficulties and diagnoses. Simon and Binet seem to have roughly defined both the slow learner and the restless child but in the years to come the concepts would be further differentiated and refined. Doll, Phelps and Melcher (1932) postulated that mental retardation seen in children with cerebral palsy was not a direct effect of brain injury but

rather due to the lack of ability to move and to explore. An important step was taken (Strauss & Lehtinen, 1947) when science was able to distinguish between syndromes of endogeneity and exogeneity in mental deficiency. Larsen (1931) summarized (in Strauss and Lehtinen, 1947) the exogenous features as "organic with acquired neurological symptoms (birth-injury, encephalitis, meningitis)". Kahn and Cohen (1934) described what they labeled 'Organic drivenness' as a consequence for some children surviving encephalitis epidemica. The primary symptom was hyperkinesis but the child also showed an inability to keep quiet, clumsiness and abruptness in the performance of movements. Silver (1951) includes in his review of the 'organic child' the hypokinetic child. This child often displays lags in language development and in motor abilities. He is extremely rigid, clings to a parent and avoids or expresses anxiety in 'anti-gravity' play. Silver suggests that both the hyperkinetic and the hypokinetic child should be tested for primitive – and postural reflexes and concludes; "There exists a large number of children with behavior disorder in whom organic signs as described in this paper are found but in whom no etiological factor can definitely be established. It is often difficult even to determine whether the organic state is developmental or acquired. Many we suspect are developmental, but in others the role of trauma or anoxia at birth is by no means ruled out" (p.42). Once again it is tempting to compare the description with present day reality. It is scary to think about all those children and youngsters who might have been regarded as mentally retarded when their problem might have been of a sensorimotor character. I will return to this below.

2.3 Towards a science of learning disabilities

The concept 'organic' is used to describe structural or 'real' diseases/disorders, "of known structural, chemical, or metabolic origin", in the domain of the neurologist as opposed to functional disorders, for example psychosomatic diseases/disorders, mainly treated by psychiatrists (Black's Medical Dictionary, 1990; The Merk Manual, 1989; Bloom & Lazerson, 1988). Body image (Schilder, 1964), for example, is based on physiological data and on the structural organization of the organism, but the final synthesis comes from the personality. However, as Bloom and Lazerson (1988) claim, the organic nature of a brain problem might be diagnosed as functional, whilst not being totally functional, due to an inability to measure the appropriate index. I will return to this problem below.

Mabel Todd, a contemporary of Larsen, Kahn and Cohen, defined proprioceptive sensations as organic (Todd, 1937) and grouped them into three types according to their origin (1). Kinesthesia, the feeling of movement. (2). Vestibular sensations, the feeling of position in space. (3). Visceral sensations, impressions from internal organs. In 1870, Ewald Hering (Finger, 1994) already used the term some what differently, in connection with memory, suggesting that 'organic memory' was more than just a part of the higher nervous system although his extension of these ideas was, and still is, very questionable. However controversial, I will return to 'organic memory' later.

In the mid 1930s, Orton made the suggestion (Ahonen, Kooistra, Viholainen, & Cantell, 2004) that 'dyspraxia' or abnormal clumsiness was a developmental disorder to be found among dyslexic children. Not only were these children late in learning to walk and run, they were also late in visuomotor and manual tasks. In his book 'Reading, writing and speech problems in children' (1937), Orton developed the idea that clumsy children could have

difficulties both in learning more complex body movements and in learning movements which are necessary for speech and writing. The following citations from Orton will serve as a background and as a bridge to my argumentation for sensorimotor therapy which follows below;

"Such children are often somewhat delayed in learning even the simpler movements such as walking and running, and have great difficulty in learning to use their hands and to copy motions showed to them. They are slow in learning to dress themselves and are clumsy in their attempts to button their clothes, tie their shoes, handle a spoon, and in other simple tasks"(p.121) .

"In the case of children who have great trouble in learning complex patterns of movement – the developmental apraxias – simpler movements are often readily acquired although they may be lacking in grace or smoothness. Here the controlling sensory element is that of kinaesthesis or the registration of movement patterns" (p.148).

"Our attention has been directed to attempting to determine very simple patterns of movement over which the child has a reasonable mastery, and gradually combining these simpler patterns into more complex and difficult ones. Here again we have been guided by the belief that it is in such re-combinations of simple movements that the crux of the apraxic child's difficulty rests" (p. 191).

"It is common to assume that the simple, largely reflex patterns of movement which enter into walking and running, for example, are sufficiently well acquired by the child without training so that in the more difficult sports, such as tennis, attention need be given only to the special instruction for that game and this, of course, is true of most children. In those with a measure of apraxia in their make-up, however, this assumption is not justified and much better headway might be made by spending some time teaching the child how to run and turn and stop without losing balance, before specific training in the sport is begun" (p.192).

Today it is obvious that learning difficulties are not to do with whether one is intelligent or not but it is very likely that many children have been and still are being misunderstood. Annell (1949) described in an article a group of children with motor dysfunction. In a cohort of 600 children aged 6 to 17 yrs, either in the ward or out-patients of the Department of Child Psychiatry in Uppsala, Sweden, 78 children (61 boys and 17 girls) or 13% had motor dysfunctions. Of these children, 57 (47 boys and 10 girls) had an average or above average I.Q. Besides having difficulties in ordinary life activities (things such as threading needles, eating without spilling and doing up buttons) they often had a history of late speech development. The children briefly described in these vignettes (Annell, 1949) are recognizable even today.

"Briefly, this 8-year old boy had the physical development of an 8-year-old, the speech development of a 14-year-old and the motor development of a 5-year-old. In his class at school he is in some respects far ahead of his class mates, but as regards motor activities he is far behind them and has no normal contact with them. He tries, when such subjects are studied in school in which his motor retardation is apparent, to compensate his weakness by clowning or by distracting interest from the work he is to do" (pp.906-907).

"A boy, aged 14, with an IQ of 139, had during the past year the lowest marks in all written subjects and gymnastics, low marks for conduct since, amongst other things, his exercise books were always full of ink-blots, etc., that it was considered due to carelessness. He showed an intense dislike of school and wanted to be a farmer. /His movements were slow, he wrote slowly and unevenly, and did up buttons slowly. He found it difficult to carry out any movements that could not be controlled visually, and could not walk on a strait line on the floor with his eyes shut" (p.907).

Under the heading 'Clumsy Children', an editorial in British Medical Journal (1962) did a follow up of Anna-Lisa Annell's article. The editor compared her observations with more recent research and concluded that clumsy children are not uncommon and, "The worst thing we can do is to call him naughty when he has a physical handicap" (p.1666).

In his book 'Reading and remedial education' (1967), the British educator A.E Tansley claimed that possible damage to the nervous system existed among children with reading and writing difficulties. A 'softer' formulation would be that there could be a physiological origin to their problems. Tansley emphasized the importance of reading readiness. Teachers, he argued, are often too anxious about getting a child to read and might push him before he is ready. It is therefore important that teachers and parents are trained to see signs of readiness. The child should have a readiness in (1) language development, (2) physical and sensory development and in (3) emotional and social development. In his book he outlined a 'remedial' treatment of a child's inability. He preferred the term 'remedial' because the treatment given is psychological, educational, social and medical relating to a scientific diagnosis of the reading disability. As the field of learning disabilities slowly grew, Ozer (1968) found it necessary to put forward the need for a more accurate neurological examination of the child with learning disabilities. This examination did not only focus on motor function, but also compared the child's brain function to its learning capacity. Still in the 1970s, when the first generation of youngsters diagnosed as learning disabled grew up (Orenstein, 2000), a true science of learning disorders seemed unreachable (Pennington, 2009).

However, Chruickshank (1981) suggested a novel perspective for teacher training and proposed the 'Neuroeducator'. Thirty years later though, as far as I know, only the University of Portland, School of Education, Oregon, USA is offering courses and a Postmaster Certification in 'Neuroeducator'. The requirements set by Chruickshank were (1) an understanding of human anatomy, (2) a solid understanding of human neurology and neurophysiology, (3) a basic understanding of intelligence, (4) a basic understanding of perception and the psychology of learning, (5) an understanding of movement education and an understanding of (6) speech communication. He also required the student's ability to communicate the child's problem accurately to its parents. Mycklebust added in his article 'Toward a Science of Learning Disabilities' (1983) that the evolving definition would come to include references to both verbal and non verbal learning and concluded; "A science of learning disabilities is forthcoming".

2.4 The present situation

Today, different kinds of learning disabilities constitute a serious, worldwide problem. About 10% of school-age children are affected (Levin, 2003) and Orenstein (2000) estimates that as many as 20% of adults suffer from different kinds of Undiagnosed Learning

Disabilities (ULD). Using the broader term 'learning disorders' (Pennington, 2009) to connote "any neurodevelopmental disorder that interferes with the learning of academic and/or social skills" (p.3), Pennington reviewed Dyslexia, Speech and Language Disorders, Autism Spectrum Disorder, Attention Deficit Hyperactivity Disorder (ADHD), Intellectual Disability, Developmental Coordination Disorder (DCD), Mathematics Disorder and Nonverbal Learning Disorder.

ADHD is recognized as a functional deficit that affects approximately 5% of the global population (Polanczyk, de Lima, Horta, Biederman & Rohde, 2007) and many children diagnosed with ADHD are described as awkward or clumsy. They exhibit motor-perceptual difficulties (Yochman, Ornoy & Parusch, 2006) and match the criteria of DCD (Feng, Cheng & Wang, 2007; APA, 1994). A Swedish study (Kadesjö & Gillberg, 1998) showed that almost 50% of the children matching the full criteria for ADHD (DSM-III-R), also matched the criteria for DCD. Gillberg (2010) has recently pointed out that within this field, the coexistence of disorders is a rule rather than an exception. Largely, DCD is equivalent to what was previously called 'Clumsy Child Syndrome' and refers to children whose motor development is delayed irregardless of whether neurological causes are evident. Between 5 and 9 % of all school children are affected (Cairney, Hay, Wade, Faught, & Flouris, 2006). Learning disabilities and emotional immaturity become more apparent over time, and as adolescents these children evince social, emotional, and academic difficulties to a greater extent than others. They also run a higher risk of starting to use alcohol (Rasmussen & Gillberg, 2000) and according to Levin (2003), 10% of adult psychiatric patients suffer from learning disabilities. In her book 'Smart but stuck', Myrna Orenstein (2000) uses the concept 'imprisoned intelligence' in the sense that ULD can cause feelings of shame because of the inability to fully achieve academically and the constant feeling of being inferior. Although in some circumstances shame can serve a positive purpose, for children and adults with learning disabilities who never fully succeed the outcome is negative. As another consequence of learning disabilities, whether diagnosed or undiagnosed, shame is of great importance not least because together with guilt, they are both (Nathanson, 1994) symptoms within the field of depression. Polatajko (1999) writes about low self-esteem and secondary emotional or behavioral problems in relation to children's motor problems. There is some evidence to show that a consequence of DCD may be internal disorders (De Raeymaeker, 2006; Cairney, Veldhuizen, & Szatmari, 2010) and still another consequence of DCD (Faught, Hay, Cairney, & Flouris, 2005) is an increased risk of coronary and vascular disease. Although it is likely that the DCD spectrum includes thin and energetic individuals as well as those who are more or less obese and less mobile, it is the latter who are probably more at risk. This view is proposed in three articles published in economy-orientated journals.

According to Lundberg, Nystedt and Rooth (2011) there is a correlation between obesity during adolescence and wages later on in life. Of equal importance, the reasons seem to be on one hand family habits during childhood and on the other hand low physical fitness and a lower non-cognitive ability. Non-cognitive abilities are described as being self confidence, ability to interact and cooperate, motivation, time preferences and endurance. Lindqvist and Vestman (2011) confirmed in their study that non-cognitive abilities, as measured above, were as important as cognitive abilities in their impact upon salary levels. Lundberg *et al.* (2011) explain that non-cognitive abilities and obesity have only recently been correlated

and that the connection is sociological rather than biological. In their example, a correlation between obesity and non-cognitive inabilities might follow if a child is excluded from sports and social activities. Cawley and Spiess (2008) claim to have identified such a connection among children aged only 2-3 years. Although a sociological explanation seems good enough, from my point of view, it is equally likely that it might be the other way around. A child who is unable or finds it uncomfortable to move is more likely to remain outside of social fellowship. Interestingly, Lundberg *et al.* (2011) conclude that although there is a correlation between obesity, non-cognitive abilities and wages there might also be other underlying, not yet considered variables affecting all three. Such variables could be parental characteristics or aspects of up-bringing, equally affecting all siblings. I will return to this in the discussion below.

Generally, learning disabilities are thought about and labeled as cognitive and, accordingly, special education seems to aim at teaching children strategies to overcome their problems, which is of benefit to some. For others, however, the difficulties more or less remain and we have to ask why this is the case. Are there factors which up until now have not properly been considered? If so, what could they be?

During the last centuries, focus on cognition, teaching, information and instruction has increased. The importance of early learning is a mantra within both politics and science, and parents are instructed how to begin to teach their children as early as possible. At the same time, more children are less mobile and less time is spent playing spontaneously. Is there a too strong belief today that what comes from the outside i.e., in teaching, information, and instruction goes in? I don't have the answer but I would like to counterbalance with a re-introduction of the concept 'education' and suggest a complementary approach. Throughout history (Arendt, 2006, Furedi, 2009, Ecclestone & Hayes, 2009) and up to the present day, the schooling of children has been a matter of values and also a matter of emphasizing education, learning or training depending on the aim of the schooling and the basic assumption of what a child really is. Arendt (2006) writes; "To educate, in the words of Polybius, was simply 'to let you see that you are altogether worthy of your ancestors' " (p.191).

2.5 A complementary approach

The word 'education' is etymologically derived from the Latin word e-duco meaning 'bring out' and suggests according to Kegan (1994) "a 'leading out from' ". My view is in line with Kegan's who writes that the focus of information is to change what people know while "*education* leads us out of or liberates us from one construction or organization of mind in favor of a larger one" (p.164). This might be very close to what Watzlawick, Weakland, and Fish (1974) and Ahrenfelt (2001) define as a first-order change as opposed to a second-order change. A first-order change (Watzlawick *et al.*, 1974) follows a 'more of the same' strategy based on common sense. It will be a 'renewal' of what is already there (Ahrenfelt, 2001). On the other hand a "second-order change usually appears weird, unexpected, and un-commonsensical; there is a puzzling, paradoxical element in the process of change" (p.83) and there is a change of the whole system (Ahrenfelt, 2001).

My first assumption, which is connected to information, is that many of the remedial teaching methods used today might create changes which are more of a first-order.

My second assumption, which is connected to education, is that change is possible from within and that such change is of a second-order.

My third assumption is that information and education are complementary and that a pedagogical challenge will be to evaluate how they can counterbalance each other according to the special needs of the child.

My fourth assumption is that it might be possible that learning disabilities to a higher degree than previously realized are due to sensorimotor immaturity.

3. Background

3.1 Developmental coordination disorder. Old problems but a new label

The vignettes, above, from Binet and Simon (Strauss & Lehtinen, 1947), Orton (1937) and Annell (1949) show that the sensorimotor and concentration problems we face today among children and adolescents are far from new. It is obvious that sensorimotor difficulties have been a documented companion to mental retardation as well as to learning disorders throughout the last century. What is now labeled DCD (Pennington, 2000) has previously been recognized under different names such as 'motor deficiency', 'congenital maladroitness', and 'minimal brain dysfunction'. As a motor skills disorder, DCD is described as follows in DSM-IV (American Psychiatric Association, 1994);

"The essential feature of Developmental Coordination Disorder is a marked impairment in the development of motor coordination (Criterion A). The diagnosis is made only if this impairment significantly interferes with academic achievement or activities of daily living (Criterion B). The diagnosis is made if the coordination difficulties are not due to a general medical condition (e.g., cerebral palsy, hemiplegia, or muscular dystrophy) and the criteria are not met for Pervasive Developmental Disorder (Criterion C). If Mental Retardation is present, the motor difficulties are in excess of those usually associated with it (Criterion D). The manifestations of this disorder vary with age and development. For example, younger children may display clumsiness and delays in achieving developmental motor milestones (e.g., walking, crawling, sitting, tying shoelaces, buttoning shirts, zipping pants). Older children may display difficulties with the motor aspects of assembling puzzles, building models, playing ball, and printing or handwriting" (pp.53-54).

It is a pity that still, after at least 100 years, we lack sufficient methods to help those affected.

One reason might be that for a long time the child was supposed to 'out-grow' his problems.

Another reason might be a lack of consensus. As mentioned above, because of the difficulty of measuring the appropriate index, problems organic in nature might be diagnosed as functional, and vice versa. Gillberg and Kadesjö (2009) give the example of Attention Deficit Disorders (ADDs) and DCD. DCD and motor clumsiness are traditionally considered to be within the territory of a child neurologist or a developmental pediatrician while ADDs, including ADHD, typically fall within the domain of child psychiatry and psychology. "This 'split' may explain the fact that few psychiatrists are aware of the implications of the motor and perceptual problems that are so often comorbid with childhood ADHD. Conversely, child neurologists often fail to appreciate the effect of attention deficits on the lives of the clumsy children whom they see for diagnosis and workup" (p.305).

A third reason might be the fact that no method, so far, has proved to be effective enough. Several longitudinal studies of DCD (Polatajko, 1999) show that motor problems persist and that other parts of the child's development are affected. Meanwhile a lot of research concerning diagnoses and conceptual issues has been published while few, if any, (Polatajko, Rodger, Dhillon, & Hirji, 2004) cohesive training methods have been developed, evaluated and used. Polatjko *et al.* (2004) end their review by stressing the importance and need for rigorous research to explore methods of treatment suitable for DCD. The method Retraining for Balance, to be presented below, is a new strong candidate which in initial studies (Niklasson, Niklasson, & Norlander, 2009; 2010) has shown not only promising results but also has opened up a novel perspective on sensorimotor training. This novel perspective might give us a hint as to why previous methods have failed to break through. I will tentatively discuss this below.

To conclude; for progress to be possible, there has to be, not only an extended co-operation between different faculties but also a recognition from the scientific community of the need for the development and evaluation of therapy methods.

Coming from the field of education, I have written this chapter in dialogue with representatives from two other fields of science, child neurology and psychology, each with its special interest in the wellbeing of the child. One has argued elsewhere for an early screening and detection of ADHD and DCD (Rasmussen & Gillberg, 2000) not least since co-existence (comorbidity) means that poor psychosocial functioning is very likely. Two of us have previously (Niklasson, *et al.,* 2009; 2010) evaluated a method for sensorimotor therapy, Retraining for Balance. Together we have published (Niklasson, Rasmussen, & Norlander, 2010) a call for the importance of further studies. At this time there exists no standardized manual for the testing of primitive/primary reflexes in older children and adolescents. Therefore, we have recently started such a study.

3.2 Different approaches to sensorimotor training

Techniques used in formalized sensorimotor training differ both from a theoretical and a methodological perspective. Pless (2001) makes a distinction between General Abilities Approach (GAA), Sensory Integration Approach (SIA) and Special Skills Approach (SSA). The GAA proposes that age-appropriate reflexes, postural reactions, and perceptuomotor proficiency form the basis of functional motor ability and the development of thought processes. The SIA stresses vestibular stimulation and suggests that sensory integration might be the basis for language, motor and intellectual development. According to the SSA, finally, more sophisticated motor skills are formed by specific motor learning.

3.3 Retraining for balance - An introduction

The method Retraining for Balance (RB) can be considered as a mixture between the approaches of GAA and SIA. The concepts of primary reflexes and postural reactions are borrowed from GAA while the theoretical foundation of vestibular stimulation is borrowed from SIA. The basic GAA perspective, theoretically and practically used in RB was developed by Peter Blythe (Goddard Blythe, 2009) at the Institute for Neuro-Physiological Psychology (INPP) in Chester, Great Britain. Peter Blythe and Sally Goddard Blythe have over the last 20 years very successfully spread their work globally and a lot of practitioners

are using their method. Although Blythe stresses the importance of vestibular stimulation (Vose, 1986), it is the ground breaking work of Jean Ayres (1973) which is to be regarded as foremost in the SIA approach.

In the early 1990s, the INPP- guidelines for how to carry out assessments (Goddard, 1990) and use exercises were strictly mechanical and linear. The meaning being, that when through assessment you identified certain immaturities (to be explained below) you were supposed to use certain exercises in a 'goal directed' way. This meant that some children went through training using just a few exercises while others had to use more exercises and the duration and content became rather different from child to child. Vestibularis, a private practice in Sweden, was not satisfied with the results achieved whilst working in this way. It had noticed that some exercises seemed more powerful than others and this inspired the attempt to create a harmonious totality of the different movements (Niklasson, Niklasson, & Bergström, 1999, 2007). To put it 'poetically', something more like soft and round rather than sharp and strait. Vestibularis' modification or rather re-construction was named 'Retraining for Balance' and aimed at forming a method with a common start and end and with a sense of cohesion between exercises. The re-construction and further development was influenced by theories from research carried out by the Finish brain neurophysiologist and physicist Matti Bergström, who also took an active part as an advisor. Bergström had previously suggested (1967, 1972, 1989) that, "The psychological state is a macrostate of the same system of which the physical state is a microstate" (1989, p. 130). Coming from another angle, Paul Schilder (1886-1940) much earlier appears to be "the first psychiatrist to view the human psyche as a physical phenomenon" (Hubbard, & Wright, 1984). This was also what empirically became obvious during training when different movement patterns seemed to affect behavior in different ways. I will return to this below.

3.4 Primitive reflexes and neurological soft signs

Among psychologists, the 'reflex' is recognized as a basic aspect of physiological psychology (Clarke, & Jacyna, 1987) and given a certain status. Although the papillary reflex (Flugel, 1933) was observed by Galen (A.D 129-199) and the word 'reflex' was used by Jean Astruc (1684-1766) the concept did not reach widespread recognition until the substantive 'the reflex' (Clarke, & Jacyna, 1987) was coined by Marshall Hall in 1833 and used in a biological and purely mechanical sense. Through his research on decapitated animals (Flugel, 1933) he had observed that by proper stimulation certain kinds of bodily movements were elicited with the help of the spinal cord and the peripheral nerves. These movements were independent of the brain and therefore had another character compared to voluntary and conscious movements. One of the first to document the development of infant reflexes from birth and beyond, through experience and learning, was W. Preyer (1841-1897) a pioneer in the science of child psychology. Preyer who was a physiologist born in England and working in Germany published 'Die Seele des Kindes' (On the Soul of the Child) in 1882.

The concept 'neurological soft signs' (NSS) (Ayd jr, 2000) is used to describe neurological aberrations not believed to constitute well-defined neurological disturbances. Because they are difficult to localize, NSS might sometimes be considered as reflecting a diffuse brain dysfunction, but they nonetheless are frequent among youths with hyperactivity and emotional disorders. According to Mitchell (2003), NSS are of importance because they are rarely present in healthy controls. There is no standard list of NSS but the concept includes

retained primitive reflexes (grasp, snout and sucking), a deficit in sensory integration and subtle deficits in sequencing of complex motor functions and in motor coordination. Children diagnosed with DCD (Polatajko, 1999) don't show any clear-cut evidence of neuropathology or neurological 'hard' signs but they might show 'soft' neurological signs.

3.5 Semantics and concepts

As neonates (Illingworth, 1987) we were all equipped with about 70 brainstem mediated primitive (primary) reflexes, some of which were closely connected to the vestibular system. To begin with these reflexes were like a 'survival kit' and easy to elicit. During the first year of life (Capute, & Accardo, 1991) as the nervous system matured and voluntary motor activity emerged they became more difficult to elicit. These early reflexes (Chrutchfield, & Barnes, 1993) are traditionally called 'primitive' either because they are thought not to persist throughout life or "because the infant's brain is considered to be a primitive-underdeveloped, incompetent, deficient- edition of the adult brain" (Touwen, 1984 p.115). There are, however, some controversies surrounding the concept which are worth mentioning.

First, Touwen (1984) argues that neither the concept 'primitive' nor the concept 'reflex' are appropriate;

"In a conception of the developing brain which emphasizes the involvement of the whole system in all changes during development, and that considers the healthy infant's brain as an age-specific and age-adequate organ system, it is no longer valid to use the term 'primitive reflexes'. The word 'primitive' is simply inadequate. Purely stereotyped reflexes do not occur, although reflex mechanisms may be hidden by the variable display of the infant's complex brain. Reflexes and reactions, and their developmental course, are useful in the neurological examination of infants but their existence in itself is not an adequate explanation of how the brain works" (pp. 122-123).

I agree with Touwen when he writes (p.120) that the concept used mirrors ones view of the developing brain. In line with his discussion, with Bergström (1972, 1989) and also with Gesell (1988) we have used the concept 'behavioral movement patterns' as a complementary term (Niklasson, *et al.*, 2009). Other authors, for example McPhillips, Hepper, and Mulhem (2000), use the term 'primary reflexes' while French authors such as Mehler and Dupoux (1994) use 'archaic'.

Second, there is a controversy as to whether,' the reflexes' persist throughout life or not. Paulsen and Gottlieb (1968) state "Senile and presenile patients who are demented may show several responses which can be called developmental, foetal or primitive reflexes. These responses are normally present during the early maturation of the central nervous system and they may reappear when the central nervous system has been altered by age and disease" (p.37). "The initial background from which the primitive reflex arose apparently still remains, and any foetal reflex responses may reappear whenever higher controls are weakened" (p.50). This view is shared by Teitelbaum (1967) who finds it obvious that the reflexes remain within the nervous system but as Jean Ayres (1973) concludes "the degree to which a person suppresses or attains mastery over them usually reflects the degree of maturation and integration of postural mechanisms" (p.80). A possible

regression to lower level brain activity when higher levels are impaired, resulting in primitive motor behavior is suggested by Bergström (1963). Jacobs and Gossman (1980) investigated certain primitive reflexes and found them active in healthy adults. So did van Boxtel, Bosma, Jolles, and Vreeling (2006) who found their increased prevalence with age but that their presence could not be a marker of cognitive decline. Touwen (1984) on the other hand, considered the morphological difference between the adult's brain and the infant's brain. Emphasizing their different functions, he argued that the adult's ageing brain and the infant's healthy brain cannot possibly display identical mechanisms. Although I agree with Touwen's semantic objections, sensorimotor training according to RB is based upon the concept of the possible life long persistence of 'behavioral movement patterns'. However, in order for me to be consistent with most literature I will use the concepts primitive/primary reflexes until my conclusion.

3.6 Primitive reflex inhibition and the emergence of postural reactions and gross motor milestones

As primitive/primary reflexes are inhibited during the first year of life postural (body-righting) reactions (Morrison, 1985; Capute, & Accardo, 1991) as well as gross motor milestones such as rolling, creeping (locomotion in prone), and crawling (quadrupedal locomotion) appear. Gross motor milestones generally emerge during the 6th to 12th month. This is also one of the intervals when the vestibular system is most sensitive and receptive to stimulation (Ornitz, 1983). During the period when the child is creeping and crawling (Maurer & Maurer, 1989) it is also very likely that a more mature sense of balance develops.

3.7 The common sense and the vestibular system

The vestibular system can easily be seen purely anatomically, as just what it is, a part of the inner ear, physiologically responsible for balance, the detection of movement and closely connected to hearing but not recognized as one of our basic senses. As the main purpose of this chapter is an attempt to connect its physiological function with psychology and behavior, I shall leave it to the reader to consult any book in basic neuroscience in order to learn more about the structure and mechanics of the vestibular system, e.g. Guyton (1991).

The vestibular system is different from other senses not least because experiences after stimulation are not specifically located as they are with other senses. Wade (2009) explains, "we feel giddy or see the world spin rather than have a single sensation like sight or hearing" (p.79). One of the first to study its psychological implications was Paul Schilder who wrote (1942), "Organic changes in the vestibular apparatus will be reflected in the psychic structures. They will not only influence the tone, the vegetative system, and the attitudes of the body, but they must also change our whole perceptive apparatus and even our consciousness. These general considerations make it possible that the study of the vestibular apparatus may have great importance for the understanding of psychotic and neurotic states"(p.85).

Even before Aristotle (ca. 384-322 B.C), Greek philosophers discussed and described perception, much of which was collected by Theophrastus (ca. 370-286 B.C.) (Stratton, 1917). The senses, as analyzed by Aristotle himself (Heller-Roazen, 2007), were sight, hearing, smell, taste and touch and to each he added a corresponding proper object, characteristic

medium and particular organ. Among the senses he considered touch to be primary. I will return to Aristotle and the senses below but first let me take a leap forward in history.

In the late 18th century (Finger, 1994, Wade, 2009), observations gave empirical support for a separation of a muscle sense from touch. The British neurologist Henry Charlton Bastian (1837-1915) who was a devoted researcher on this muscle sense believed that information, necessary for the brain's coordination of motor acts, was provided by the muscles. In 1880 he coined the term 'kinaesthetic' a concept replaced in 1906 by Sherrington's term 'proprioceptive'.

The late 18th and early 19th centuries were very active and fruitful years for physiological research. Although giddiness and vertigo (Wade, 2009) had been well known phenomena described mostly in medical terms since ancient times it took a long time for science to connect the feelings to the vestibular system. By 1765, Robert Whytt included vertigo among the symptoms caused by nervous diseases. In 1803, Bell discussed diseases of the inner ear documenting that an inflammation around the auditory nerve also gave an increased sensitivity for vertigo but concluded "Of the diseases of the labyrinth, there is little on the record" (p.71). The gross anatomy of the labyrinth was known but its function was not understood. Through the interest in vertigo, the vestibular system was obviously investigated indirectly. William Charles Wells (1757-1817) who carried out research on post-rotational vertigo and nystagmus was later to be recognized as the first to give "…the first clear behavioral evidence for the vestibular sense" (p.75). Theoretically, he also understood that some neurological system must register the body's position in relation to gravity but he never came up with an answer. The answer was provided in the 20th century when the electron microscope was invented and scientists were able to identify hair cells in the cochlea and later in the vestibular system. By habit or tradition the senses had been studied separately and it was not until the 1960s (Berthoz, 2000) that physiologists realized the importance of studying the combining of sensations. In the light of history this is strange especially as Aristotle once wrote (Berthoz, 2000),

"We perceive things as a whole, rather than what some may refer to as a continuity of their parts. Yet we can say that things do not always appear to us as they are; and that is why the size of the sun as we see it is not its true size. But let us return to our earlier question, whether we can perceive several things simultaneously, that is, in a single part of the soul, in an indivisible moment. It has been proved that the soul perceives all sensations with one and the same faculty, which collects the information from all the senses. Yet this faculty, though numerically one, differs in its accounts: it is the same soul, but differently disposed" (pp 57-58).

In 'De Anima', 'On the soul', (Aristotle, 1992) book II and III, Aristotle discusses the senses and concludes that there could not be more than five. Yet, he argues, each sense is not enough to explain the totality of sensory experience and proposes the perceptual phenomena 'common sensibles'. "'Common sensibles' are movement, rest, number, figure, magnitude; these are at any rate certain kinds of movement which are perceptible by touch and by sight" (book II, ch.6).

In book III, chapter 1 he advises, as interpreted by Alexander of Aphrodisias, (Heller-Roazen, 2007) that "There Is Something with which We Sense Everything Simultaneously" (p.48). Throughout history the term has been used and discussed within Greek, Arabic and

Latin scholastic traditions. Thomas Aquinas wrote in 'Commentaria in Aristotelem' "it is by the common sense that we perceive that we are living" (p.162). Another man of the church, Jean d'Arckel (1314-1378) is ascribed with saying "The common sense is a power that embraces all proper things that affect the proper senses…We thus say that the common sense is the fountain and the source of all the individual senses, to which all sensible movement is brought back, as to its ultimate end…Some locate this capacity in the back of the brain, where the nerves of the five senses meet; others place it in the heart, since it is the fountain and the source of life" (pp.160-161). Returning to the 18th century (Clarke & Jacyna, 1987) and to Jiri Procháska (1749-1820), most famous for his publications about the reflex but also interested in 'sensorium commune', which for him was the place where the sensory impression turned into a motor message which activated the muscle. He proposed 'sensorium commune' to be located in the brain stem, spinal cord, cerebellum and thalamus. Consulting 'The Oxford Companion to the Mind' (2004) for an up to date definition of 'common sense' it says, "The original meaning is a 'common centre' or neural pool, into which all the five senses were supposed to contribute to give coherent perceptions, though the various senses are so very different" (p.193). From my point of view it is very tempting to think in terms of the vestibular system, knowing also that Schilder (1933) described the vestibular apparatus as a coordinating system for sensory functions, "The vestibular apparatus is an organ the function of which is directed against the isolation of the diverse functions of the body"(p.161). This is an opinion also held by Ayres (1973) who emphasized the importance of the functional integration of the senses. Could it be that Aristotle, the scholars and even the physiologists of the 18th century were intuitive forerunners to the discovery of the function of the vestibular system? Although Aristotle declares firmly that there is no sixth sense, he states that all form a unity through incidental perception (book III, ch.1). Over the centuries we have seen a slight movement from his original writing towards the essence of the vestibular system as it is understood today, especially with its closeness to proprioception and to the reticular formation. It is not unlikely that they, in their time, were closer to nature than we are today. However, none seems to have come up with a suggestion as to what makes the 'common sense' able to combine different perceptions in to a coherent one. The vestibular system together with the reticular formation (Guyton, 1991) and the proprioceptive system (Brodal, 1960, 2004; Robbins, 1977) appear to be good candidates for an integrating system as impulses from the five senses and from muscle joints are directly and indirectly received by vestibular nuclei. But which factor might be the integrating factor?

3.8 The gravitational force

Turning to Bergström (1997) the answer is the gravitational force;

"We have to proceed from the premise that the human brain belongs to nature instead of being separated from it. This means, for us to understand child development and play, we must presume nature to be a larger system containing the brain as a smaller system which is influenced by incoming and outgoing information" (p.22).

He continues with a description of how the proprioceptors are driven by the gravitational force and how this force is a precondition for a proper brain stem function and for consciousness. "We can now understand that consciousness is basically transformed gravitation, thus being a 'planetary' quality bound to matter"(p.25). (These citations are translated from Swedish. For another summary in English, see Bergström, 1989).

In a scientific context it might seem a bit odd to write about us humans in a universal perspective but it is not only Bergström who holds this view. Further east, V.I Hasnulin, member of the Russian Academy of Medical Sciences Siberian Branch, wrote in a monograph (2004), "Every particle of a human body, as of any other material object is connected simultaneously by means of gravity with all the bodies in the Universe" (p.33).

Appearing nine weeks after conception, the vestibular nuclei are functional by the eleventh week (Humphrey, 1965). At about the 21st week (Robbins, 1977; Larsen, 1993), aside from the interoceptive sensory receptors (sensory receptors in the walls of the thoracic, abdominal, and pelvic viscera), the vestibular system is the only sensory system which is mature. Although developed this early, some authors (Windle, 1971; Prechtl, 1984) believe that the system is inhibited during prenatal life. Others like Odent (1986) and Restak (1979) claim that the floating fetus is constantly stimulated by the mother's movements and registers its first perceptions through the vestibular system. It is because of this early maturation that the vestibular system is so important for brain development and "a disturbance of its function by any factor will be reflected in the formation of the whole nervous system" (Klosovskii, 1963, p. 116)). In favour of the proposition that the fetus reacts to the gravitational force (Hubbard, & Wright, 1984, Eliot, 2000) is the turning of its head into the head-down position weeks or days before birth. The first scientific evidence that the early development of the vestibular system is dependant upon gravitational stimulus was provided by a study (Ronca, & Alberts, 2000) on pregnant rats flown on the Space Shuttle. The rats, developed in space, had a limited sense of balance after delivery on earth. The study showed that the vestibular system needs the gravitational force to mature correctly. Meanwhile the British journal 'New Scientist' (MacKenzie, 2000) reported on a study involving a chemical reaction and the gravitational force. Initially, physicists insisted that the research was not worth doing because the force of gravitation on molecules was presumed to be too weak to affect chemical reactions, compared to other forces. However, the study (Papaseit, Pochon, & Tabony, 2000) was completed and results showed how gravitation had indeed influenced chemical reactions on the cellular level. The scientists studied microtubules, fibers made of a protein called tubulin. When cold solutions of mammalian tubulin mixed with GTP (an energy releasing compound) were adjusted to body temperature for a certain time, distinct bands of microtubules were formed at right angles to gravity. When the procedure was repeated in microgravity the bands pointed in all directions. This spontaneous generation of patterns in a chemical reaction, due to tiny environmental asymmetries, was the first experimental model of biological self-organization. The result had previously been predicted by the biophysicist Ilya Prigogine and by Alan Turing in the 1950s. I will return to Prigogine's research below.

3.9 Music of the spheres

Gravitation (Rees, 2000) is the most perplexing of the basic forces of nature and still today is a mystery. The force is so fundamental that if we should start anew with intelligent life on another planet we would have to start with gravitation. As gravitation is always an attraction it is the organizing force for the cosmos. Even Isaac Newton (1642-1727) had difficulties understanding what gravitation really is. Just the scientific, mechanical explanation did not seem to satisfy him. It is said that he regarded Pythagoras´ (569-475 BC) concept 'music of the spheres' as a metaphor for the law of gravitation. Although (Torretti, 1999) Newton's most celebrated scientific achievement is the discovery of universal

gravitation he also communicated a spiritual side. In General Scholium, an appendix to the second edition of 'Principia' (1726, p.528), he writes that God "endures forever, and is everywhere present; and, by existing always and everywhere, he constitutes time and space".

As healthy humans we take an upright position for granted although defying the gravitational force is a life long struggle. Very soon after birth the infant starts to lift his head up against gravitation. According to Paul Schilder (Hubbard & Wright, 1984) it will take the growing child about 15 years to master the force. However, this struggle might have its rewards as Lin, Woolacott and Jensen (2004) showed that postural control among elderly people was not only linked to age but correlated with functional balance as well. In another study (Carpenter, Adkin, Brawley, & Frank, 2006) it was examined how young adults and older adults with balance problems reacted when balance demands increased. In both groups, increased demands affected both blood pressure, anxiety, and the capacity to handle the body. At the beginning of the 20th century, Joel E. Goldthwait (Goldthwait, Brown, Swaim, & Kuhns, 1937; Oschman, 2000) and his colleagues at Harvard Medical School were trying to attract scientific attention with their research on patients with various chronic disorders all of which were due to faulty 'Body Mechanics'. Goldthwaith stressed the importance of people paying attention to how they moved and held their bodies in relation to gravitation. If posture was correct more energy would be left for use in daily activities and less strain would be put on different body parts and joints. An incorrect posture would be likely to also have unhealthy effects on the viscera of both the thorax and the abdomen. Once again we can hear history speaking to us but unfortunately the trace left from Goldthwait is not to be found within traditional science but has been picked up by movement therapies and modern body work.

In his sequel to 'Zen and the art of motor cycle maintenance', 'Lila-an inquiry into morals', Robert M. Pirsig (1991) wrote:

"The law of gravity, for example, is perhaps the most ruthlessly static pattern of order in the universe. So, correspondingly, there is no single living thing that does not thumb its nose at that law day in and day out. One could show that the degree to which an organism disobeys this law is a measure of its degree of evolution. Thus, while the simple protozoa just barely get around their cilia, earthworms manage to control their distance and direction, birds fly in the sky, and man goes all the way to the moon"(p. 147).

Pirsig suggests that man's bodily struggle against the gravitational force has over time contributed to an intelligence good enough to conquer space and by doing so even gravitation itself. Much focus is presently placed on cognition and cognitive development while our neurological heritage seems to have been neglected or even forgotten when it comes to education. So how do we connect the gravitational force to learning disabilities?

I propose that an important connection between the gravitational force and learning disabilities is the maturation of the vestibular system and the integration of primitive/primary reflexes.

3.10 Summary

So far, you have been provided with an historical background as to how learning disorders in general have been viewed over the centuries. From there, I moved towards DCD and

sensorimotor problems which made it suitable to discuss some essential features concerning primitive/primary reflexes, the vestibular system and the gravitational force. I will now re-connect to **3.3** and give a brief presentation of assessment and training according to the method RB. For a more thorough description see Niklasson, *et al.*(2009, 2010).

4. Retraining for balance

4.1 Clients

Vestibularis is a private practice using the method Retraining for Balance. Clients are mostly children and youngsters with concentration problems and / or learning disorders. Not all of them are considered clumsy by their parents but notwithstanding this, they will display sensorimotor immaturities on our tests. Adults can also benefit from the training and have completed it with very good results – this has included people who were initially suffering from such diffuse pain and fatigue that it was making them unable to work.

4.2 Instruments of assessment

The initial assessment uses the instruments (Niklasson, *et al.*, 2009) *RB–Physiological Test* (Niklasson & Niklasson, 1999a, 2007a), *Retraining for Balance-Orientation and Balance Test* (Niklasson & Niklasson, 1999b, 2007b) and *Retraining for Balance-Audiometric test*, based on a technique developed by Johansen (1993).

RB–Physiological Test consists of 41 different tests which assess sensorimotor (physiological) proficiency (maturity) of clients in terms of primitive/primary reflexes, postural responses, gross motor milestones, and vestibular ability. The tests are divided into six groups;

1. Primitive/primary reflexes-vestibular stimulation; tonic labyrinthine reflex prone and supine, symmetric tonic neck reflex, tonic labyrinthine reflex in upright position, Schilder's test (asymmetric tonic neck reflex and tonic labyrinthine reflex), asymmetric tonic neck reflex supine, asymmetric tonic neck reflex on all fours (Ayres' test), and the Moro reflex.
2. Primitive/primary reflexes- tactile stimulation; spinal Galant, palmar grasp reflex, rooting reflex, and the suck reflex.
3. Postural reactions; Landau reaction, amphibian reaction prone, segmental rolling reaction, the oculoheadrighting reaction, and the labyrinthine headrighting reaction.
4. Gross motor milestones; rolling, crawling on the stomach, creeping on hands and knees, and skipping.
5. Eye movements; passive horizontal-tracking and active horizontal tracking in three positions (sitting on the floor with legs crossed, sitting on a stool, and in erect position).
6. Sports related gross motor skills; spring jumping, skipping with a rope, bouncing and catching a tennis ball, and tandem walk.

Each test is scored on a quantitative 5-point scale from 0 – 4 (Field & Blythe, 1989; Niklasson & Niklasson, 1999a, 2007a).

0: No deviation, 1: Small remainder of a primitive/primary reflex or minor difficulty completing a specific feature, 2: Remainder of a primary reflex or partial absence of a postural response or difficulty completing an item, 3: Almost intact primary reflex or almost

a total absence of a postural response or a marked difficulty completing a particular item, and 4: Intact primary reflex or a total absence of a postural response or an inability to complete or execute a specific item.

Retraining for Balance-Orientation and Balance Test. This test (Field & Blythe, 1989; Niklasson & Niklasson, 1999b, 2007b) consists of a standing balance assessment (Rodnitzky, 1988; Cherng, Chen, & Su, 2001; Geuze, 2005) done on two occasions (the Romberg test), a vestibular test (rotating on a chair) (Vose, 1986; Guyton, 1991; Niklasson et.al., 1999, 2007), and two tests of orientation (body-space perception, perception of time).

Each test is assessed according to whether there is either "no deviation from normal age-appropriate behavior" or "deviation from normal age-appropriate behavior".

Retraining for Balance-Audiometric test with the aim to determine whether the client has right or left ear dominance or whether dominance is lacking. Right ear dominance facilitates a more rapid processing of speech sounds (Sininger & Cone-Wesson, 2004). The tests' rationale for importance of right-ear dominance was validated by Tallal, Miller, and Holly Fitch (1993) and by Okamoto, Stracke, Ross, Kakigi, & Pantev (2007).

4.3 Training

The decision as to whether to start the training or not is taken with respect to the scoring on each test and with respect to the child's developmental history as described by its parents. However strange it may sound, low scoring does not necessarily imply that the client would not benefit from the training. This is especially relevant for those older children or adolescents who may be able to compensate for their difficulties. If this is the case, the history as described by parents is of particular interest. When the decision has been made to start the training, the client trains at home with his parents. The fact that the parents themselves are 'solving' a problem together with their child is a methodological asset. An association between the development of movement and emotion has been argued by Schilder (1964, 1971) and Erikson (1987) and they also emphasize importance of the parents in this process. The estimated time needed for training is about 15 minutes/day although it often takes longer because of obstinacy which seems to be a part of the regressive behavior which emerges during training. The child with its parents returns to Vestibularis every 8th week for re-assessment and in order to get new exercises. During a re-assessment, appropriate primitive/primary reflexes, postural reactions, vestibular function and gross motor milestones are checked and suitable new exercises are introduced. Generally fifteen sessions are needed to complete the program.

Retraining for Balance –Methods (Niklasson, *et al.,* 1999, 2007) describes 48 exercises which comprise the training and which in many ways are the same as those used at INPP (Goddard, 2002) although modified and in some cases further developed. The exercises are divided into the following seven categories:

1) Fetal movements and neonatal movements 2) Vestibular stimulation 3) Auditory perceptual stimulation 4) Tactile stimulation 5) Basic gross motor movements or milestones 6) Sports-related gross motor skills 7) Complementary play exercises.

For further description of the categories see Niklasson, *et.al.,*(2009).

The basic theory behind the training was formulated by Blythe in 1980 (Goddard, 1990), "the innate mechanistic processes involved in the inhibition, modification and transformation are observable, and more importantly are **replicable** at any age, to assist in the rehabilitation of impairment" (p.12). Goddard (1990) continues, "… it is possible to give the brain a second chance to **register** the inhibitory movement patterns which should have been made at the appropriate stage of development, or, to recapitulate a stage of development which may have been omitted, or incompletely worked through, for one reason or another, during intra-uterine life or infancy. The remediation of aberrant reflexes is based on the primary concept of replication, together with three concomitant theories:

1. Every reflex has a purpose, and will not be fully suppressed unless it has successfully completed the job it was designed to do.
2. All human babies make certain stereotyped movements during the first year of life, (Thelan, 1979). These movements contain within them the natural antedote to the appropriate reflex at that stage in development, thus facilitating inhibition of a primitive reflex on the one hand, and the subsequent release of a postural reflex on the other, together with continued CNS development…
3. There is a **sequence** and pattern to reflex inhibition" (pp.12-13).

As explained above, Vestibularis had identified a need to bring coherence and continuity to the different exercises. One reason for this was that different physiological and psychological regressions emerged when certain exercises and vestibular stimulation were used, a phenomenon not mentioned by Blythe. When an exercise was used long enough the regressions faded and physiological and/or psychological behavior seemed to be transformed to a more mature level. Instead of breaking the apparent 'flow' by being too mechanical, Vestibularis aimed at creating a smooth succession of exercises, thereby achieving a maximal 'squeeze' from each one. Through continuous supervision from Professor Matti Bergström, Vestibularis came to understand the significance of regressions from a developmental point of view. As an expert on the brain and coming from a research tradition with an interest in sensory and motor behavior, Bergström (1964) was well acquainted with the concept. Another reason for the re-construction undertaken by Vestibularis was that vestibular stimulation seemed to be effective with all clients when used as a complement to fetal and neonatal movements. This view was not shared by INPP as Goddard (1990) wrote;

"In certain cases where there is severe impairment in all sensory channels, and this impairment goes beyond the area of dysfunction into suggested damage, vestibular stimulation and rotation appear to open the gateway to further remediation, where formerly nothing else has worked" (p.15).

In a randomized, double-blind, controlled study McPhilips *et al.* (2000) used stereotypical neonatal movements similar to those developed by INPP, but no vestibular stimulation, on children with specific reading difficulties. After training, the experiment group showed significant results both regarding reflex inhibition and reading improvements. A recent study by Brookes, Tinkler, Nicholson, and Fawcett (2010) concludes "that there is a significant incidence of balance difficulties in children and adults with dyslexia, even for those without comorbid attention deficit". Comparing under achieving children with well performing children, Franco and Panhoca (2008) found a statistically significant relationship between vestibular disorder and learning impairment.

Empirically, over the years, Vestibularis has experienced very good results practicing a combination of stereotypical movements and vestibular stimulation. As a first step in studying whether RB could be successful as a complement to regular treatment of DCD, Specific Learning Difficulties (SLD), and ADHD, one quantitative naturalistic study and one qualitative study were conducted.

5. Evaluation

5.1 Study I

The first study (Niklasson, *et al.*, 2009) was quantitative, naturalistic and examined whether sensorimotor therapy utilizing the training program RB, might be an appropriate technique for sensorimotor proficiency. The 232 children (181 boys, 51 girls) whose mean age was 9.3 yr. (SD=2.7), presented with attention and motor difficulties (according to the School Health Care) as explained by their parents before starting training. The children were divided into three groups, i.e., a younger group (7yr. old or younger, n=65), a middle group (8 to 10 yr. old n=91), and an older group (11 yr. old or older, n=76). The program has seven categories as explained above (**4.3**). The training period was close to 3 years on average. Analyses in a repeated-measures design indicated significant improvement of sensorimotor skills among the three age groups, but the older children performed better than the others on several tests. There were only a few differences between the sexes. Our conclusion was that RB may be a functional technique for training children and young people with sensorimotor difficulties and might constitute a complement to regular treatment of DCD, Specific Learning Difficulties (SLD), and ADHD, but controlled studies are necessary before more decisive conclusions can be drawn. Therefore, we plan to begin a controlled study in the near future.

5.2 Study II

The second study (Niklasson, *et al.*, 2010) was qualitative and aimed at gaining an increased understanding of the effects of sensorimotor therapy, using the training program RB, on the physical and psychological development of children and young people. The records of 8 children who had completed the program were randomly selected from a cohort of 232 with sensorimotor difficulties and concentration problems. The participants, 7 boys and 1 girl, averaged 9 years of age. The Empirical Phenomenological method (the EEP-method, Gunnar Karlsson, 1995) was used for the analysis, which resulted in 29 categories which yielded 3 overarching themes: a) the introduction of sensorimotor exercises, b) regression to earlier sensorimotor and psychological behaviors, and c) transformations in which the sensorimotor and psychological skills of the children matured and developed. The themes formed the kinesthetic-vestibular developmental model illustrating how sensorimotor exercises push the therapy process forward with recurrent regressions being followed by positive developmental phases. The results of the study were generalized to the remaining 224 children in the cohort by comparing each individual's records to the kinesthetic-vestibular model.

5.3 Summary

The aim of the training was to enhance physical maturity and sensorimotor development. Initially, the participants struggled with aberrant primitive/primary reflexes, underdeveloped postural reactions and gross motor milestones all of which were a

hindrance in the learning process. Goddard Blythe (2009) is recommended as a learned companion when it comes to a more detailed description of how these phenomena can affect a child's possibilities at school and in its social life. Our quantitative naturalistic study (Niklasson, *et al*., 2009) showed a significant increase in the physical and sensorimotor maturity of participants after completion of the training. The findings also suggested that problems of concentration and attention should be viewed as connected to sensorimotor difficulties. After training, participants generally performed better at school in reading, writing and physical education although with some children difficulties with mathematics persisted. Regarding improvements in the area of reading and writing, we suggested that not only is the integration of primitive/primary reflexes of importance but also the maturation of the vestibular system due to there being a close connection (Simon, Aminoff, & Greenberg, 1989; Goddard, 2002) between the vestibular apparatus and horizontal tracking required for these skills. As a reminder of this chapter's heading, it is of significant interest that physiological improvements in participants were the results of development which had not previously taken place. By this I mean that participants in the study developed as a child would in its early years of life (as explained in **3.6**) despite them being much older. Results from the qualitative study (Niklasson, *et al*., 2010) showed psychological improvements shaped as regressions and transformations. Viewed in the totality of the training, the phenomena (of regressions and transformations) were complementary and were labeled as either negative or positive developments. The study identified three periods of regression (negative developments) all of which were followed by transformations (positive developments). Using the concept 'negative development' for regression does not necessarily imply something bad. In this context and in accordance with Kris (1952) who distinguished a regression where the ego itself is in charge, a 'regression in the service of the ego', we suggested the opposite. Regression and progression (Werner, 1957; Loewald, 1981) are complementary and of great importance concerning both organization on the psychological level and physical development (McGraw, 1995). The qualitative study was able to show, for the first time as far as we know, both physical and psychological regressions and transformations in connection with sensorimotor training. But what might be the driving force?

6. Emergence

6.1 A possible driving force

In **3.8** we learned that Papaseit, *et al.* (2000) were advised not to conduct their study because the gravitational force was considered to be too weak to make any physiological difference. Still, they got unexpected results pointing in another direction. When Vestibularis, during training, placed great emphasis upon vestibular stimulation our studies as well showed unexpected results, especially within the psychological domain. My suggestion is that the gravitational force is an important and hitherto neglected factor in human development. Holger Hydén (1961) famous for his research on RNA and memory wrote; "One unchanging stimulus, for example, is the force of gravity, which maintains a high activity in the gravity-responding brain centers throughout the life cycle" (p.33). Before him D. and K. Stanley-Jones (1960) considered that, "The force of gravity is the most unchanging, and therefore the most reliable physical fact on the surface of the earth, whether by sea or on land or air. It is therefore on the gravity-receptors, with their unchanging response to an unchanging stimulus,

that the nervous system has come to depend on for an unceasing and therefore reliable source of energy, without which it is unable to perform any part of its function" (p.60).

As mentioned earlier, there is no consensus as to whether the vestibular system is active in utero or not. Nevertheless, the study of fetal movements is of great interest. Life in utero is a preparation for life to come. All fetal movements observed (Prechtl, 1993) in utero have also been observed in the newborn. As long ago as 1885, Preyer was convinced that the fetus moved its legs and arms before the 16th week. He also considered that movements performed by the newborn (Thelen, 2000), were the same as those developed in utero. However right he was, it took almost 100 years to confirm fetal movements during the first trimester (Reinold, 1976). Regarding the movements of the neonate, De Vries, Visser and Prechtl (1984) wrote, "The similarity between prenatal and postnatal patterns of movement is also striking. The only differences are in quality of movement, probably because of the increased influence of gravity after birth" (p.62).

Metaphorically, birth is a transition from one 'planet' to another, from water into air. For nine months the fetus has been held and contained in a restricted and rather secure universe. Being born is said to be the most stressful and dramatic event ever to be experienced, a preparation for life to come. This brings to mind an old cartoon showing twins in the uterus, with one saying to the other, "do you really believe in a life after birth?". During delivery through the birth canal primitive/primary reflexes such as the asymmetric tonic neck reflex (ATNR) and spinal Galant are set to work and the intense squeezing of the body activates the hormone system. The newborn's first cry comes after contact with air (Casaer, 1993; Prechtl, 1993) and it is likely that the increase in oxygen tension switches on the vestibular system which increases muscle tone. For survival it is of importance that sensory trigger mechanisms such as sucking and rooting are activated soon after birth. Common to all infants are also the palmar grasp, plantar and Moro reflexes. These reflexes are old adaptations of the clinging to the mother. The Moro reflex is of significant interest in RB. Although it is supposed to be inhibited by the fourth to sixth month after birth, with most of the clients at Vestibularis it has been retained. Retention of the Moro reflex (Goddard Blythe, 2009) is associated with an increased sensitivity to vestibular stimulation and might affect both emotional behavior and physiological processes. Because the Moro reflex is ontogenetically very old its retention will hinder (ontogenetically) younger primitive/primary reflexes from fulfilling their work as it, practically, will keep these contained. My experience is that a transformed/integrated Moro will not only create a kind of 'body lightness' with increased flexibility and sometimes an 'uncontrolled' joy in the client but will also set (ontogenetically) younger reflexes to work. Essentially, the Moro reflex is purely vestibular and, as such, fundamental when it comes to the baby's relationship to the earth. At birth, the newborn is almost insensitive to external stimuli but a common fear for all is the fear of falling (Hubbard, 1971; Feldenkrais, 1988). David Hubbard (1971) psychiatrist and a consultant at the Medical Center for Federal Prisoners in Springfield, Missouri, states bravely that the fear of falling is so basic that it might as well "serve as a paradigm for all subsequent fears". Paul Schilder (1964) stresses the enormity of the problem and proposes that because of it, the child should be given 'motor help'. He adds, "We may suspect that mere knowledge on the part of the parents will not be sufficient to handle the problems of equilibrium in the child in a correct way. The parents will need, besides their motor equipment and their will to help the child in his motor expression and

security, an emotional inner balance" (p.183). Schilder demanded a lot from parents and in doing so he may have caused them to feel guilty but we must not forget that these lines were written in the 1940s. In **6.5** I will return to the importance of the child - parent relationship in RB. Gravitational security (Ayres, 1979) is a prerequisite for a good relationship not only to one self but also to other people not the least to one's parents. Elsewhere Jean Ayres writes (1973), "This relationship [child-parent, *my bracket*] provides one of the most basic forms of physical and emotional security. It is far more primal than relationships with people, but may be somewhat less so than the individual's relationship with his physical body" (p.60). The child's attempt to overcome the gravitational force is the primal struggle during the first years of life but as mentioned above, it will take about fifteen years for the child to master movements in relation to the gravitational force. Despite this effort, once achieved, gravitational security is not a given.

On one hand, a continuous and life long struggle is required to keep the balance which has been gained.

On the other hand, vestibular receptors are tonically active which means that even when the head is at rest they send a continuous stream of neural impulses to the brain. Hubbard (1971) writes about this, the second language of the vestibulum, which he labels as a crypto-vestibular speech. This language "is subliminal in intensity, chronic in character, and almost entirely sensed through other organs (i.e., the eye, muscle tone, vagal distribution, and endocrine responses)" (p.232). In this way we are always connected to earth via the gravitational force. Metaphorically, just as the transmission to the cell phone or to the TV-set needs to be as sharp and as clear as possible, we are the same as regards vestibular transmission. My suggestion is that the gravitational force is an important factor when it comes to a child's sensorimotor development. I also propose that there most probably are connections between sensorimotor maturation and learning disorders. If so, empirical evidence has shown that it is never too late to re-educate the nervous system but the right key has to be used.

6.2 Developmental re-education

I have tried to explain that aberrant primitive/primary reflexes, probably constitute a hindrance for both physical and psychological development. In the 1880s Pierre Janet (Tallis, 2002) wrote, "in the human mind, nothing ever gets lost" and Feldenkrais (1988) claimed in the 1940s that, "The functions that are fully matured, or nearly so, at birth, remain strictly localised in the organs and in the nervous system" (p.144). When everything is still there, then obviously there is a possibility to un-lock the system to give it a second chance to mature. In **3.6** we briefly described how postural reactions and gross motor milestones emerged as reflexes were inhibited. This happens naturally at one of the times when the vestibular system is most receptive to stimulation. Our two studies (Niklasson, *et al.*, 2009, 2010) support the view that sensorimotor development is an emergent property of this and from the tentative evidence given above we suggest that vestibular stimulation is the key factor. For a possible explanation I have to turn to systems theory and the thermodynamics of non-equilibrium systems. Today it is possible (Nicolis, 1993) to use concepts such as coherence, order and complexity, traditionally used within biology, to describe the behavior of ordinary physical systems as well as living beings.

6.3 Emergence and thermodynamics

According to Woollacott (1993), the development of motility and balance can be viewed as emergent properties. The meaning of the concept emergence is "an apparently spontaneous generation of novel systematic properties that could not be predicted from the properties of components (parts) of a complex system alone" (Konopka, 2007, p.9). This happens because human beings (Scrimali, 2008) are open, very complex and organized systems which perpetually exchange energy, information and matter with the outside world. An open system (Schrödinger, 1992; von Bertalanffy, 1993) is not in equilibrium. Instead it tends actively towards a higher state of order by reducing the entropy (disorder) which by necessity is produced as a consequence of life. The striving of an open system is to reach further and further from equilibrium and therefore when it is able to import more negentropy (ordered information) than the entropy it dissipates the complexity increases. Prigogine and Stengers (1984) wrote "The 'historical' path along which the system evolves as the control parameter grows is characterized by a succession of stable regions where deterministic laws dominate, and of instable ones, near the bifurcation points, where the system can 'choose' between or among more than one possible future" (pp.169-170). In open systems far from equilibrium small effects will be magnified and this holds also for the gravitational force. Prigogine (2003) stated that, "gravitation keeps things going. In thermodynamics, gravitation disturbs equilibrium, you cannot speak about equilibrium including gravitational forces" (p.66). Therefore (Nicolis, 1993), "Gravity should be regarded as a basic organizing factor in the universe mediating the passage from equilibrium to nonequilibrium and enabling in this way microscopic events to manifest themselves at a global scale" (p.330). My suggestion is that the gravitational force is a vital force also in the self-organization of the human nervous system.

6.4 Self organization

Mainzer (1994) argues that genes alone cannot fully determine an organism. Self-organization of some kind is involved in each stage of brain development and it is necessary for ontogeny to use the self-organization of neural systems in order to handle their complexity. Referring to Hydén (1961) who rotated experimental animals and found an increased production of RNA in the big vestibular cells, the Deiter's cells, Pribram (1999) wrote that a striking fact regarding neurons is that they produce more RNA than any other cells when stimulated. According to Gottlieb as cited in Dalton and Bergenn (2007), "experimental animals that receive unexpected or unusually enriched early experiences express more complex RNA sequences, indicating a higher level of brain-based DNA activity" (p.107). Hydén himself wrote (1961), "As Stanley-Jones (1960) has pointed out, the sensory receptors of the vestibular apparatus in the inner ear responding to the force of gravity are non-adaptive and are the most important energy source for increased neuronal activity" (p.40). Turning to Gazzaniga (1992) we learn that "Both animal and clinical data together indicate that normal brain development requires a key signal from the environment if normal connections are to occur. This does not mean that brain development is not driven by genetic factors. What it does mean is that the developing brain has evolved in the context of a particular environment" (pp.37-38). This particular environment is the earth and nothing on earth can escape the gravitational force.

6.5 Sensorimotor development and irreversibility

From what I have described, I regard it to be of utmost importance to monitor the newborn's adaptation to earth and to the gravitational force. During the first year of life a stable nervous system should, from my perspective, be built with the gross motor milestones as 'girders'. For this to be realized, the primitive/primary reflexes have to be inhibited in order for postural reactions to develop. Also, in the first years of life, until the nervous system is stable, the child is at risk of losing stages of development which it has reached. This can arise from various kinds of infections of the nervous system and also, for example, from Otitis media. The necessity of paediatric vestibular assessment in various situations is stressed by Nadi and Luxon (2008).

It is the experience of Vestibularis from children and young people coming to it for training, that all of them lack sensorimotor maturation as defined above and that all of them have learning difficulties in one way or another. It is not unusual that they are frustrated and angry and sometimes they have difficulties expressing themselves verbally. Difficulties remembering are also rather common. In **2.3,** Ewald Hering and his speculations about an 'organic memory' were mentioned. From the perspective of the vestibular system his ideas might not be as questionable as they have seemed. The British psychoanalyst Christopher Bollas (1987) uses the concept of 'unthought known' as a description of 'prints' of early experiences. How these early sensations are cultivated might determine the long-term memory, so important (Carr, 2010) for a well functioning working memory. The science of thermodynamics (Prigogine & Stengers, 1984) tells us that both reversible and irreversible processes are possible. Reversible processes are independent of time while irreversible processes are dependent on time.

Training according to RB gives the nervous system a second chance to mature. I interpret, from experience, that as long as the nervous system is unstable, reversible processes are possible and this is one likely reason why we have been able to identify both psychological and physiological regressions during training. From what I have experienced, I actually prefer to use the concepts 'therapy' instead of training and 'behavioral movement patterns' instead of primitive/primary reflexes. In line with Schilder and Bergström, I find it possible to view the human psyche as a physical phenomenon. During therapy 'Playfulness' (Kroebner, 1963) is a way to cope. This might spread some light on Schilder's view (**6.1**) that parents need an emotional inner balance to be able to guide their child. Describing Schilder's theories, Kestenberg (1984) uses the expression 'regression in service of parenting' meaning that "In each phase of parenthood, parents, especially mothers, regress with their children. This gives them a second chance to reorganize their psyche. In the process of reorganization, parental clashes with babies, toddlers, and older children can be ameliorated" (p.117). When the nervous system is ontogenetically set on each developmental level the process will be irreversible. This means that no more regressions are anticipated and the transformations gained will guide further development until the next unstable level is reached.

7. Conclusion

Learning disorders constitute huge problems in many children and youngsters today. Unfortunately, possible connections between learning disorders and sensorimotor

immaturity have so far been disputed (Hattie, 2009). I argue that one reason why studies have failed to find a connection is that the power of the gravitational force and the vestibular system have been neglected. My conclusion is that sensorimotor development could be an emergent property of vestibular stimulation and the inhibition of behavioral movement patterns. Summing up the assumptions in **2.5,** I propose that therapy according to RB creates a change from within, a second order change, and that this is one prerequisite for sustainable academic achievement. Unfortunately, much of the remedial education offered today seems to be based on the principle of 'more of the same', a first order change, i.e., if you can't read, read more. A challenge for the educational system will be to accept that some children have to regress in order to progress. During this period of transition, information and education have to be in balance. From my point of view it is highly possible that learning disabilities to a higher degree than previously realized are due to sensorimotor immaturity. It is equally highly possible that too many people through out history have been wrongly diagnosed as mentally retarded or have been misunderstood because of problems originating in sensorimotor immaturity. For science to be able to move the complicated issue of learning disorders closer to a coherent view it will have to cooperate over faculty borders. In a way, we are in a situation today similar to the one scientists were in a century ago, though on a higher level. Through the observation of behaviour, theories have been developed and through measurement, improvements perceived as possible. What is needed for the future is a more thorough synthesis of first/third person account, measurement and neuroscience. Boyle (2008) has proposed "a three-tiered intertheoretic model of explanation in which there is explanatory coherence across three levels of investigation: phenomenology, psychology and neuroscience" (p.37). Such a triangulation should make it possible to understand what happens in the brain during RB and during other kinds of therapy. Until then we have to rely on observations and measurements.

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14

Contributions of an Augmented Reality Musical System for the Stimulation of Motor Skills in Music Therapy Sessions

Ana Grasielle Dionísio Corrêa[1], Irene Karaguilla Ficheman[1], Marilena do Nascimento[2] and Roseli de Deus Lopes[1]
[1]*Escola Politécnica da Universidade de São Paulo, Cidade Universitária, São Paulo-SP,*
[2]*Associação de Assistência à Criança Deficiente (AACD), São Paulo-SP*
Brasil

1. Introduction

The music is able to awaken the most varied emotions in humans. According to Robert et al. (1988), listening to music, the ear transforms sound into electrical signals reaching the brain leading to increased production of endorphins. This hormone causes a sensation of well-being and relaxes the body, reducing heart rate and blood pressure. Human organism is endowed with a sound system capable of commanding the perception and production of sounds. When there is an imbalance in this system, the sick person feels less motivated and sadder. In this context, music can act as a therapeutic factor bringing back the balance that this person needs (Robert et al. 1988), (Leme, 1999).

Throughout history, music has been used in many ways and for different purposes, whether as a form of expression, communication and interaction, the source of meditation, hobbies, income, either as an aid in the process of prevention, restoration and rehabilitation of health.

A music therapist can develop the process through several approaches and methods, the most common: improvisation, recreation and music composition, sound and musical sound and musical imitation (Benezon, 1998), (Baranow, 1999), (Nascimento, 2006), (Ikuta, 2009).

According to Streeter (2001), recreational activities and musical composition when they involve the execution of musical instruments, for example, can increase performance in sessions of physical rehabilitation while regular physical exercise become repetitive and tiresome. These activities can arouse the interest of the individual primarily for use of the upper limb and provide stability of body, better range of motor movement thin or thick. During these activities, it is often necessary to use adaptive musical instruments to meet specific physical needs of the patient and help him use (Louro, 2005, 2009), (Lina, 2009).

By adapting instruments, to introduce postures, invest in equipment in the music therapy sector, the therapist contributes directly to improved performance in an area that applies different strategies to motor rehabilitation (manual dexterity, etc.), improved communication and speech, and especially self-esteem.

Many patients have varying degrees of disability, from the lightest to the most serious, requiring specialized teams that contribute to better adaptation of technologies and procedures to the needs of each patient (Nascimento, 2006), (Lina, 2009).

Some technological adaptations are made by order to selected music therapists and, therefore, in small quantities for the sector (Nascimento, 2006), (Lina, 2009). Sometimes, an instrumental resource adapter practice serves only the needs of a particular disability, and for others, this same feature can be uncomfortable. Another relevant factor is the cost to manufacture and purchase of adaptive resources. It is also recommended for many patients to continue treatment at home. However, many patients do not have money to buy musical instruments adapted.

On the other hand, the number of computers and Internet access in households in Brazil is growing rapidly (CETIC, 2010). In addition to promoting access to information and communication, digital inclusion, has become an important ally of teaching and learning (Rekimoto; Nagao, 1995), (Thomas et al., 2010), (Lopes et al., 2010), training (Holden; Dyar, 2002), (Golomb, et, al, 2010) and simulation (Hoffman et al., 2003), (Botella, 2010). Thus, various computer technologies, with resources for people with severe physical disability, making it possible to have access to the tasks of daily living.

Systems for speech recognition (Wald, 2008), (Hua; Lieh-ng, 2010) and eye tracking (Jacob, 1991), (Chen; Pu, 2010) are used to provide access to reading, writing and communication. Brain-computer interfaces (Wolpaw et al., 2002) help people with severe physical disabilities to communicate and move around.

In health care, computers are used to motivating patients during therapy and to provide quantitative data for monitoring by the therapist (Oliveira et al, 2010). In particular, in the field of music therapy, software and electronics have enabled the "music making" therapeutic and educational for people with severe physical limitations.

Computer vision techniques, for example, enable capture and convert physical gestures of fingers, hands and feet to sound and graphic information (Gorman et al, 2007). Ultrasonic sensors can also be used for the same purpose (Soundbeam, 2011).

The virtual rehabilitation is gaining notoriety in the scientific community for providing the use of virtual environments, developed with virtual and augmented reality technology to rehabilitation. If compared to procedures performed manually, the Virtual Rehabilitation can provide numerous benefits, such as the ability to (Burdea, 2003), (Sveistrup et al., 2003): perform repetitive exercises more attractive with visual and auditory representations that motivate the patient, to obtain objective measures of exercise (speed of limbs, range of motion, hit rates and/or error scores in games, among others), to increase or reduce the complexity of the exercises, store the data collected for remote access, to do household activities assisted or not by the therapist, among others.

With augmented reality is possible create different computer systems for users unable to use conventional device such as keyboard and mouse (Garbin et al., 2006), (Garbin, 2009). This technology provides added virtual elements to the real world user, whose manipulation occurs in a natural way, by hand, without use of conventional devices such as keyboard and mouse adapters and.

This augmented reality feature provides access for people with physical disabilities to virtual environments facilitating educational and therapeutic procedures (Thomas et al., 2010) and Therapeutics (Richard et al, 2007), (Assis; Lopes, 2008), (Botella, 2010). There are several ways of building Augmented Reality environments. The most common, affordable is to use a webcam to capture images of the real world, augmented reality software to mix them with virtual elements and a video monitor to display the images mixed (Nischelwitzer, et al, 2008).

However, the high potential of augmented reality for rehabilitation, were not found in the literature, works that demonstrate their effectiveness in music therapy. So far, augmented reality has been used as an attractive instrument to support the process of musical learning, but no major concerns with the interaction of people with disabilities (Zorzal et al., 2005), (Kirner et al, 2006), (Constanza et al, 2003).

Given the benefits provided by this technology in relation to the forms of interaction, we assume that the music therapist procedures when directed to people with disabilities can be facilitated by the use of this technology. In addition, systems designed with augmented reality can be easily accessed at home, which can enhance the treatment, including possibilities for remote monitoring. Another relevant factor is the potential of this technology to improve motivation and satisfaction of patients and positively influence their treatment in rehabilitation. In this research we describe a system that was developed with augmented reality technology to support music therapy and its evaluations.

2. Characteristics, behavior and benefits of augmented reality

Augmented reality is a technology that allows mixing user real environments with virtual environments. Azuma (1997) defines augmented reality as the overlay of virtual objects, computer generated, in a real environment, generating a mixed environment that can be perceived by some technological device in real time. Figure 1 shows two examples of applications of augmented reality: a sandwich and a butterfly overlayed on the real environment.

Fig. 1. Examples of augmented reality environments (Fischer et al, 2006)

The creation of an augmented reality environment requires a computer, a webcam and paper cards (Azuma, 2001). First, a webcam (connected to the computer) captures images of the real environment in search of cards. These cards have printed symbols that are cataloged

in the computer software database. Symbols found on the cards are analyzed and interpreted by a software application. Symbols interpretation produces 3D virtual objects that are combined with the user's actual environment. The mixture of two environments is displayed either on a video monitor or on special glasses or a helmet display.

Possibility of transporting virtual objects to the user's physical space (for overlapping) facilitates interaction, which no longer occurs through a single specific component (conventional devices such as mouse and keyboard), but with the whole environment that surrounds the user. Thus, the virtual objects can be manipulated through actions involving tangible and multimodal touch, gestures and voice, making the process easier and more intuitive without using special equipment. Figure 2 shows the basic components of an augmented reality environment.

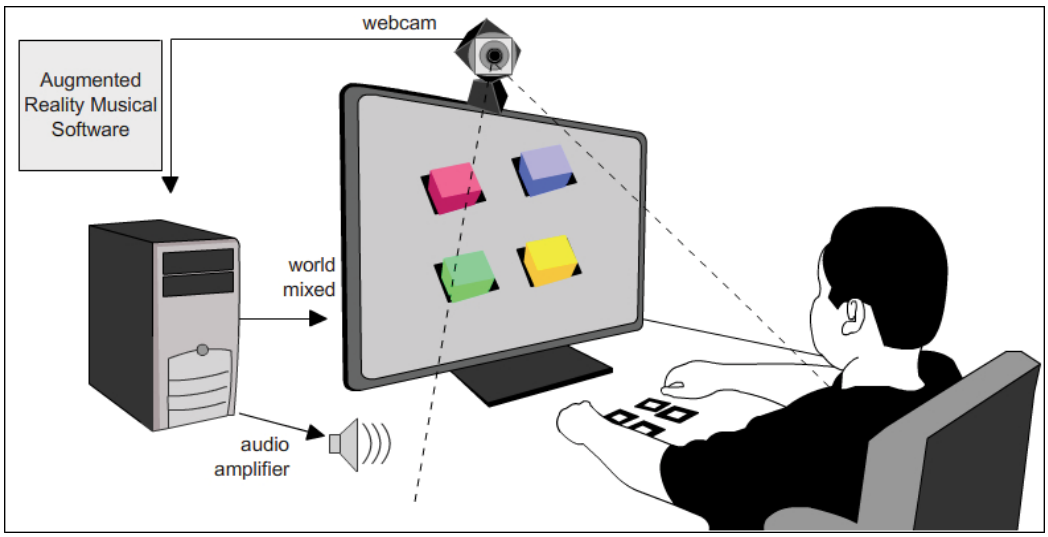

Fig. 2. Basic components of an augmented reality environment

Ability to carry virtual objects into the real world has fostered new forms of human-computer interaction, making the process more natural and intuitive. This feature of augmented reality can facilitate the interaction of individuals with severe motor problems. The handling of virtual objects can occur naturally, dragging or touching an object with fingers (Figure 3.a), hands (Figure 3b) or feet (Figure 3c), without necessarily using peripheral or adapters to interact.

Often, computer adaptations are created to attend specific needs of individuals with disabilities. However, depending on the disability specificity, some individuals may require specific resources hindering the therapeutic process, promoting even higher cost for design and use. Augmented reality allows environments to build economically viable systems compared to other environments that use expensive electronic devices such as helmets and electronic gloves. With a computer (for software processing), a webcam (to capture the real environment) and a video monitor (to display mixed environments) a simple augmented reality system can be created. This system has a variety of potential applications to work with individuals with various disabilities (Richard et al, 2007), (Assis and Lopes, 2008).

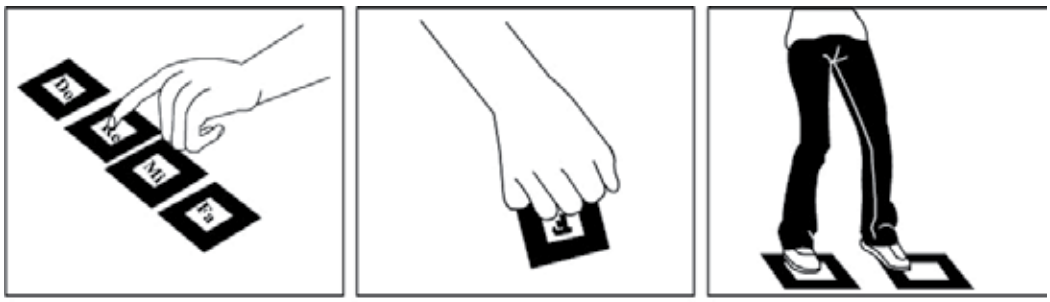

Fig. 3. Possibilities of interaction with augmented reality cards

The presence of cards in the webcam view field triggers the overlaying of the virtual object associated with the card and the real world captured by the webcam. The manipulation of the card in the real environment also moves the virtual object. If the individual drags the card, the virtual object associated with it moves along. This augmented reality feature facilitates the process of communication of children with learning difficulties or people with physical disabilities in many different difficulty levels, allowing their intellectual and motor development. For physically disabled with a moderate or severe physical capacity degree, the use of conventional musical instruments is restricted (Louro et al, 2005). Interacting with virtual musical instruments in the real world can facilitate interaction in music therapy especially when the therapy takes place in a specialized center for motor rehabilitation.

The next section presents GenVirtual, indications for its use in music therapy sessions and preliminary results of using GenVirtual with patients with motor disabilities.

3. GenVirtual musical system

We developed an augmented reality musical system (GenVirtual) that allows creation, improvisation and music reproduction such as composition and tunes playing. Also the system enables the user to hear sounds and music, and musical memory games.

GenVirtual adds virtual musical instruments to the real world. Colored three-dimensional cubes represent the instruments. Cubes are able to simulate the sounds of wind, string and percussion instruments. Interaction occurs through GenVirtual cards with musical symbols. Cards replace the keyboard for music composition and are low cost since they can be printed on plain paper in various colors and sizes (Figure 4).

Cards to interaction of GenVirtual:

- Musical notes (Dó, Ré, Mi, Fá, Sol, Lá e Si).
- Stringed musical instruments (piano, violin and guitar).
- Wind musical instrument (flute);
- Percussion musical instruments (plate, box, tambourine and triangle);

GenVirtual processes the images captured by a webcam to identify the cards on the table. The webcam is connected to a computer and strategically positioned on top of the table (Figure 4). Symbols on the cards are detected and associated with a sound. To execute a sound, the user just hides a card with his/her hand, without necessarily touching them with

his/her fingers (Figure 5). By detecting the occlusion of a card, the system runs the corresponding sound the card represents.

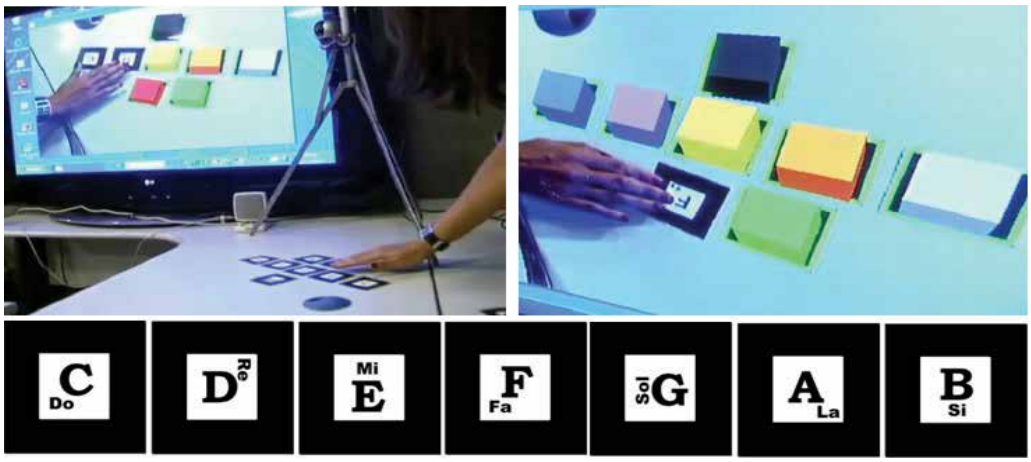

Fig. 4. Musical Cards of GenVirtual

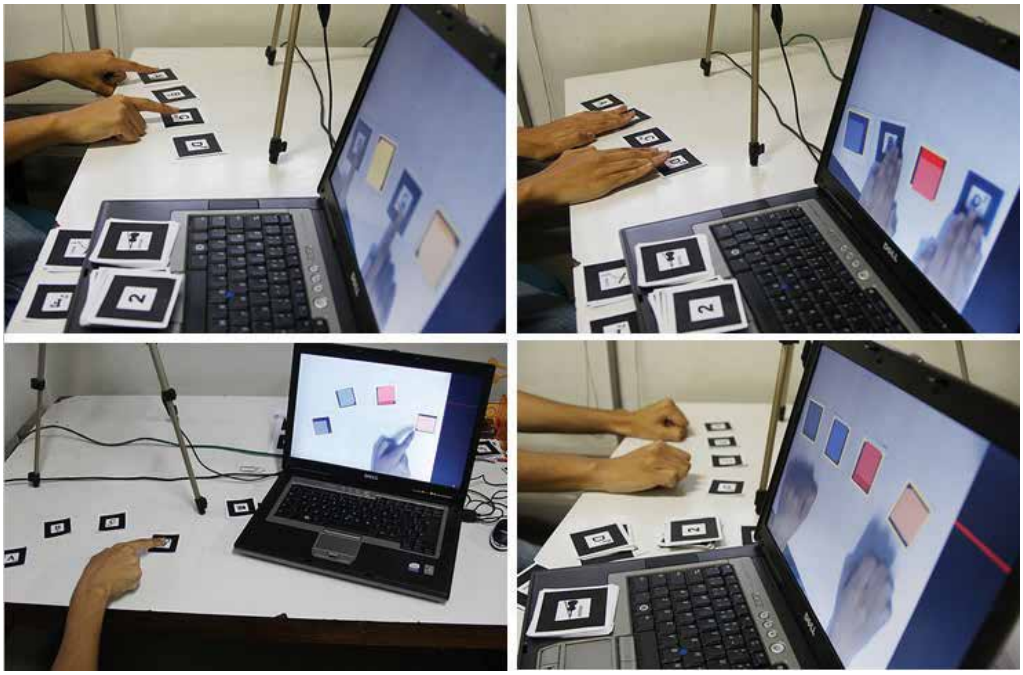

Fig. 5. Interaction forms of GenVirtual

The piano sound is associated to the default sound cards, but there is possibility to change the musical instrument sounds played by the cards. Simply add a new card on the table containing the symbol of the desired musical instrument (Figure 5). Thus, the same virtual elements emit different sounds, tones and may take a wind instrument (flute, trombone, trumpet, etc.). or string instruments (violin, guitar, etc). Another possibility is to use cards

with symbols corresponding to the percussion instruments, like drums, tambourines, triangles, and symbols that represent sounds of electronic instruments (Figure 6).

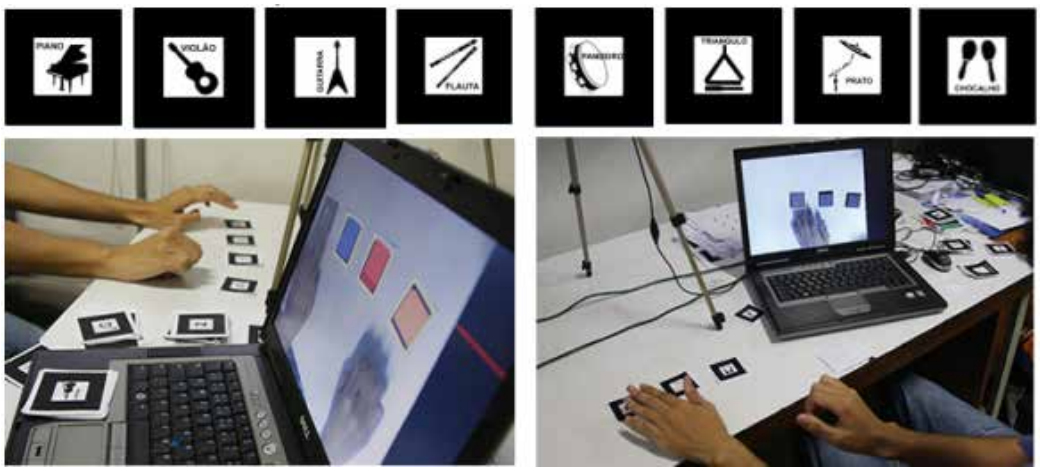

Fig. 6. GenVirtual Musical Instruments

GenVirtual allows change images of musical instruments (virtual black cubes) for 3D model of the instrument. Figure 7 shows an image of the violininstrument.

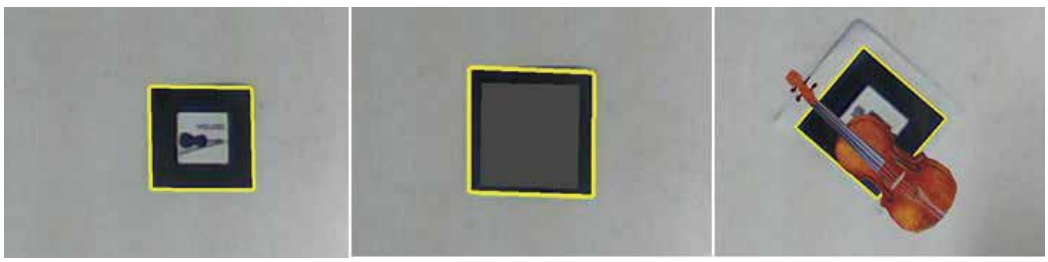

Fig. 7. 3D Musical Instruments of GenVirtual

The main characteristic of this virtual environment is the interaction flexibility. Unlike the keyboard, consisting of fixed keys and sizes, in GenVirtual, the therapist can print cards in different sizes and position them on the table in various ways, according to the motor limitations of each individual. Cards can be arranged on the table, or on the ground, depending on whether the interaction will occur using hands or feet. According to Nascimento (2006), it is important to have a reference of the motor movement so that motor learning occurs.

GenVirtual also has a feature to assist in recreational actives in music. Composite scores were created by melodies that can be read using colored balls. Colors of musical notes of score correspond to the colors of same musical notes GenVirtual. Figure 8 shows one of musical scores available GenVirtual from the book "Song at the piano" featuring the works of Winnie the Pooh Disney Enterprises Company.

Figure 9 shows musical score being projected on the computer screen. Note tha tthe virtual cubes have the same colors of the colored balls from the score.

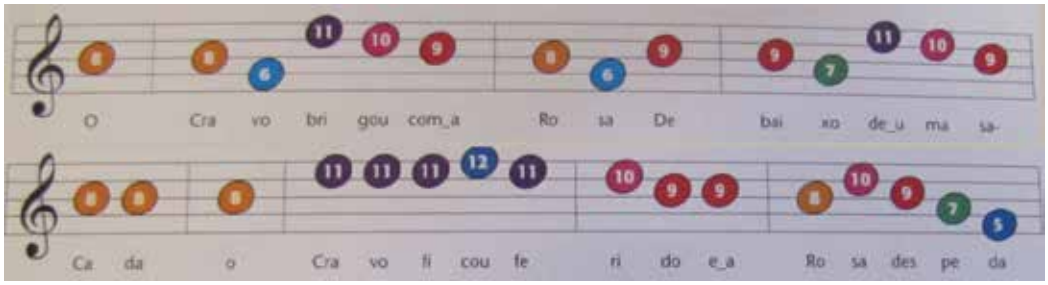

Fig. 8. Musical score of GenVirtual

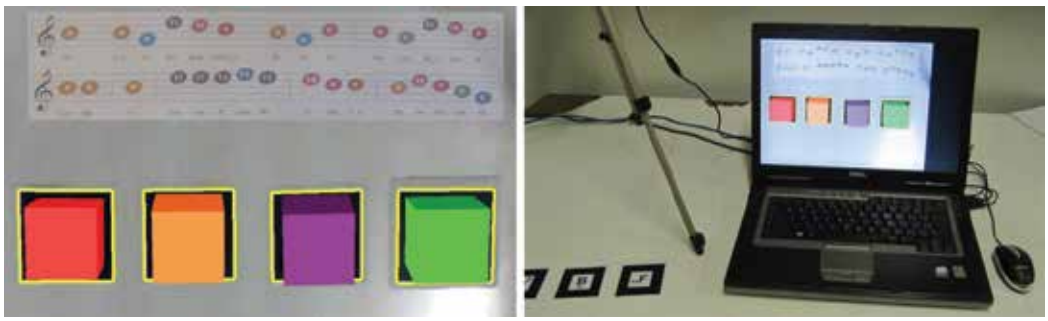

Fig. 9. Musical score of GenVirtual

4. Indicators to use GenVirtual in music theraphy

GenVirtual indications beyond the scope of rehabilitative therapy, allow household use of the system. With systematic and repetitive use of GenVirtual, individuals are spontaneously motivated. This can be enhanced with memory cognitive rehabilitation and visual stimuli (colors of virtual objects), as well as audio stimulation (sound of virtual objects). Therefore, motor rehabilitation is exercised with repetition of the sequence of motor movements necessary to strike the sounds.

From the analysis of music therapy approaches, Benezon (1998) establishes the four main methods of music therapy: improvisation, re-creation, composition and listening. All these methods can be applied using GenVirtual. For the clinical cases, the re-creation method was used, where the patient performs, reproduces, transforms or interprets a piece of music or musical model as a whole. The objectives of clinical re-creation, according to Benezon (1998) can be:

- Develop sensory motor skills.
- Promote rhythmic behavior and adaptation;
- Improve care and guidance;
- Develop memory;
- Promote the identification and empathy with others;
- Develop skills of interpretation and communication of ideas and feelings;
- Learn to play specific roles in various interpersonal situations.

We can consider that music therapist intervention with an individual with an extremely hypotonic hand, for example, can be processed by GenVirtual in the following aspects: these

individuals are not able to keep their fingers extended on the keyboard, or do not have the enough muscular strength to strike piano keys or strum a guitar (Louro et al, 2005). Typically, in these cases, the patient uses adaptations like tips on the hands to play the piano, tambourine fasteners for bimanual hand use, and the help of a music therapist to carry out interventions of music expression, the "music making" (Nascimento, 2006).

With GenVirtual, the performer can use his/her hands closed into a fist to play a musical note, since the cards can be printed in larger proportions. There is no need to adjust the interaction with the virtual environment. To use GenVirtual to play an instrument, the user needs to cover a card without using adaptations.

5. Evaluation of GenVirtual in music theraphy rehabilitation

Experiments with GenVirtual were performed in music therapy intervention. Five markers formed by symbols and colors of respective musical notes (C, D, E, F and G). Figure 10 shows the music therapist interacting with GenVirtual.

A video monitor was used to visualize the animation of virtual cubes. The webcam was placed on top of the monitor to capture images of cards on the table. As can be seen in Figure 8, the music therapist obstructed cards with her hands without using adapters.

Fig. 10. Evaluation of GenVirtual by music therapist

After testing, the music therapist noted that besides the possibility of using GenVirtual in music therapy, it can bring benefits to individuals with disabilities, since it is a facilitator and motivational tool in the rehabilitation process. As one example:

- Arm extension exercises: the goal is to reach a virtual object. With cards' flexibility, specific challenges can be created for each patient according to their motor limitations.

- Wrist flexion exercises: support the forearm on the table and bend wrist up and down "touching" virtual objects to execute the sounds.
- Repetitive motor training: a sequence of motor movements facilitated by the musical memory game.
- Visual perception exercises: identifying musical elements from the representation of these elements by colourful virtual objects.
- Auditory perception exercises: identify high and low tones (listen to sound) and identify familiar melodies (listen to music);
- Reproduction and development of more sophisticated music pieces, experience the "music making" to amplify their cognitive functions like attention, concentration and memory.

5.1 Methodology

This research was approved by the responsible Scientific Review Committee: the Committee for Scientific Affairs of the Association of Assistance Children with Disabilities (AACD) under Protocol 089/10. Several experiments were performed in the AACD music therapy field in order to test the impact of GenVirtual when treating two patients with cerebral palsy and three patients with neuromuscular diseases.

The patients' ages were established between five and six years old, with individuals of both sexes, being 01 (one) girl and 04 (four) boys. Patients underwent a trial test with the specific goal of rehabilitation for upper limb by motivation stimulation of musical function through interaction with music. The process began with the implementation of the User Interaction Satisfaction Questionnaire (QUIZ), repeated at the end of the interaction. The objectives of the experiments were:

- Assessing motivation, satisfaction and enthusiasm of patient to interact with GenVirtual.
- Observe the motor effort motivated by using virtual objects that allow music expression.
- Observe the ability to concentrate.
- Observe family interaction during the intervention.

During the experiments with patients, we used a computer, a sound box, a webcam with a tripod and sixteen cards: seven cards representing seven musical notes (C, D, E, F, G, A and B), three cards representing instruments (piano, violin and guitar), a marker representing a wind instrument (flute) and four markers representing the percussion instruments (cash, plate, drum and tambourine). The experiments were recorded as illustrated in Figure 11.

Initially, the music therapist prepared a linear design with cards on the table. The goal of linear motor planning for these patients was to stimulate the active pendulum motion to the shoulders, push your arm back and forth so as to touch the virtual objects.

After the demonstration of active music therapist's tool operation, the patient spontaneously was motivated and interacted with the system, making the shoulder and arm extension to reach the cards on the table and thus play the virtual objects and enjoy the unique and individual musical composition. The music therapist encouraged the activity by asking the patient to interact with the cards, to switch the left arm with the right, to exercise and active pendulum motion with left and right shoulders.

Fig. 11. Use GenVirtual by patients of AACD

The activity was held in a few moments as an expression of patient musicality (through motor activity). Also, the music therapist used an electronic keyboard to accompany the patient's musical activity. The music therapist process is a sequence of interventions and not simply a single act or therapeutic maneuver alone. A therapist-patient relationship was created, even for those cases where the therapy period was relatively brief.

The type of therapeutic process involved in this clinical trial, where the therapist used the virtual tool, depended on the type of patient and the nature of his/her problem. According to Benezon (1998), there are different types of proceedings, as follows: developmental, educational, interpersonal, artistic, creative and scientific process which can be applied as such individual processes and are not mutually exclusive, but instead overlap, with greater or less emphasis on the process, as presented in these cases.

5.2 Results

According to the results collected in the Quiz and to the patient and family feedback, all patients participated actively in the therapy with the strategies suggested by the therapist showing interest in the activities. The musical cards triggered curiosity and demanded concentration and reasoning during the activity. All patients achieved the proposed objectives for the intervention.

GenVirtual fostered the development of therapeutic activities using virtual reality with the computer such as playing percussion instruments with open hands, for example, triangle plate and without the need of a stick, which cannot be used by children with severe upper limb motor problems. As of the Benezon (1998), music therapy analysis approaches, the four

main methods of music therapy: improvisation, re-creation, composition and listening, can be applied through using GenVirtual. For the clinical cases presented, the model re-creation where the patient performs, reproduces, transforms or interprets the piece of music or musical model as a whole was the most commonly used method

6. Concluding remaks

In recent years there has been a trend in software development for the treatment of various motor and cognitive disorders of people with disabilities. In particular, the use of augmented reality technology has been highlighted and enhanced by having an attractive interface generating greater motivation and consequently greater acceptance and participation in therapeutic treatment.

It is important to involve a multidisciplinary team during the inception of a virtual environment for therapeutic interventions. Thus, it is necessary to analyze the characteristics and abilities of patients considering their limitations. Therefore, a team of engineers conducted this research along with AACD therapists. The team especially considered patients treated in the field of music therapy in order to stimulate their musicality functions (through the motor potential), a cognitive characteristic, motivational aspects and individual characteristics.

Results showed that GenVirtual can be useful to include therapeutic interventions for cognitive learning, motor, psychological and social stimulation through musicality. Social programs have disseminated computers even in low-income families. And since the system is based on a conventional computational platform, the prototype can already be used at home. This may provide for family involvement in complementary activities. Therefore, the sequences of operations with GenVirtual may involve stages of maturation or development, gradual learning, development of personal relationships, the performance, composition and spontaneous child improvisation, exploration, experimentation and alternatives selection, as well as ongoing evaluation of the effects of therapy on patient's progress through treatment targets.

Nevertheless, the virtual environments do not replace conventional medical therapies, but the tool will help empower existing treatments. We consider the positive data collected as a result of the patients' satisfaction evaluations and the family feedback is a preliminary result that needs to be extended to a greater number of individuals ('n') to confirm or not the encountered results.

7. References

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15

Deafness-Specific Tactic Knowledge: A New Understanding of Mental Health, and Social and Professional Participation

Paul G. Jacobs
Melbourne
Australia

1. Introduction

Living with a disability offers inordinate cognitive and social challenges. A person with a disability that is maximizing their social and professional opportunities therefore offers a unique understanding of human potential. This chapter proposes that a deaf individual's mastery and execution of disability-specific tactic knowledge is essential for their mental health, and their social and professional participation. Tactic knowledge defines the cognitions that an individual uses to perform practical everyday tasks to maximize their social or professional outcomes (Sternberg, 1985; Sternberg & Wagner, 1986). Disability-specific tactic knowledge is the individual's use of specialized proactive cognitive and social (psychosocial) strategies to identify, circumvent, or master disability-related psychological, social, or professional challenges (Jacobs, 2010). Disability-specific tactic knowledge is also speculated to be absent in individuals without disabilities. They have no need to acquire, nor require the use of, such an esoteric psychosocial skill set (Jacobs, 2010). As such, it appears that deaf individuals need to master two sets of tactic knowledge to maximize their potential.

These concepts derive from my research with professionally successful deaf participants and owe much to research into Learning Disabilities (LD) by Henry Reiff, Paul Gerber, and Rick Ginsberg. Before elaborating on this cross-disability connection, attention will be given to issues linked with social and professional participation and also the mental health of deaf people. At the outset, however, the author acknowledges that certain mental health conditions have biological origins. But this should not distract us from the reality that adverse environmental influences and an individual's maladaptive coping strategies can negatively impact on their mental health, and social or professional pursuits. In addition, this book chapter is by no means an exhaustive survey of the deafness literature of social and professional participation, and mental health. The main aim is to canvass themes and to thereafter illustrate the associated importance of disability-specific tactic knowledge.

2. Social participation and mental health issues in deaf children

By definition, deafness is not a learning disability. Deafness, however, can significantly impact on the individual's spoken expression and listening comprehension, and - by

extension - their social learning, development, and interaction. Deaf people appear to be more prone to social isolation or exclusion than the general population (de Graaf & Bijl, 2002; Punch, Hyde, & Power, 2007). Deaf child participants have reported higher prevalence of emotional and conduct problems when compared with hearing peers (Hintermair, 2006; van Gent et al., 2007). Qualitative studies have additionally observed ongoing social difficulties by deaf children in their interactions with hearing peers (Bat-Chava & Deignan, 2001; Punch & Hyde, 2011). An Australian study by Remine and Brown (2010) found that the prevalence rate of mental health problems in deaf child participants (n = 38) were comparable to that of Australian population norms. Deaf participants in this study were mostly conversant with spoken language unlike an earlier Australian study by Cornes et al. (2006) whose deaf participants (n = 54) mostly preferred sign language (SL) for communication. SL is a manual language that has many official forms (e.g., American Sign Language [ASL], Auslan [Australian SL]) and places a premium on hand signs over speech and listening for communication (Scheetz, 2004). Using an interactive Auslan assessment tool instead of a standard English version, Cornes et al.'s study yielded a prevalence of clinically significant emotional and behavioral problems in deaf adolescents (42.6%) when compared with the standard English version (21.4%).

The higher reported psychopathology rates in Cornes et al.'s (2006) study compared with Remine and Brown's (2010) study may be associated with the deaf participants' communication competence. According to Hindley (2005), children with early onset and severe to profound deafness are more likely to experience mental health problems than their hearing peers. Early communication deprivation is one of the key risk factors. For example, van Gent et al.'s (2007) study with deaf adolescents (n = 70) found that of psychopathology was related to a signing mode of communication among other factors (e.g., low IQ). By contrast, a study by de Graaf and Bijl (2002) found that deaf participants with a higher speech-reading competence were less likely to report mental distress than those with lower competence. Speech-reading is the ability to synchronize body language - particularly the formations of the lips - with the auditory input and pretexts of the conversation when the speaker is talking (Jacobs, 2007). Good speech-reading ability and speech intelligibility by deaf individuals are also indicators of psychosocial adjustment with hearing peers (Arnold, 1997; Bain, Scott, & Steinberg, 2004; Polat, 2003). Studies additionally suggest that deaf individuals with same aged or superior spoken language skills have fewer relationship problems with hearing peers than do deaf individuals lacking spoken language skills (Fellinger, Holzinger, Beitel et al., 2009; Hintermair, 2006).

According to Toe, Beattie, and Barr (2007), deaf individuals with under-developed pragmatic skills are likely to experience social difficulties, and are at risk of lower self-esteem and social isolation. Pragmatic skills are defined by conversational and communicative competence. Language proficiency is required to perform pragmatic skills effectively. As pragmatic skills develop through conversations with numerous people, the individual learns more about the rules of conversations and how relationships are formed. Toe et al.'s study was with 18 participants aged between six and 16 years who had severe and profound deafness, and included both hearing aid users and cochlear implant (CI) users. All conversed using spoken English and attended regular classroom settings for at least daily. Video analysis of these participants conversing with their supporting teacher of the deaf showed that very few conversational breakdowns occurred. Younger participants

relied heavily upon simple responses to teacher questions whereas the older students were more likely to initiate conversational turns and to evenly share the conversational talk time. A strong relationship was observed between students' age, linguistic competence, and pragmatic skills. The authors speculated that the participants' engagement in mainstream secondary school environments gave them opportunities to practise, and therefore develop, pragmatic skills with hearing peers.

The literature therefore suggests that there is a strong link between the use of language, social participation, and mental health. It is pertinent, however, to note that discretion is required when considering studies with deaf child participants. For instance, studies may show that deaf children or adolescents have similar levels of language development or social adjustment to their same age hearing peers; but this may say little about their capacity to deal with a whole new set of deafness-related psychosocial challenges when they leave the confines of school or family life as a young adult. I sought to convey as much of my own experiences living with profound deafness in *Neither-nor: A young Australian's experience of deafness* (Jacobs, 2007). Leaving the protective environs of school and family may confront a deaf individual with a series of persistent psychosocial challenges for which they may be woefully underprepared. While the use of language appears to be essential in facilitating social participation, additional cognitions are likely required to attain and sustain quality of life. Namely: deafness-specific tactic knowledge. Before elaborating on this key concept, it is necessary to provide a short survey of serious challenges encountered by many deaf adults.

3. Mental health, and professional and social participation in deaf adults

Given the reported psychosocial challenges experienced by young deaf participants, attempts to attain and maintain quality of life in adulthood are perhaps more difficult for deaf individuals than for individuals without a disability. Chronic unemployment, under-employment, and maintaining employment are problems for many deaf adults (Hogan et al., 2009a; Punch, Hyde, & Creed, 2004; Rosengreen, Saladin, & Hansmann, 2009). For example, a disproportionately high 45 percent of unemployed deaf Australians were deaf before 20 years old (Hogan, O'Loughlin, Davis, A., & Kendig, 2009a). Moreover, deaf Australians with just one disability (i.e., deafness) are currently nine times less likely to be employed than average Australian (Access Economics, 2006). Individuals with additional disabilities to deafness are also proportionately less likely to be employed per additional disability (Australian Safety & Compensation Council, 2007).

Career difficulties for deaf people can include physical or structural impediments such as excessive background noise, the workplace requirement of using telephones, the non-provision of assistive auditory devices (e.g., FM systems), and auditory rather than visual alerting signals (e.g., colleagues announcing departure) (DeCaro, Mudgett-DeCaro, & Dowaliby, 2001; Scherich, 1996). Other difficult workplace circumstances include group situations such as departmental, staff meetings, work-related social functions, in-service training sessions, and informal social interactions (e.g., lunch breaks) (Hyde & Punch, 2009; Scherich & Mowry, 1997; Scherich, 1996; Steinberg, Sullivan, & Montoya, 1999). Additional barriers are the discriminatory practices of being refused workplace promotion on merit, being bullied, and being denied necessary and reasonable deafness-related accommodations (e.g., a note taker for meetings) (Scherich, 1996; Scherich & Mowry, 1997; Wheeler-Scruggs, 2002). Many deaf people are also significantly disadvantaged because they have not

developed strong social skills necessary for effective workplace relationships before entering the workforce (Rosengreen et al., 2009).

Unemployment and living alone have been found to be significant indicators of mental distress in deaf adults (de Graff & Bijl, 2002). Social isolation or unsatisfactory social participation has been linked with loneliness, exhaustion, lethargy, anxiety, apathy, despondence, social dissatisfaction, and severe self-doubting (Backenroth-Ohsako, Wennberg, & af Klinteberg, 2003; Heydebrand et al., 2005; Steinberg, Sullivan, & Montoya, 1999; Wheeler-Scruggs, 2002). Cited problems include communication difficulties in group situations, understanding conversational nuances, and learned helplessness (Heydebrand et al., 2005; Hyde, Punch, & Komesaroff, 2010). Studies have also reported higher levels of mental distress, depression, interpersonal sensitivity, phobic anxiety, substance abuse, and hostility in deaf individuals compared with population norms (Brunnberg, Boström, & Berglund, 2007; de Graaf & Bijl, 2002; Fellinger et al., 2007; Jones, E.G., Ouellette, & Kang, 2006; Monzani et al., 2008). Irritability, feelings of inferiority, and phobias can create a mutually impacting cycle of social rejection and psychological dejection, and deliberate self-seclusion from social and professional activities (Heydebrand et al., 2005). Kvam, Loeb, and Tambs (2007) further found that negative childhood experiences (e.g., parental abuse, bullying, and sexual abuse) increased the probability of mental health problems in deaf adults. Hearing spouses of people with acquired deafness have additionally reported comparatively poorer psychological, physical, and social wellbeing when measured with population norms (Fellinger et al., 2005; Hogan et al., 2001; Hogan, O'Loughlin, Davis, A., & Kendig, 2009b).

The aforementioned studies mostly had small sample sizes and were conducted in Western nations. Larger studies by Hintermair (2008) and Hogan et al. (2009b) suggested that many themes in the smaller studies are prevalent across the broader population of deaf people. When interacting with hearing peers, deaf individuals are often required to make sense of - and to concurrently act upon - the social situation with less-than-ideal hearing. Another important finding is that stress and anxiety tends to occur when the environmental demands exceed a deaf individual's resources for coping with events (Hogan et al., 2009b; Jones, E.G., et al., 2006). As such, it is not deafness per se that contributes to psychiatric problems. Rather, maladaptive communication and coping strategies appear to be the chief problems for deaf individuals in their quest to gain and sustain social and workplace participation and a healthy mental well-being (Fellinger, Holzinger, Sattel et al., 2009; Hintermair, 2008; Monzani et al., 2008; van Gent et al., 2007). Ineffective communicative abilities can also retard the development of emotional and social skills vital to social participation (Leigh et al., 1996).

It is speculated that the deafness-related difficulties are associated with 1) an individual being a member of a minority that can encounter considerable and consistent ostracism – whether subtle or overt (Hogan, 2001); 2) the cognitive demands deriving from learning and executing deafness-specific proactive psychosocial skills, and; 3) difficulties deriving from real-time interaction with less-than-ideal hearing. Deaf individuals therefore appear to encounter more psychosocial challenges than do nondisabled individuals (Kvam et al., 2007; Lukomski, 2007). These extra and unique psychosocial difficulties for deaf individuals – or disability-related psychological, social, and professional challenges - may negatively impact on their mental health (Jones, E.G., Ouellette, & Kang, 2006). In addition, these challenges

appear to have two primary characteristics: external and internal (Glickman, 2008). External challenges are outward social and professional pressures encountered by the individual. Internal challenges are the individual's cognitive capacity to deal with these external challenges.

4. Shifting focus: A strength-based understanding

The previous survey of the literature runs the risk of portraying a dire picture of living life with deafness. However, when viewed from another angle, positives also appear. For example, studies show that a majority of deaf participants are achieving workplace participation and a healthy mental well-being. An additional finding is that the attainment of tertiary qualifications is an indicator of deaf people achieving near identical incomes to similarly qualified hearing peers (Jones, D.D., 2004). But what are these deaf people actually doing in their daily lives to maximize their social and professional potential? This question may be best answered by a focus shift.

According to Hintermair (2006), there is a need for a "capabilities-resources" perspective of understanding deaf people. This focuses on 'what works' as opposed to describing the dimensions of deafness-related problems. In 1998, the then president of the American Psychological Association Martin Seligman stressed the need for substantial strength-based research into psychosocial attributes and tactics for coping with day-to-day life (Hintermair, 2006). Seligman also argued that research focusing on personal weaknesses has contributed to mental health professionals being ill-equipped to conduct or devise effective interventions (Hintermair, 2006). Similarly, describing the dimensions of deaf people's social isolation, employment disadvantages, and mental health problems may not actually benefit deaf people, their peers, or family. This is a deficit mode of thinking because it focuses on what deaf people cannot do, or have difficulties with. Descriptions of problems can have little or no practical value for everyday living. Oppositely, strength-based research seeking to understand what deaf people can do – or how their healthy personalities are operationalized – can uncover knowledge of their capabilities and utilization of resources. This practical knowledge also has a prescriptive value. The specialized tactics gleaned from the research can thereafter be used to inform educational or intervention practices designed to assist deaf people who, in turn, will use these skills. That is not to dismiss that challenges do and will continue to exist – or underestimate the importance of research identifying these challenges - but to emphasize a shift in focus toward deaf people's strengths and capabilities (Hintermair, 2006).

Three examples of studies seeking to understand strength-based psychosocial attributes in deaf participants are as follows. Powers (2011) studied factors influencing the success of high achieving English deaf adolescents. Interviews were conducted with the deaf students themselves (n = 27), their parents (n = 27), teachers of the deaf (n = 27), and professionals other than teachers of the deaf (n = 21). The methodology was similar to Luckner and Muir's (2001) American study and also produced remarkably similar findings. In both studies, each of the participant groups attributed success to 1) the child's own personal attributes and character over other factors in order of importance: 2) the influence of parents, 3) the support of teachers of the deaf and teaching assistants, and 4) skills in language, communication, and reading. In addition to the crucial finding that attributes and character are key aspects to success in deaf people, studies by Powers and Luckner and Muir also

revealed specific cognitive attributes (e.g., hard work and high expectations). In another strength-based study, Bain et al. (2004) sought to understand the connection between coping strategies and socialization in deaf adult participants (n = 38) raised using spoken language. The majority of participants had developed psychosocial strategies to negotiate deafness-related social difficulties. Strategies included initiating modifications of the environment to ensure communication ease, adapting to the needs of others, participating in activities, and maintaining a lifestyle with hearing peers. Participants in Bain et al.'s study also expressed self-confidence, little social anxiety, and pride in their strategic adaptive skills.

Given the unique psychology required to contend with inordinate challenges, a deaf individual who is achieving social and professional participation, and who sustains a healthy mental wellbeing, can be considered a remarkable example of human performance. Strength-based studies by Bain et al. (2004), Luckner and Muir (2001), and Powers (2011) emphasized the importance of the deaf individual's own attributes and character, and also alluded to proactive psychosocial strategies. Despite this, Bain et al. and Powers both opined that there is scarce research of how deaf children become successful adults regarding their professions, relationships, mental health, and overall quality of life. Should such future research be undertaken, much could be gained from understanding how deaf individuals operationalize their success in their daily interactions. This focus may become sharper when viewed from the perspective of expert performance.

5. Expert performance and practical intelligence

In recent years, the general public's interest has been captured by the role of expert performance by individuals who have achieved world-class acclaim in their chosen profession. Books of the topic include Geoff Colvin's *Talent is Overrated* (2010), Daniel Coyle's *The Talent Code* (2009), and Malcolm Gladwell's (2009) *Outliers*. Each book has popularized the seminal work of Professor Anders Ericsson, widely acclaimed as the world's leading authority on expert performance, and his colleagues. Ericsson, Charness, Feltovich, and Hoffman's (2006) review of studies regarding expert performance has suggested that deliberate practice is more valuable than innate talent. Deliberate practice is defined as the individual's intense and often repetitive practice of a technique, craft or skill. Many of these tasks are highly sophisticated and specialized, and cannot be mastered or executed without sustained deliberate practice. Ericsson, Krampe, and Tesch-Romer (1993) further noted that ten or more years of sustained, intense, and specified practice are the norm with world-class performers across the breadth of professions. Gladwell (2009) refined this concept as the '10,000 hour rule'. Expert performers typically devote 1,000 hours of deliberate practice yearly to their craft for at least a decade before operating at a world class level of performance; beyond 1,000 hours practice a year diminishes the quality due to the human inability to sustain such effort.

The consensus is that no amount of innate talent will achieve optimum outcomes if practice is forfeited, denied, or is of a continuous poor quality. Ericsson et al. (1993) additionally note that efficient learning is impossible and improvement minimal - even for highly motivated individuals - without adequate tuition or feedback. Nevertheless, Ericsson et al. suggested that the intervention of specific instruction can lead to the eventual improvement of temporarily arrested or suboptimal skill levels. The acquisition of expert knowledge ideally requires an individual to receive explicit instructions through supervision of a teacher who

can make astute diagnoses of errors and provide corrective feedback when necessary. Training and monitoring of expert performance also involves the administering of appropriate tasks according to the individual's skill level. Individualized instruction is generally recognized as superior to training by curricula or in groups. After tuition, a high performer can operate alone to accumulate and refine knowledge of the effective methods and associated practices necessary for expert performance.

However, Ericsson et al.'s (2006) investigated foci are located in the diverse professions within which extraordinary individuals have maximized or are maximizing their potential. Examples are sport, art, science, and medicine - but professions nonetheless. Taking nothing away from this exemplary research, expert performance also appears to have an association with the mental health, and the social and professional participation for people with disabilities. Here is where deaf individuals, or individuals with a LD, can offer contemporary science a greater understanding of human potential. Instead of using expert knowledge for a profession alone, successful individuals with a disability are likely using additional specialized skills to maximize their professional, social, and romantic potential. Explicitly: psychosocial skills specific to dealing with disability-related challenges. This expert knowledge may, in turn, be instrumental to the individual maintaining and sustaining their healthy mental well-being over time. But how is this potential operationalized on a daily basis?

Everyday psychosocial skills specific to identifying, circumventing, or mastering disability-related challenges appear to be a specialized form of tactic knowledge. Also known as practical intelligence, tactic knowledge defines an individual's competence in everyday real-world settings (Sternberg, 1985, 1988). According to Wagner and Sternberg (1986), tactic knowledge is "(1) practical rather than academic, (2) informal rather than formal, and (3) usually not directly taught" (p. 54). Tactic knowledge also regards managing the self, managing others, and career management. Management of the self connotes knowledge of conducting daily tasks efficiently and how to maximize one's own productivity through self-initiative (Wagner & Sternberg, 1986). Management of others refers to tactic knowledge which tailors and assigns tasks that utilizes the strengths and minimizes the weakness of others, and also how to cooperate with others generally (Wagner & Sternberg, 1986). Management of career includes tactic knowledge of what is valued in the workplace, how to convince others of your work's value, and how to sustain a good reputation (Wagner & Sternberg, 1986).

Individuals with high practical intelligence are skilled at absorbing tacit information and then utilizing that information in every day contexts (Sternberg, 2003). Practical intelligence is also used by individuals to shape to their environment and to also adapt to the needs of others. Experience plays a crucial role in the acquisition of, and effective use of, practical intelligence (Sternberg, 2003). Through the use of creative or synthetic intelligence, an individual undertakes a challenge – or a new type of problem – by incorporating the new knowledge with their pre-existing knowledge (Sternberg, 1985). They will then sift purpose-irrelevant from purpose-relevant information, synchronize this selected information into a plausible whole, and then act on this evaluation. It is by successfully dealing with what Sternberg (2003) calls 'relative novelty' that an individual becomes skilled to the point of 'relative familiarity.' Having acquired the experience through practice, an individual will likely become so familiar with a process of a task that their actions will be automatic. When

such mastery occurs, the individual will have the mental resources for coping with new challenges associated with the process or task. It is through active risk taking and continual interpersonal engagement that individuals develop tactic or practical knowledge in diverse social settings. Otherwise, successful social or professional participation cannot occur (see Sternberg & Wagner, 1986). Individuals who avoid engagement, or to overly seek protection in parents, an organization, or peer group, are more likely to experience negative cognitive and social outcomes when confronting adversity (Sternberg, 1988). The reason: they have not practiced or developed the psychosocial skills necessary for optimal functioning. As Kentish (2007) noted, parents who shelter their deaf child from emotionally or socially awkward situations (e.g., as an interpreter or negotiator) can compromise their child's opportunities, and therefore ability, to develop coping skills. Parental overprotection can result in the child remaining dependent, passive, and socially immature.

6. Psychosocial skills and social participation

To illustrate the proposed phenomenon of two types of psychosocial skill sets required of a deaf individual to maximize their potential, it is perhaps helpful to review themes in the following studies. These studies are grouped according to the roles of five themes relating to the acquisition of tactic knowledge: 1) spoken language and cognitive capacity, 2) the onset of deafness as impacting on psychosocial performance, 3) the pre-existing lack of psychosocial development despite improved hearing through cochlear implantation, 4) parenting and deafness-specific tactic knowledge, and 5) the idea that deafness-specific tactic knowledge can be taught through expert tuition.

Studies by Roberts, Brown, and Rickards (1996) and Brown et al. (2000) of pre-schoolers show that the deaf participants appeared to lack tactic knowledge when compared with hearing participants. The studies were of entry behaviors into play groups. Hearing children appeared to be more innovative with entry behaviors when met with resistance from the play group. These persistence strategies commonly saw the child eventually gaining acceptance. The deaf children, however, tended to use the same strategies regardless of previous failure. As such, their comparative lack of tactic knowledge saw them being continually rejected by the play group. It is probable that less-than-perfect hearing had restricted the deaf children's acquisition of language. Hearing children have the advantage of learning through their greater listening capacity to acquire and use effective tactic knowledge. Another factor is worth considering: pre-schoolers are yet to develop their powers of concentration, attention, and cognitive reasoning. Trying to make sense of the situation – particularly with the additional challenge of deafness – may be beyond the capacity of the human brain at this age. Furthermore, deaf preadolescents are yet to acquire the numerous hours of practice necessary to produce consistent optimal social outcomes for themselves.

Studies have further indicated that the later the onset of deafness the poorer was the participants' psychosocial adjustment (de Graaf & Bijl, 2002; Polat, 2003; Powers, 2003). For example, de Graff and Bijl's study with 23 deaf adult participants found that more post-lingually than pre-lingually deaf participants experienced daily deafness-related problems. Participants who acquired deafness after the age of three were more likely to report mental distress than participants who were deaf prior to that age. Mental distress was also linked with communication problems, lower self-esteem, inferior speech-reading competence, and

lesser acceptance of deafness-related psychosocial problems. Onset of deafness places certain demands on an individual's cognitive capacity. The tactic knowledge they acquired and executed as a 'hearing person' prior to their deafness is not enough; mastery of a new additional set of deafness-specific tactic knowledge is required for their potential to be maximized. One example of a deafness-specific skill is speech-reading - a learned skill that takes much practising, and therefore time, to master (Arnold, 1997).

Many hearing parents of deaf children have additionally reported stress and anxiety regarding the increased social demands during their deaf child's adolescence (e.g., difficulties with group conversations and fitting in a social group) (Hintermair, 2006; Hyde et al., 2009). Polat (2003) further found that deaf participants with deaf parents were better adjusted than were deaf participants with hearing parents. Hintermair additionally reported that deaf mothers were less stressed than were hearing mothers of deaf children. Reported high stress levels in the hearing mothers may be a consequence of them not having access to, or possessing, knowledge of the skills required to identify, circumvent, or master deafness-related psychosocial challenges. Hearing parents typically 'start from scratch' with little or no pre-existing experience of deafness. Deaf parents, by contrast, have first-hand experience of deafness. They are therefore more likely to be conversant and resourceful with deafness-specific knowledge to instruct and nurture their deaf children than are hearing parents. For example, Meadow-Orlans (1990) observed that deaf parents tend to grant their deaf children independence and are less anxious to about their child's ability to navigate the world. As Ericsson et al. (2006) reasoned, expert tuition is essential for the nurturing of specialized performance. Polat also speculated that hearing parents may exert "strong parental control which reinforces passivity rather than active exploration" (p. 331) in their deaf children. Active exploration links with Sternberg's (2003) idea that experience is necessary for the acquisition and optimal functioning of tactic knowledge.

Several studies report varying degrees of social skills functioning and social participation in children with CIs (Bat-Chava & Deignan, 2001; Bat-Chava Martin, & Kosciw, 2005; Punch & Hyde, 2011). Cochlear implantation in profoundly deaf people brings their hearing capacity into the speech range and has been found to improve their social interaction (Hogan et al., 2001). While cochlear implantation can improve a deaf individual' speech retention, it does not necessarily translate directly into improved social participation (Punch & Hyde, 2011; Leigh et al., 2009; Schorr, 2006). For example, Schorr found that children implanted at older ages were more likely to report loneliness, were slower to adjust, and had difficulties achieving feelings of belongingness at school than were children implanted at earlier ages. Despite an improved hearing capacity gained through a CI, the individual may have pre-existing maladaptive behaviors associated with their deafness. However, Bat-Chava et al. report that developmentally delayed deaf children had achieved significant progress in age-appropriate development of communication, socialization, and daily living skills after years of hearing aid or CI use. According to the authors, deaf children's communication and social skills may be improved through CIs. Another possibility is that deafness-specific tactic knowledge develops over time through practice. According to Ericsson et al. (1993), deliberate practice is time consuming but essential for expert performance.

Findings in de Graff and Bijl's (2002) study indicated that the improvement of communication skills in a variety of situations could help avert mental health problems in deaf adults. Books by Glickman (2008) and Hogan (2001) contain a diverse range of

prescriptive communication and psychosocial skills specific to deafness-related social challenges. The value of Glickman's text is that it makes cognitive behavioral therapy accessible to low functioning deaf individuals and also to deaf people whose first language is SL. Hogan's communication skills program adapted the Hearing and Listening Skills Program published by Hetu and Getty (1991) - perhaps the most acknowledged intervention for deaf people to enhance their management of everyday difficulties (Heydebrand et al., 2005). Hogan's program aims to equip deaf people with 1) problem identification, 2) problem exploration, and 3) problem resolution. Many excellent deafness-specific strategies are provided. Hogan's program was additionally adapted for a study by Heydebrand et al. Adaptation of the program included enhancement of communication skills through cognitive behavioral techniques designed to positively reframe the participants' negative assumptions, attitudes, and beliefs associated with their deafness. Participants were taught to identify the emotional reasons and consequences of why they might not, or should, initiate strategies (e.g., asking to turn down loud music at a party to improve conversational ease). These are examples of deafness-specific tactic knowledge. Heydebrand et al. found that the psychosocial skills program proved effective to the study's participants, which highlights the value of specialist tuition in the nurturing of expert performance (Ericsson et al., 1993). Without question, the aforementioned books and programs have covered much ground regarding the understanding and prescription of deafness-specific tactic knowledge. But a systematic and comprehensive framework of proactive deafness-specific tactic knowledge may further improve our understanding of deaf people's social and professional participation and mental wellbeing.

7. A framework of disability-specific tactic knowledge

In their seminal qualitative study, Reiff, Gerber, and Ginsberg (1995) used a framework of proactive cognitive and social tactics to define how 71 participants maximized their social and professional potential despite living with LD. The framework also appears in other works by the same authors (e.g., Gerber, Ginsberg, & Reiff, 1992; Reiff, 1998, 2004; Reiff, Gerber, & Ginsberg, 1997). Perhaps the most unique feature of this research is the pursuit of what could be termed expert knowledge in a disability context. Unsurprisingly, Reiff et al. (1995) stated that a study of expert performance by Bloom (1982) was a significant influence on their framework. Bloom's study was with 25 participants who achieved world class accomplishments before the age of 35 and predates the works of Ericsson and colleagues. The link between expert performance and disability-specific tactic knowledge is therefore clear.

A distinctive feature of Reiff et al.'s (1995) framework is that it defines how individuals maximize their potential through their operationalization of psychosocial attributes and tactics to identify, circumvent, or master disability-related difficulties. Maslow (1970) defined psychosocial attributes as an individual's cognitive traits and processes. For Reiff et al., these are defined as 'Internal Decisions' and consist of three parts: Desire, Reframing, and Goal Orientation. Sternberg (1985) further theorized that psychosocial tactics are externalized behavior outcomes caused by cognitive attributes. For Reiff et al., these are defined as 'External Manifestations' and consist of four parts: Persistence, Goodness of Fit, Learned Creativity, and Social Ecologies. As such, the individual's Internal Decisions are instrumental to their adaptive behavior, which is defined as External Manifestations. Overriding these seven psychosocial skills is the eighth theme of Control, which has a dual

role as being both independent of and also inherent within the seven other themes. A summary of Reiff et al.'s framework appears below:

Control: is controlling one's own destiny, both in real time interaction and with general life circumstances, through use of proactive thinking strategies and social skills.
Internal Decisions
Desire: is putting motivation into action and also describes the individual's endeavor to achieve professional and social outcomes.
Goal Orientation: is the purposeful planning and pursuit of short- or long-term goals in social and professional situations.
Reframing: is purposefully challenging negative thought processes in order to create proactive behavioral outcomes.
External Manifestations
Persistence: is proactively dealing with immediate or long-term disability-related adversity.
Learned Creativity: is the use of various disability-specific compensatory strategies, techniques, methods, or aids.
Goodness of Fit: is choosing social environments that suit personal strengths and/ or avoiding or minimizing entry into settings where success is unlikely.
Social Ecologies: is initiating and maintaining relationships of varying degrees of intimacy to gain the assistance or emotional support of others.

Table 1. Reiff et al.'s (1995) framework of proactive cognitive and social tactics

My PhD research used Reiff et al.'s (1995) framework to observe how deaf participants maximize their social and professional potential (Jacobs, 2009). Although numerous deaf adults have achieved prominence in a variety of professions, scarce research has been systematically undertaken to understand how their success is attained. The review of the literature suggested that the aforementioned eight themes in Reiff et al.'s framework could be applied to a deafness context (see Jacobs, 2010). In other words, deaf people likely use tactic knowledge specific to identifying, circumventing, or mastering social and professional deafness-related challenges. Unlike Reiff et al.'s (1995) study, my study sought to compare the psychosocial competencies in deaf adult participants with a control sample of adult participants without a disability (Jacobs, 2009). This exploratory study was with 49 deaf (n = 30) and hearing (n = 19) adult participants who were residing in America, Australia, England, and South Africa. All participants regarded themselves as maximizing their potential and were currently employed.

Survey items were created for both quantitative and qualitative analyses. In order to conduct statistical analyses, Reiff at al.'s framework was modified so that the eight psychosocial themes combined to create the overall outcome of Potential Maximization (see Jacobs, 2010). The theme of Control was assigned to an independent thematic category mostly to reduce the ambiguity of Reiff et al.'s definition of the theme. This adaptation

enabled the implementation of statistical procedures whereby survey items could be scored. As such, Potential Maximization was the combined score of the three grouped competencies of Control, Internal Decisions, and External Manifestations. At the time of writing, a paper reporting the empirical findings prepared by myself with Dr Louise Paatsch and Associate Professor Margaret Brown was accepted for publication with the *Volta Review*. Summarized, however, there were remarkable findings. Statistical data found no significant differences between deaf and hearing participant groups across four variables of Control, Internal Decisions, External Manifestations, and Potential Maximization. As such, this study's deaf and hearing participants shared similar psychosocial attributes, and tactics to maximize their potential. Qualitative data further revealed that deaf participants maximized their potential using two types of proactive psychosocial attributes and tactics: 1) skills that individuals with typical hearing use to socially participate combined with 2) specialized skills for identifying, circumventing, or mastering deafness-related difficulties. These attributes and tactics were uncovered using Reiff et al.'s (1995) framework, which can further be used to frame previously unpublished findings from my study (Jacobs, 2009). As such, the coming analyses of case studies may provide greater clarity of expert performance that is the proactive use of specialized psychosocial skills by deaf people.

8. Case studies

Investigating outliers of a professionally successful participant sample offers an interesting insight when considering their use of psychosocial skills. In order to better understand proactive deafness-specific tactic knowledge, the scores of the 49 participants were scrutinized and the highest and lowest scoring participants for Potential Maximization (the overall score) were selected as case studies. These participants included two deaf Anglo-Saxon males and who both used spoken language to communicate. The highest scorer was Anthony[1], an American dentist in his early forties from New York. The lowest scorer was Jason, an Australian public servant in his late thirties from Canberra. English was their parents' and their own first language. Neither participant had experienced more than one year's unemployment or had an additional disability. It is prudent to note that both participants considered themselves as maximizing their potential as defined by a preliminary survey item. Both participants were also professionally successful, meaning they were two high functioning deaf individuals.

Deaf from birth, Anthony reported profound bilateral deafness, had a CI, and regarded himself as a "master" speech reader. He had attended a School for the Deaf in which the primary means of communication was spoken language. His highest educational qualification was unspecified. He learnt SL at 19 years old, and was a continued and fluent signer. He did not, however, nominate himself as Culturally Deaf or feel that his life would be better with greater Deaf community involvement. His reason was: "I have greater stimulation and more interests in the hearing world … the Deaf community/culture limits me, narrows my interests." Cultural Deafness indicates that the deaf individual self-identifies as belonging to a community of Deaf people who share the commonalities of 1) deafness, 2) a similar language (e.g., ASL, etc.), 3) often a similar education in a segregated specialist education setting for deaf students, and 4) a shared cultural and social history

[1] Pseudonyms are used for both participants.

(Davis, L.J., 1995). In short, the Deaf community has a biological, linguistic, and cultural uniqueness that defines it as a legitimate social minority. However, the majority of deaf people do not self-identify as being culturally Deaf largely due to their having no association with this community or use of SL (Access Economics, 2006).

Jason wore hearing aids and reported moderate bilateral deafness. All deaf participants in the study reported a greater severity of deafness than he. He did not specify when his deafness occurred, or whether it was gradual or sudden. Qualitative data, however, suggested that he likely lost his hearing in adulthood. Jason had attained a Masters degree. He reported no Deaf community involvement and had not learnt SL. He did, nonetheless, agree that his life would be better with greater Deaf community involvement.

From here we can look at the two participants' responses to select survey items that were guided by deafness-related studies grouped according to Reiff et al.'s (1995) framework (Jacobs, 2010). The following three tables summarize responses according the three thematic categories of Control, Internal Decisions, and External Manifestations. The purpose of such analysis is to provide a contrast effect whereby responses to survey items can illustrate trends. Table 2 summarizes the responses of the two participants for items related to Control.

	Anthony	**Jason**
Control		
I am in control of my work and social life	Strongly agree	Disagree
Adulthood is easier for me than childhood	Strongly agree	Disagree
My life is miserable because of deafness	Strongly disagree	Agree
Summary of deaf person who has maximized their potential	Numerous actual attributes and tactics	"John Howard"
I have overcome the challenges of my deafness	Yes	No

Table 2. Comparisons of Anthony's and Jason's distinctive responses to items: Control

The two participants' responses to five Control items reveal some interesting insights. Anthony strongly agreed and Jason disagreed that he felt in control of both his work and social life, and also that adulthood was easier than childhood. Anthony also strongly disagreed but Jason agreed that his life is miserable because of his deafness. In addition, and interestingly, Jason simply wrote the former Australian Prime Minister "John Howard" when summarizing a deaf person maximizing their potential with hearing peers. For the same item, Anthony elaborated that such a deaf person has attributes such as acknowledging deafness-related challenges and the quickness "to formulate ways to get around the problem" by using tactics such as providing an email address or a SMS number and not "a voice phone number, and explaining it is the preferred way to contact the deaf person, etc." Anthony further agreed that he had overcome the challenges of his deafness,

whereas Jason did not. Jason cited "practical, technical and aesthetic difficulties with needing to use hearing aids" as his reasons. Anthony, however, mentioned specific deafness-related social strategies: "I always let the other person know that I am deaf and lip-read, and need the other person to face me while speaking. I also ask for clarification, repetition, rephrasing when I do not understand a particular word." Summarized, Jason's responses suggest that being deaf has rendered him without a sense of control of his life. Anthony, by contrast, appears use deafness-specific tactic knowledge and to be in control of his destiny.

Table 3 shows the two participants' different answers to the items associated with the thematic codes of Internal Decisions: Desire, Goal Orientation, and Reframing.

	Anthony	**Jason**
Desire		
Successful people seem to be lucky	Strongly disagree	Agree
Negative childhood experiences made me try harder	Strongly agree	Disagree
Goal Orientation		
I am a risk taker	Strongly agree	Disagree
Reframing		
I am proud of the skills I use to maximize potential with hearing peers	Strongly agree	Disagree
Dealing with deafness has made me a better person	Agree	Disagree

Table 3. Comparisons of Anthony's and Jason's distinctive responses to items: Internal Decisions

Both participants had different responses to two Desire items. Anthony strongly disagreed and Jason agreed that successful people seem lucky. This is perhaps understandable considering that Anthony responses to other items suggested his greater use of purpose-driven tactics that Jason appeared not to possess, let alone be able to use. Anthony also strongly agreed and Jason disagreed that negative childhood experiences made him try harder. Different responses to this item may be related to Jason not being deaf in childhood whereas Anthony was. Jason's response may also illustrate the difficulty of adjusting to the onset of deafness in adulthood.

Responses to a Goal Orientation item saw Anthony strongly agree and Jason disagree that he was a risk-taker. Jason believed he would be in "the same place, vocationally, socially, physically" in five years time, and wrote "Nil" as strategies he would use. In contrast, Anthony stated "I want to finish off my 115 North East 4000' mountains." He also explained the importance of continuing a balanced life while working hard, and "not dwelling on failure" as strategies he will use. While not disability-specific, Anthony's response expresses comparatively greater exploration – a key prerequisite for the acquisition of tactic knowledge (Sternberg, 2003) – than does Jason's response.

Two Reframing items received different responses. First, Anthony strongly agreed and Jason disagreed that he was proud of the skills he used to maximize his potential with hearing peers. Anthony also agreed and Jason disagreed that dealing with deafness had made him a better person. Jason wrote that he would be "more vocationally and socially successful" if not deaf. Anthony believed he would have been "more of a product of my parents' influence ... Mine was more on my own … I think I would have done just great no matter if I were deaf or hearing." Anthony therefore appears to have reframed negative connotations related to deafness as positives whereas Jason has not.

Table 4 shows the two participants' different answers to the items associated with the thematic codes of External Manifestations: Persistence, Goodness of Fit, Learned Creativity, and Social Ecologies.

	Anthony	**Jason**
Persistence		
The process of self-determinism helps me to be more self-determined	Strongly agree	Disagree
Mastering speech-reading requires practice	Strongly agree	Disagree
Goodness of Fit		
I have chosen employment where my deafness is not a problem	Agree	Disagree
I have made life choices that suit my strengths	Focused on strengths from childhood; chose dentistry because less emphasis on hearing	Misunderstood concept
Learned Creativity		
Text-based telecommunications have put me on a 'level playing field' with hearing people	Strongly agree	Disagree
Captioned TV/DVD has improved my social skills	Can make out irony, sarcasm, jokes which helped him with social interaction	"No relationship between watching captions and socialising"
Social Ecologies		
I have had a close hearing friend throughout adulthood	Yes	No
I am sociable with hearing peers	Strongly agree	Disagree

Table 4. Comparisons of Anthony's and Jason's distinctive responses to items: External Manifestations.

Answers to two Persistence items saw Anthony strongly agree and Jason disagree that the process of self-determination helped him learn to be more self determining, and that mastering speech-reading requires continual practice. Jason believed that "self-determination is a trait developed in upbringing through good parenting, social interaction, and personal value. Difficult to develop later in life." This response may allude to the difficulty of acquiring and understanding deafness-specific tactic knowledge – especially without expert instruction. Anthony, however, gave three examples whereby learning to drive, doing taxes, and buying a house require proportionately greater degrees of self-determinism because each require exponentially more complex processes. As such, he identifies a key aspect of tactic knowledge being exponentially related to experience (Sternberg, 2003).

Different responses to a Goodness of Fit item saw Anthony agree and Jason disagree that he had chosen employment whereby deafness is not a problem. Both Jason and Anthony agreed he had made lifestyle choices that suited his strengths. A difference, however, was in the participants' understanding of the concept. Jason simply stated: "Academic and vocational choices and interests", which do not define the active engagement in social or professional settings in which success is likely. In contrast, Anthony provided a 152 word justification that began with "I analyzed my strengths in early childhood and realized that I would have to capitalize on my strengths to be used in a career that did not require hearing skills." Anthony thereafter mentioned that he ignored the advice of "well meaning teachers" who discouraged him to pursue a dentistry career. Now a dentist of 20 years, and having achieved a goodness of fit with personal interests and strengths, Anthony concluded "I look back and think 'what if I were more naïve and allowed my teachers to decide my future job for me?'"

Responses to two Learned Creativity items were different. Anthony strongly agreed and Jason disagreed that text-based telecommunications (e.g., email, sms, online chat) placed him on a 'level playing field with hearing peers' and that watching captioned DVDs and television programs had improved his social skills. Jason did not perceive text-based telecommunications as an aid for connecting with others when stating "Hearing remains a critical element in vocational and social situations." Anthony, however, wrote that he appreciated the greater ease of social contact through range of text-based telecommunication that was unavailable in his younger years. Jason additionally saw "No relationship between watching captions and socialising", whereas Anthony stated that watching captioned TV/DVD assisted his social development. Captioned TV/DVD bypasses the auditory challenge whereby subtitled dialogue can be read by the deaf person when watching a program. Anthony explained that he "was able to make out irony in spoken lines … and understand how a particular line was inflected and 'read between the lines' if a character was being sarcastic, flippant or joking, or merely making a statement, which I couldn't hear in spoken language." As such, he has creatively learned social nuances and strategies that he can use in face-to-face interaction. Again, we see Anthony's greater understanding of deafness-specific tactic knowledge.

Two Social Ecologies items received different answers. First, Anthony had close hearing friends throughout his adulthood but Jason had not. Second, Anthony strongly agreed and Jason disagreed that he was sociable with hearing peers. Anthony mentioned that his friends helped him integrate by acting as a 'sounding board' for social situations and by

answering hypothetical questions such as "what would you do if this happened to you?" This seems to be an effective strategy to gain tactic knowledge that his deafness may otherwise prevent him from gaining. However, Jason's apparent lack of social interaction and support is perhaps unsurprising given his responses to other items.

9. Deafness-specific tactic knowledge and expert performance

The case studies illustrate three important findings. First, Reiff et al.'s (1995) framework can be applied across disabilities from a LD to a deafness context. Second, the framework is a useful tool for identifying proactive psychosocial attributes and tactics in deaf participants. Third, the case studies suggest that certain deaf individuals have more deafness-related tactic knowledge than do others. Anthony's survey responses differed greatly to Jason's - both quantitatively and qualitatively. Anthony clearly appeared to be maximizing his psychosocial potential more so than Jason. Compared with Jason, Anthony displayed consistently a greater range of psychosocial skills specific to identifying, circumventing, and mastering deafness-related social and professional challenges. A key to this trend can be found in the relative pessimism and helplessness that Jason reported compared with Anthony's optimism and resourcefulness – which are telling indicators of their mental health.

Jason became deaf in adulthood whereas Anthony had been deaf since birth. Studies report that the later the onset of deafness the poorer was the participants' psychosocial adjustment (de Graaf & Bijl, 2002; Polat, 2003). Anthony has had many more years experience with challenges associated with deafness than has Jason, and therefore much more time in which to practise deafness-specific proactive psychosocial skills. Anthony's deafness-specific expertise has likely been honed through more intense practice and application – the stimulus of acquired learning and adaptation through social exposure. Jason's evident self-seclusion and introversion may also impair his acquisition of deafness-specific tactic knowledge. The onset of deafness in adulthood particularly impacts on real-time communication, which - by extension - can devastate the individual's social, professional, and romantic standings (Hogan, 2001). The onset of deafness also confronts individuals with the need to acquire esoteric deafness-specific psychosocial skills – or tactic knowledge - they had no need to practise prior to the onset of their deafness. More dauntingly, late deafened individuals typically learn the esoteric skills by trial and error without expert tuition. The ramifications for the individual's mental wellbeing are therefore likely to be negative, if not traumatic.

Interestingly, Anthony attended a school for the deaf, which means he likely had access to specialist teaching and also other people (i.e., his classmates) whom have an experience of deafness. That early and continuous social exposure may have resulted in the sharing of esoteric deafness-specific knowledge that stood him good stead into his middle age. Jason's desired contact with the Deaf community also may reflect his desire for peer support and, perhaps, access to tuition of deafness-specific psychosocial skills.

10. Conclusion

This chapter emphasized that deaf individuals require deafness-specific tactic knowledge to achieve a healthy mental wellbeing, and quality social and professional participation. The

case studies indicate that deaf individuals require two forms of intelligence to maximize their potential: 1) psychosocial skills expected of the common person in addition to 2) psychosocial skills specific to identifying, circumventing, and mastering deafness-related social challenges. Effective use of pragmatics is an example of psychosocial skills expected of the common person. Knowing the value of watching captioned TV/DVD to understand how social interaction may occur is one example of deafness-specific tactic knowledge. Given their inordinate cognitive, professional, and social challenges, the concept of having to master and to use two types of intelligences makes the feat of human endeavor in successful deaf people remarkable. The case studies further indicate that deafness-specific tactic knowledge is learned just like any other specialized skill. Many years of deliberate practice leads to expert performance in the form of attaining, maintaining, and sustaining quality of life. But if this practice is forfeited, denied, or is of a continuous poor quality, the limitations of deafness may cast a stronghold on the individual's ability to actualize their potential.

The deaf individual's sustained daily efforts to maximize their potential, or quality of life, is the outcome of their mostly unseen psychological processes. In the research of expert performance, this is known as the 'iceberg illusion'; we observe simply an individual's performance - their externalized behavior when interacting with us - which is the metaphorical iceberg's tip (Ericsson & Simon, 1984). Hidden is the submerged evidence of their performance, or direct behavior toward us - the outcome of their cognitive process, or numerous processes, operating concurrently. This unseen quality of human performance may explain why a person without a disability may have difficulty understanding or empathizing with disability-specific psychosocial strategies. They themselves do not use these skills nor contend with disability-related challenges – daily for a lifetime. This issue is of vital importance when considering many, if not most, significant others in a deaf person's life – family, friends, and partners, as well as strangers and acquaintances - are typically not deaf themselves. The same can be said of deafness-related researchers and service providers. A deaf individual's sophisticated hard-earned cognitions and efforts can easily be discounted or overlooked.

According to Gladwell (2009), *opportunity* is the crucial twin to *practice* for potential to be fully maximized. Opportunity consists of a coalition of external factors necessary for the nurturing of an individual's potential. Examples are the accommodations made by parents and the educational system being important factors for optimal psychosocial functioning whether the deaf child had a CI or not (Leigh et al., 2009). While an absolute necessity for potential maximization, the provision of opportunity - commonly worded as providing 'access' in the disability literature - can have a flaw. It can assume that access – in the form of services or improved hearing technology - will translate instantly into participation for the individual. Much, however, is dependent on the quality of service provision or social interaction *when access is gained*. For example, access to a psychologist – an expert in their own right – may be a futile venture for a deaf client if the psychologist knows nothing of the specialized psychosocial skills for identifying, circumventing, or mastering deafness-related challenges (Jacobs, 2007). Without adequate support, deaf children can be vulnerable to isolation within their own families or schools and be deemed 'problem children' (Fellinger et al., 2005). People who become deaf in adulthood can face a similar predicament in the workplace, and in their social and romantic endeavors. Quality of service provision is

therefore vital. Without sufficient psychosocial tuition, deaf people and families with deaf children may encounter needless adversity.

Disability-specific expert performance may today seem an improbable concept. Consider, however, that the English scholar Roger Bacon argued in the thirteenth century that a human required at least thirty years of study to master the mathematics as was then understood (Colvin, 2010). Today, Colvin reminds us, almost every college student has mastered the mathematics Bacon described. Innate human talent has not changed. Rather, the understandings of techniques that foster human potential have considerably improved. Training systems, our education, have become smarter and more efficient to produce mastery in shorter time. Similarly, we may currently assume that the proactive deafness-specific skills that deaf people use to maximize their potential are so random as to be without possible underlying order. As the research presented here and that of Reiff et al. (1995) attest to, the complex and seemingly random psychosocial skills specific to successfully dealing with a disability can be codified as a systematic and comprehensive framework.

Purposefully seeking to understand strength-based psychosocial attributes and tactics in deaf people is in alignment with the scientific study of the healthy personality and also expert performance. Future research with deaf adults who are achieving social and professional success and quality of life is therefore strongly encouraged. The investigation of positive behaviour offers a richer understanding of human psychology and, importantly, has a prescriptive quality that can be applied to practice. The effect will likely be twofold: we gain a deeper understanding of human potential regarding deafness and we will be able to provide more effective prescriptive measures not yet in practice. Identifying and then cataloguing proactive deafness-specific psychosocial skills may provide additional knowledge to existing programs (e.g., Hetu & Getty, 1991; Heydebrand et al., 2005; Hogan, 2001). Given the seriousness of the social, professional, and psychological challenges reported in the literature, it is also essential that these programs be made widely available in deafness-related education, service delivery, and rehabilitation. The desired outcome: greater social and professional participation, and a healthier mental wellbeing for individuals living with deafness.

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12. About the author

Dr Jacobs graduated with a PhD in Education from the University of Melbourne in 2009. He is the author of *Neither-Nor: A young Australian's experience of deafness,* which portrays the social and romantic challenges of being a deaf person who is neither fully hearing nor has a cultural Deaf identity. He also wrote the award winning column *Psychosocial Potential*

Maximization for the *Volta Voices*. Written for parents of deaf children, it defines everyday deafness-specific life skills according to the framework outlined in this book chapter. He is currently designing an education program of deafness-specific tactic knowledge. His contact is neithernor74@yahoo.com.au.

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16

Environmental Chemical Substances in Relation to Neurodevelopmental Disorders: A Systematic Literature Review

Hideko Sone, Tin-Tin Win-Shwe, Xian-Yang Qin,
Hiromi Akanuma and Satoshi Imanishi
National Institute for Environmental Studies
Japan

1. Introduction

Since the 1950s-70s, increasing number of regulations have rapidly expanded for the global usage of industrial, agricultural and other environmental chemical substances (ECSs). It is believed that children are at high risk of exposure to ECSs, which are produced in quantities greater than one million tons per year and widely dispersed in air, water, food crops, communities, waste sites and homes (Landrigan et al. 2006). Prevalence rates of many common diseases in children, including certain childhood cancers (Devesa et al. 1995; Robison et al. 1995; Schechter 1999; Supriyadi et al. 2011), birth defects (Ananth et al. 2005; Gilboa et al. 2010) and neurodevelopmental disorders (Malik et al. 2011), have been increased or maintained at high levels in industrialized countries. Although primary etiologic factors contributing to these diseases are unknown yet, accumulating evidences indicate that exposure to ECSs are partially responsible for the developmental disabilities, such as autism spectrum disorders (ASDs), attention deficit hyperactivity disorder (ADHD), and other developmental delays (Boyle et al. 2011; Larson et al. 2001) (Figure 1). In this chapter, we conducted a systematic literature review for neurotoxic agents in environment to elucidate the relationship between exposure to ECSs and neurodevelopment disorders in children.

2. Exposure to ECSs and neurodevelopmental disorders in children

According to the Fourth National Report on Human Exposure to Environmental Chemicals (Fourth Report), 212 ECSs were detected in the urine and blood samples from the civilian, noninstitutionalized U.S. population (CDC 2009). Therefore, we searched literatures for these 212 ECSs with keywords of "learning disabilities", "developmental delay" and "autism" by PubMed (http://www.ncbi.nlm.nih.gov/pubmed), and then a total of 1075 literatures were selected published during 1972 - 2011 July. These ECSs were categorized by their chemical features in this review (Table 1). Neurodevelopmental disorders in children are disabilities associated primarily with the functionings of the neurological system and brain, which include ADHD, ASDs, mental retardation (MR) and learning disabilities (LD). It has been known that children with neurodevelopmental disorders experience problems

with language and speech, motor skills, behavior, memory, learning, or other neurological functions. Therefore, we further selected important papers by the review of the keywords, such as children, exposure, neurobehavioral, neurotoxicity, neuropsychological, disabilities, cognitive, development, behavior and school-aged for human study and learning memory, exposure, neurobehavioral, neurodegeneration, neurogenesis, neuropathological, neurotoxicity, impairments, deficits, behavior, hippocampus, developmental, cognitive, disorders, receptors and model for animal studies. Here, a total of 142 literatures for human study (Table 2) and 168 literatures for animal experiments were listed (Table 3).

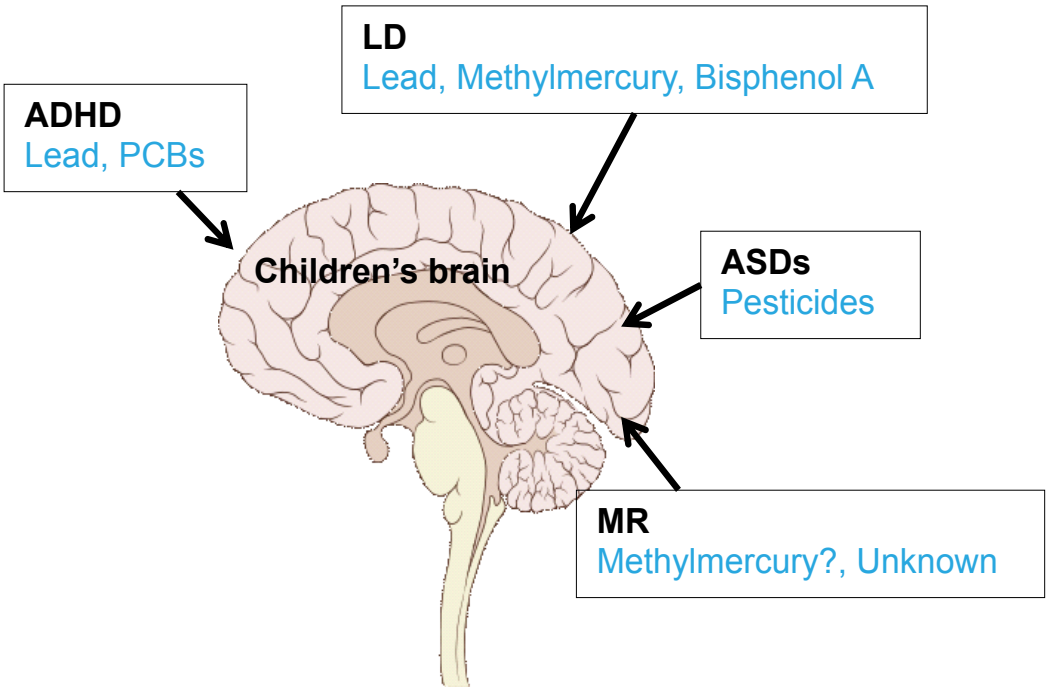

Fig. 1. Relationship between ECSs and neurodevelopmental disorders in children. ADHD: attention deficit hyperactivity disorder, LD: learning disability, ASDs: autism spectrum disorders, MR: mental retardation.

Categories	Chemical substances
Metals	Antimony, Arsenic, Dimethylarsinic Acid, Monomethylarsonic Acid, Trimethylarsine oxide, Barium, Beryllium, Cadmium, Cobalt, Lead, Mercury, Molybdenum, Platinum, Thallium, Tungsten, Uranium
Particulate matters and smoke	
Particulate matters	PM10, PM2.5, Carbon monoxide (CO) Sulfur dioxide (SO2), Nitrogen oxides (NOx), Ozone (O3) , Asbestos
Smoking	Cotinine, NNAL(4-methylnitrosamino)-1-(3-pyridyl)-1-butanol)

Categories	Chemical substances
Agricultural related chemicals	
Herbicides and metabolites	Acetochlor mercapturate, Alachlor mercapturate, Atrazine mercapturate, 2,4-Dichlorophenoxyacetic acid, Metolachlor mercapturate, 2,4,5-Trichlorophenoxyacetic acid, N,N-Diethyl-meta -toluamide (DEET)
Insecticides and metabolites	Carbamates, Carbofuranphenol, 2-Isopropoxyphenol
Organochlorines and metabolites	Aldrin, o,p' -Dichlorodiphenyltrichloroethane, p,p' -Dichlorodiphenyltrichloroethane (DDT), p,p' -Dichlorodiphenyldichloroethene (DDE), Dieldrin, Endrin, Hexachlorobenzene, beta -Hexachlorocyclohexane, gamma-Hexachlorocyclohexane (Lindane), Heptachlor epoxide, Mirex, trans -Nonachlor, Oxychlordane, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol
Organophosphorus insecticides: dialkyl phosphate metabolites	Diethylphosphate (DEP), Dimethylphosphate (DMP), Diethylthiophosphate (DETP), Dimethylthiophosphate (DMTP), Diethyldithiophosphate (DEDTP), Dimethyldithiophosphate (DMDTP)
Organophosphorus insecticides: specific insecticides and metabolites	3-Chloro-7-hydroxy-4-methyl-2H-chromen-2-one/ol, 2-(Diethylamino)-6-methylpyrimidin-4-ol/one, 2-Isopropyl-4-methyl-6-hydroxypyrimidine, Malathion dicarboxylic acid, para -Nitrophenol, 3,5,6-Trichloro-2-pyridinol
Pyrethroid pesticide metabolites	cis -3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid, cis -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid, trans -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid, 4-Fluoro-3-phenoxybenzoic acid, 3-Phenoxybenzoic acid
Persistent organic pollutants	
Perfluorinated compounds	Perfluorobutane sulfonic acid (PFBuS), PFDeA, PFDoA, PFHpA, PFHxS, PFNA, PFOA, PFOS, PFOSA, Et-PFOSA-AcOH, Me-PFOSA-AcOH, PFUA
Polybrominated diphenyl ethers and polybrominated biphenyl	2,2',4-Tribromodiphenyl ether (BDE 17), BDE 28, BDE 47, 2BDE 66, BDE 85, BDE 99, BDE 100, BDE 153, BDE 154, BDE 183, 2,2',4,4',5,5'-Hexabromobiphenyl (BB 153)

Categories	Chemical substances
Polychlorinated biphenyls, non-dioxin-Like	PCB 28, PCB 44, PCB 49, PCB 52, PCB 66, PCB 74), 2,2',3,4,5'- PCB 87, PCB 99, PCB 101, PCB 110, PCB 128, PCB 138 , PCB158, PCB 146, PCB 149, PCB 151, PCB 153, PCB 170, PCB 172, PCB 177, PCB 178, 2,2',3,4,4',5,5'- PCB, 180 PCB 183, PCB 187, PCB 194, PCB 195, PCB 196, PCB 203, PCB 199, PCB 206, PCB 209
Dioxin-like polychlorinated Biphenyls	
Coplanar polychlorinated biphenyls	PCB 81, PCB 126, PCB 169
Mono-ortho-substituted polychlorinated biphenyls	PCB 105, PCB 118, PCB 156, PCB 157, PCB 167, PCB 189, 1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF), 1,2,3,4,7,8,9-
Polychlorinated dibenzofurans	HpCDF, HxCDF, HxCDF, HxCDF, HxCDF, OCDF, 1PeCDF, PeCDF, TCDF
Polychlorinated dibenzo-*p*-dioxins	2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD), HpCDD, HxCDD, HxCDD, HxCDD, OCDD, PeCDD,
Polycyclic aromatic hydrocarbon metabolites	2-Hydroxyfluorene, 3-Hydroxyfluorene, 9-Hydroxyfluorene, 1-Hydroxynaphthalene (1-Naphthol), 2-Hydroxynaphthalene (2-Naphthol), 1-Hydroxyphenanthrene, 2-Hydroxyphenanthrene, 3-Hydroxyphenanthrene, 4-Hydroxyphenanthrene, 1-Hydroxypyrene
Volatile organic compounds (VOCs)	Benzene, Chlorobenzene, 1,2-Dibromo-3-chloropropane, Dibromomethane, 1,2-Dichlorobenzene, m-Dichlorobenzene, Paradichlorobenzene, 1,1-Dichloroethane, Ethylene dichloride, Vinylidene chloride, cis -1,2-Dichloroethene, trans -1,2-Dichloroethene, Dichloromethane, 1,2-Dichloropropane, 2,5-Dimethylfuran, Ethylbenzene, Hexachloroethane, Methyl tert -butyl ether (MTBE), Nitrobenzene, Styrene, 1,1,2,2-Tetrachloroethane, Perchloroethylene, Carbon tetrachloride, Toluene, Methyl chloroform, 1,1,2-Trichloroethane, Trichloroethene Trichloroethylene, o -Xylene, m- and p –Xylene

Categories	Chemical substances
Hormones and environmental hormones (endocrine disrupting chemicals)	
Environmental phenols	Bisphenol A (2,2-bis [4-Hydroxyphenyl] propane), Benzophenone-3 (2-Hydroxy-4-methoxybenzophenone, 4-tert -Octylphenol (4-[1,1,3,3-Tetramethylbutyl] phenol) , Triclosan (2,4,4'-Trichloro-2'-hydroxyphenyl ether)
Phthalate metabolites	Mono-benzyl phthalate (MBzP), MiBP, MnBP, MCHP, MEP, MEHP, MEHHP, MEOHP, MECPP, MiNP, MMP, MCPP, MOP
Phytoestrogens and Metabolites	Daidzein, O-Desmethylangolensin, Enterodiol, Enterolactone, Equol, Genistein
Other combustion products and by-products	
Acrylamide Adducts	Acrylamide, glycidamide
Chloromethane related by-Products	Bromodichloromethane, dibromochloromethane (chlorodibromomethane), Tribromomethane (bromoform), Trichloromethane (chloroform)

Table 1. List of ECSs detected in human blood and urine that has been related with LD.

2.1 Association between ECSs exposure with LD

Studies have found that several widespread environmental contaminants can damage the children's developing brains and nervous systems. In our literature review, lead, methylmercury, pesticides, tobacco (cotinine), persistent organic pollutants such as polychlorinated biphenyls (PCBs), and environmental hormones such as bisphenol A and phthalates have been indicated association between neuronal disability and exposure levels in children (Table 3). For instances, prenatal tobacco and childhood lead exposures may be significant risk factors for ADHD, especially when individuals are exposed to both of these toxicants (Froehlich et al. 2009). Although the U.S. has made considerable strides in reducing these toxicant exposure, 15% of women reported smoking during pregnancy in the U.S. population-based study in 2004 (Allen et al. 2008), and an estimated 1.6% of U.S. children showed blood lead levels of concern (≥10 μg/dL) in 1999–2002, with almost 14% having levels of 5 to 9 μg/dL (CDC 2005). These findings suggest that reduction of toxicant exposure may be an important role for the preventions of ADHD as well as other neurodevelopmental disorders in children.

In addition, the accumulating evidences suggest a link between lead exposure and memory impairment. van Wijngaarden *et al.* (2009) conducted a pilot study of 47 healthy subjects aged 55-67 years to examine associations between bone lead levels and 4 tests sensitive to the natural history of Mild Cognitive Impairment (MCI) and Alzheimer's disease (AD), which included 3 subtests of the Cambridge Neuropsychological Test Automated Battery (delayed match-to-sample, paired associates learning and spatial recognition memory) and

the Montreal Cognitive Assessment Test. By measurements of bone lead concentrations, higher tibial and calcaneal bone lead values were significantly ($p<0.05$) associated with lower performance levels on delayed match-to-sample and paired associates learning in unadjusted analyses with Spearman rank correlation coefficients of about 0.4. Multiple linear regression analyses (i.e., least-squares means of cognitive test scores across tertiles of lead exposure) adjusted for age, education and smoking status continued to show an association of higher calcaneal lead levels with increasing memory impairments on delayed match-to-sample ($p=0.07$). As might be expected, additional adjustment for history of hypertension reduced the strength of this association ($p=0.19$). Given the demonstrated impact of lead exposure on hypertension and the vascular aetiology of certain dementias, authors speculated that hypertension could play a mediating role in the association between lead exposure and memory impairment.

Pesticides and their degradation products are ubiquitous in the environment. The most commonly detected indoor pesticides (organophosphates and pyrethroids), which are routinely applied in classrooms and playgrounds, are well-known neurotoxicants that affect the ability to learn and process information (Tulve et al. 2006). In our literature survey, Xu *et al.* (2011) examined the association between body burden of trichlorophenol (TCP) (ie, 2,4,5-TCP and 2,4,6-TCP) and ADHD by logistic regression analyses using data from the 1999–2004 National Health and Nutrition Examination Survey (NHANES) to evaluate the association between urinary TCPs and parent-reported ADHD among 2546 children aged 6–15 years. Their results showed that children with low levels (<3.58 μg/g) and high levels (≥3.58 μg/g) of urinary 2,4,6-TCP had a higher risk of parent-reported ADHD compared to children with levels below the limit of detection (OR 1.54, 95% CI 0.97 to 2.43 and OR 1.77, 95% CI 1.18 to 2.66, respectively; p for trend=0.006) after adjusting for covariates. No association was found between urinary 2,4,5-TCP and parent-reported ADHD. These results suggested that exposure to TCP may increase the risk of behavioural impairment in children, especially in countries where organochlorine pesticides are still commonly used. It also should be noted that Rauh *et al.* (2006) reported the impact of prenatal exposure to chlorpyrifos on 3-year neurodevelopment and behavior in city-residential minority 254 children. The report examined cognitive and motor development with the Bayley Scales of Infant Development II and child behavior with the Child Behavior Checklist and chlorpyrifos levels in umbilical cord plasma. Highly exposed children (chlorpyrifos levels of >6.17 pg/g plasma) scored, on average, 6.5 points lower on the Bayley Psychomotor Development Index and 3.3 points lower on the Bayley Mental Development Index at 3 years of age compared with those with lower levels of exposure. Children exposed to higher in compared with lower chlorpyrifos levels were also significantly more likely to experience Psychomotor Development Index and Mental Development Index delays, which are attention problems, ADHD problems, and pervasive developmental disorder problems at 3 years of age. The proportion of delayed children in the high-exposure group, compared with the low-exposure group, was 5 times greater for the Psychomotor Development Index and 2.4 times greater for the Mental Development Index.

It was also reported that children prenatally exposed to PCBs might be related with lowered intelligence and behavioral deficits. Relationships between adverse health effects and PCB exposure during infancy and childhood have been examined. Although some inconsistencies in the literature exist, the overall evidence supports a concern for adverse

effects of PCBs on children's neurological development. It should be noted that adverse effects on intelligence and behavior have been found in girls who were highly exposed to mixtures of PCBs, chlorinated dibenzofurans, and other pollutants prior to conception (Chen et al. 1992; Chen et al. 1994).

Chemicals	Study type/hazard effects	References
Arsenic	Encephalopathy: an uncommon manifestation of workplace arsenic poisoning?	Morton and Caron 1989
Arsenic	Neuropsychological impairment following inorganic arsenic exposure	Bolla-Wilson and Bleecker 1987
Cobalt	Hair element content in learning disabled children	Pihl and Parkes 1977
Cobalt	Evidence for interactions of lithium with vitamin B12 and with other trace elements	Schrauzer et al. 1992
Copper	Dose-effect relationships	Bowler et al. 2007
Copper	Hair mineral analysis and behavior: an analysis of 51 studies	Rimland and Larson 1983
Copper	Manganese inhibits NMDA receptor channel function: implications	Guilarte and Chen 2007
Copper	Poor cognitive development and abdominal pain: Wilson's disease	Gronlund et al. 2006
Copper, Zinc	Brain and behavior	Pfeiffer and Braverman 1982
Copper, mercury	School children	Capel et al. 1981
Lead, arsenic	Two metals, ADHD	Calderon et al. 2001
Lead	The Edinburgh Lead Study	Thomson et al. 1989
Lead	Cognition in children and very low lead exposure	Minder et al. 1998; Surkan et al. 2007
Lead, smoke	verbal memory, ADHD	Bleecker et al. 2005; Braun et al. 2006
Lead	Preschool children	Bellinger et al. 1987; Bellinger et al. 1991; Benetou-Marantidou et al. 1988; Fergusson et al. 1997; Jusko et al. 2008; McMichael et al. 1988; Mendelsohn et al. 1998; Rabinowitz et al. 1992; Stokes et al. 1998; (Schwartz et al. 2000; Ris et al. 2004; Shih et al. 2006; Schwartz et al. 2007; van Wijngaarden et al. 2009 ; Mahmoudian et al. 2009

Chemicals	Study type/hazard effects	References
Lead	School children (ADHD, learning disabilities)	Fergusson and Horwood 1993; Lyngbye et al. 1990; Tong et al. 1996; Tuthill 1996; Leviton et al. 1993; Minder et al. 1994; Buchanan et al. 1999; al-Saleh et al. 2001; Lanphear et al. 2005; McMichael et al. 1988; Canfield et al. 2003; Chiodo et al. 2007; Counter et al. 2008; Nigg et al. 2008; Schnaas et al. 2006; Wang et al. 2002; Wang et al. 2008; Kim et al. 2010
Lead, mercury, PCB	Children study three chemicals	Stewart et al. 2006
Mercury	infant immunizations	Redwood et al. 2001
Mercury	Children study	Grandjean et al. 1997; Schettler 2001; Counter et al. 2005; Johansson et al. 2007; Dufault et al. 2009; Valent et al. 2011
Mercury	Adult exposure	Yokoo et al. 2003
Mercury	Workers	Piikivi and Hanninen 1989; Counter et al. 2005
Molybdenum	A case report	Momcilovic 1999
Phosphorus-31 magnetic	Children study	Moss et al. 1997
Carbon monoxide	Children study	Binder and Roberts 1980
Carbon monoxide	Workers	Deschamps et al. 2003; Katirci et al. 2011
Cotinine	Adult Patients study	Smith et al. 2009
Smoking	Children study	Marshall et al. 1995; Robertson and Jackson 1996 Lassen and Oei 1998; Rowland et al. 2002; Batstra et al. 2003; Najman et al. 2004; O'Brien et al. 2004; Matsumoto et al. 2005; Uzun and Kendirli 2005b; Kukla et al. 2008; Petry et al. 2008; Kargoshaie et al. 2009; Anderko et al. 2010; DeGarmo et al. 2010; Freire et al. 2010; O'Callaghan et al. 2010
Smoking	Adolescent student study	Ivanovic et al. 2000; Molina and Pelham 2001; Kalyva 2007; Keselyak et al. 2007; Wang et al. 2009b
Pesticide	A case study.	Reidy et al. 1994
Pesticide	Children study	Stephens et al. 1995; Schettler 2001; Kofman et al. 2006; Rauh et al. 2006; Xu et al. 2011
Pesticide	Workers	Srivastava et al. 2000

Chemicals	Study type/hazard effects	References
DDT	Children study	Christenson et al. 2001; Griffin et al. 1993; Aase et al. 2006; Christenson et al. 1991; Dorner and Plagemann 2002; Sharma et al. 2009
Dioxin	Children study	van den Hazel et al. 2006; Lee et al. 2007
Formaldehyde	Children study	Madrid et al. 2008
Formaldehyde	Workers	LoSasso et al. 2001
PCBs	Children study	Chen et al. 1992; Chen et al. 1994; Roegge and Schantz 2006; Lin et al. 2010
Polyaromatic hydrocarbon	Children study	Sheng et al. 2010
Polychlorinated biphenyl	Children study	Sandberg et al. 2003; Lin et al. 2008
Polycyclic aromatic hydrocarbon	Children study	Walhovd et al. 2007; Bandstra et al. 2010; van Elderen et al. 2010
Phenol	Children study	Gross et al. 1987; Hertz-Picciotto et al. 2011
Industrial solvents	Children study	Uzun and Kendirli 2005a; Dick et al. 2010
Industrial solvents	Workers	Hanninen et al. 1976; Ryan et al. 1988; Moen et al. 1990; Morrow et al. 1992; Stollery and Flindt 1988; Bowler et al. 2001; LoSasso et al. 2001; Morrow et al. 2001; LoSasso et al. 2002

Table 2. Literature lists for the hazard effects of ECSs on human memory and cognition.

2.2 Possible mechanism of ECSs-induced autism and developmental delay

As above mentioned, several ECSs have been related with developmental delay such as ADHD and LD in human studies. However, little is known about the underlying mechanism by which ECSs could induce developmental delay. Animal experiments and *in vitro* studies using cells are useful to elucidate these kinds of mechanisms and understand the results of human studies. Animal studies listed in Table 3 indicate that most attentions have been focused on lead, mercury, pesticides and polycyclic aromatic hydrocarbons (PAHs). For example, toxic properties of lead have been attributed to its capability to mimic calcium and alter calcium homeostasis. One of the reasons for the deleterious effects of lead is its ability to strongly bind to sulfhydryl groups of proteins and to mimic or compete with calcium (Flora et al. 2007). It is known that lead, even at picomolar concentration, competes with calcium for binding sites on cerebellar phosphokinase C, thereby affecting neuronal signaling and neurotransmitter release (Bressler and Goldstein 1991), inhibiting calcium entry into cells (Simons 1993). Lead disrupts mitochondrial calcium homeostasis, intercellular oxidants levels, ATP production, and apoptogenic factors.

Rats in the benzo(a)pyrene (B(a)P) -treated groups have significantly impaired Morris water maze performance when compared to controls (Chengzhi et al. 2011). The B(a)P-induced neuronal damage was found in the hippocampus under transmission electron microscopy. Their results demonstrated that LM deficits associated protein expression signatures could be identified from tissue proteomes, as well as potential biomarkers such as retinoic acid receptor b (RARb), synaptotagmin iosfomrs 1 (Syt1) and brain-derived neurotrophic factor (BDNF). This finding is the first time that multiple novel proteins that are dysregulated by B(a)P, which both enhance our understanding of B(a)P induced locomotor deficits and represent targets of novel therapeutics. Prenatal morphine can alter the synaptic complex of postsynaptic density 95 with N-methyl-D-aspartate receptor subunit in hippocampal CA1 subregion of rat offspring leading to long-term cognitive deficits (Lin et al. 2009). This morphine model might be useful for understanding mechanisms of long-term cognitive deficit induced by other ECSs such as lead and PCBs.

Originally, organophosphate pesticides (OPs) have been thought to exert their effects on brain development secondarily by their ability to inhibit cholinesterase. However, it became now clear that these agents act as developmental neurotoxicants through a number of differential mechanisms. Some of which operate at exposures below the threshold for cholinesterase inhibition may differ in their effects on brain development and their consequent impacts on behavioral performance (Paul et al. 1994; Cohn and MacPhail 1997; Itoh et al. 1997a, 1997b; Palumbo et al. 2001; Castillo et al. 2002; Levin et al. 2002; Aldridge et al. 2005; Spowart-Manning and van der Staay 2005; Timofeeva, 2008; Verma et al. 2009; Levin et al. 2010). A series of studies with toxico-dynamically equivalent exposures in neonatal rats showed that chlorpyrifos, diazinon and parathion (PRT) elicit behavioral abnormalities in association with adverse effects on acetylcholine (ACh) and serotonin (5HT) circuits, but that the underlying defects and behavioral outcomes differ among the three OPs. In particular, PRT exposure did not elicit the cognitive impairment noted with the other two OPs, as evaluated in the radial-arm maze in adolescence and young adulthood, although, it did share adverse effects on indices of ACh synaptic function.

Chemicals	Animal Species	Models and experimental types	References
Arsenic	mice	Behavioral analysis	Miyagawa et al. 2007
Arsenic	mice	Mechanistic study	Martinez-Finley et al. 2009
Arsenic	rats	Developmental exposure and behavioral analysis	Rodriguez et al. 2002
Arsenic	rats	Mechanistic study	Rodriguez et al. 2001
Aluminium-maltolate complex	mice	Mechanistic study	Kaneko et al. 2006
Aluminum	rats	Mechanistic study	Sethi et al. 2009
Aluminum	rats	Aluminum-induced memory deficit model rats	Gong et al. 2006
Copper	mice	Behavioral analysis in Alzheimer's disease models	Grossi et al. 2009

Chemicals	Animal Species	Models and experimental types	References
Copper	mice	Indicator in the Alzheimer's disease model	Fisher et al. 1991; Quinn et al. 2010
Copper	mice	Mechanistic study	Lu et al. 2006; Lu et al. 2009
Copper	hamster	Mechanistic study	Bareggi et al. 2009
Copper	rats	Mechanistic study	Obernier et al. 2002; Begum et al. 2008
Copper	rats	Competition with zinc	Railey et al. 2010
Copper	rabbit	Mechanistic study	Sparks and Schreurs 2003
Copper	rabbit	Indicator in the Alzheimer's disease model	Woodruff-Pak et al. 2007
Cobalt	rats	Mechanistic study	Nerobkova and Voronina 1988
Lead	mice	Mechanistic study	Gao et al. 2005; Railey et al. 2011
Lead	mice	Developmental exposure and behavioral analysis	Garavan et al. 2000
Lead	rats	Mechanistic study	Alkondon et al. 1990; Adhami et al. 2000 Zhang et al. 2002; Garcia-Arenas et al. 2004; Vazquez and Pena de Ortiz 2004; Haider et al. 2005; Flora et al. 2007
Lead	rats	Developmental exposure and behavioral analysis	Kumar and Desiraju 1992; Altmann et al. 1993; Yang et al. 2003
Lead	rats	Behavioral analysis	Tang et al. 1994; Fan et al. 2009
Mercury	mice	Prenatal exposure and Behavioral analysis	Montgomery et al. 2008
Mercury	mice	Developmental exposure and behavioral analysis	Yoshida et al. 2005; Eddins et al. 2008
Mercury	rats	Mechanistic study	Vicente et al. 2004
Mercury	rats	Developmental exposure and behavioral analysis	Sakamoto et al. 2002; Falluel-Morel et al. 2007
Mercury	rats	Dose-dependent study of Developmental exposure	Sakamoto et al. 2004
Mercury	monkey	Developmental exposure and behavioral analysis	Hellberg 1972
Uranium	rats	Behavioral analysis	Albina et al. 2005; Houpert et al. 2007
Uranium	rats	Developmental exposure and behavioral analysis	Sanchez et al. 2006
Vanadium	mice	Mechanistic study	Han et al. 2008
Vanadium	mice	Behavioral analysis	Avila-Costa et al. 2006
Vanadium	rats	Mechanistic study	Mao et al. 2008
Carbon monoxide	mice	Behavioral analysis	Meunier et al. 2006

Chemicals	Animal Species	Models and experimental types	References
Carbon monoxide	rats	Mechanistic study	Thom et al. 2004
Carbon monoxide	rats	Mechanistic study and Behavioral analysis	Han et al. 2007; Wang et al. 2009a
Nitrogen oxide	mice	Mechanistic study and Behavioral analysis	Reddy and Kulkarni 1998; Palumbo et al. 2007
Nitrogen oxide	rats	Mechanistic study and Behavioral analysis	Jevtovic-Todorovic et al. 2003; Kumar and Kumar 2009; Comin et al. 2010
Nitrogen oxide	rats	Behavioral analysis	Paul et al. 2003
NNAL(4-methylnitrosamino)-1-(3-pyridyl)-1-butanol)	hamster	Use of precision-cut tissue s Behavioral analysis	Richter et al. 2000
Ozone	rats	Mechanistic study and Behavioral analysis	Guerrero et al. 1999
Smoking	mice	Behavioral analysis	Paz et al. 2007
Smoking	rats	Mechanistic study	Liang et al. 2006
Smoking	rats	Developmental exposure and behavioral analysis	Levin et al. 1996
Pesticide	mice	Gufosinate-ammonium	Calas et al. 2008
Pesticide	mice	Organophosphates	Billauer-Haimovitch et al. 2009; Post et al. 2011
Pesticide	mice	quaternary ammonium herbicide	Chen et al. 2010
Pesticide	rats	Aconitine Mechanistic study	Curzon et al. 2006
Pyrethroid	rats	Pyrethroid behavioral analysis	Sinha et al. 2006
Pesticide	rats	Organophosphates	Cohn and MacPhail 1997; Paul et al. 1994 Itoh et al. 1997a; Itoh et al. 1997b; Palumbo et al. 2001; Castillo et al. 2002; Levin et al. 2002; Aldridge et al. 2005; Spowart-Manning and van der Staay 2005; Timofeeva, 2008; Verma et al. 2009; Levin et al. 2010
Pesticide	rats	Clozapine	Levin et al. 2009
Pesticide	rats	Vinclozolin fungicide	Andre, 2006
Pesticide	rats	DEET	Abdel-Rahman, 2004
Dioxin	mice	Mechanistic study	Akahoshi, 2009

Chemicals	Animal Species	Models and experimental types	References
Dioxin	rats	Mechanistic study	Marcus, 2005
Formaldehyde	mice	Mechanistic study	Tong et al. 2011
Formaldehyde	rats	Mechanistic study	Aslan, 2006; Liu, 2010
Hexachloro-Benzene	rats	Behavioral analysis	Valkusz, 2011
PCB	rats	Developmental exposure and behavioral analysis	Piedrafita, 2008; Boix, 2010 ; Jolous-Jamshidi et al. 2010
PCB	fishes	Behavioral analysis	Schantz, 2001
PFOS	mice	Developmental exposure and behavioral analysis	Johansson et al. 2008
Polycyclic aromatic hydrocarbon	mice	ADHD model	Fredriksson and Archer 2004
Polycyclic aromatic hydrocarbon	mice	Behavioral analysis Down syndrome model	Rueda et al. 2008
Polycyclic aromatic hydrocarbon	rats	ADHD model	Chengzhi et al. 2011; Lin et al. 2009; Nishio et al. 2001
Polycyclic aromatic hydrocarbon	rats	Behavioral analysis	Sun, 2005; Fedotova and Ordyan 2010
Polycyclic aromatic hydrocarbon	rats	Developmental exposure and behavioral analysis	Benetti, 2009
Polycyclic aromatic hydrocarbon	rats	Adult behavioral analysis	Revest, 2009
Trimethyltin	mice	Mechanistic study	Dey et al. 1997; Maurice et al. 1999; Kassed, 2002 ; Kim, 2007
Trimethyltin	rats	Behavioral analysis	Cohn and MacPhail 1996
Trimethyltin	rats	Mechanistic study	Oconnell et al. 1994; OConnell et al. 1996 Tsutsumi, 2002
Bisphenol	mice	Developmental exposure and behavioral analysis	Miyagawa et al. 2007
Bisphenol	rats	Mechanistic study	Poimenova et al. 2010
Paraben	rats	Developmental exposure and behavioral analysis	Kawaguchi et al. 2009
Salicylate	rats	Developmental exposure and behavioral analysis	Butcher et al. 1972

Table 3. Literature lists for effects of environmental chemicals on memory and cognition in experimental animal models.

3. Conclusion

ECSs are distributed widely and in increasing amounts over the world in the last few decades. ECSs exposure could occur through breastfeeding and hand-to-mouth activities in small children. In this review, epidemiological studies of children between ECSs exposure and neurodevelopmental disorders and experimental animal studies were focused. In our literature review, lead, methylmercury, pesticides, tobacco (cotinine), persistent organic pollutants such as PCBs, and environmental hormones such as bisphenol A and phthalates have been indicated association between neuronal disability and exposure levels in children. Children's brain and nervous system are vulnerable to adverse impacts from pollutants because they go through a long developmental process beginning shortly after conception and continuing through adolescence. This complex developmental process requires the precise coordination of cell growth and movement, and may be disrupted by even short-term exposures to environmental contaminants if they occur at critical periods of development. This disruption can lead to neurodevelopmental deficits that may have an effect on the children's achievements and behaviors even though they do not result in a diagnosable disorder.

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17

Disability and Oral Health

Jenny Gallagher and Sasha Scambler
King's College London Dental Institute
United Kingdom

1. Introduction

This chapter will address the oral health needs of people with learning disabilities and access to oral healthcare, drawing on policy, research and action in the UK. It will provide insight to the principles and practice of dental care including the creation a new dental specialty, 'Special Care Dentistry'. This dental specialty was developed to provide oral health care for vulnerable people including those with a learning disability; it provides a case study of a public health approach to developing specialist services. The case study highlights how the process has significantly improved the profile of the oral health needs of vulnerable adults in general, including people with a learning disability. The importance of promoting health using the common risk factor approach and empowering people with a disability to make healthy choices is stressed, drawing on the current evidence base. The chapter concludes with the challenges for the future which will be pertinent to those involved in the care of people with a disability worldwide.

2. Disability and oral health

This section will examine the disability from a UK perspective, the principles of providing healthcare for people with a learning disability and the challenges faced in doing so. Traditionally, it has been found that people with a disability or other impairment (such as a mental illness or a learning difficulty) may have worse oral health than those without such disabilities or impairments; not only can this cause physical problems, but it can potentially have a wider reaching impact as poor oral health can have a negative effect on self-esteem, quality of life and general health. Improving the levels of oral health in those with impairments or disabilities is, consequently, a major issue for the dental care services.

2.1 Disability in the UK

At a global level, it is suggested that approximately 10% of the world's population, more than half a billion people, are disabled and it is predicted that this number will rise dramatically in the next quarter of a century (International Disability Foundation, 1998). It is estimated that between 1.3% and 3.5% of the population in the UK has a learning disability (Department of Health, 2007). The government strategy for people with a learning disability for the 21st century entitled 'Valuing People' defines learning disability as including the presence of:

- A significantly reduced ability to understand new or complex information, to learn new skills (impaired intelligence) with;
- A reduced ability to cope independently (impaired social functioning);
- Which started before adulthood, with a lasting effect on development.

(Department of Health, 2001)

Estimates suggest that there are somewhere between 230,000 and 350,000 people with a severe learning disability and a further 0.58M to 1.75M with a mild to moderate learning disability in the UK alone (Department of Health, 2007). This means that learning disabilities are common; however, the nature and extent of disabilities vary widely. It is therefore important that adults with learning disabilities should not be viewed as a homogeneous group (British Society for Disability & Oral Health et al., 2001). Learning disabilities may be associated with a physical disability or medical condition which further adds to the complexity of their lives, and those of their carers (British Society for Disability & Oral Health et al., 2001). This has implications for the level of support that they require in daily living.

2.2 The principles

There is ongoing debate about how disability should be defined and the impact of definitions on the provision of care; whereby disability is defined either as 'functional limitations based on an impaired body' or 'oppression caused by a social world which is not made accessible to everyone regardless of impairment' (Scambler et al., 2011). The argument hinges on the extent to which disabled people are seen as tragic victims to be 'helped' (the medical model approach) or individuals who happen to have an impairment but have the same rights and needs as their non-disabled peers (the social model approach). Whilst much dental training adopts, often unconsciously, a medical model approach, there is a growing awareness of the need for a social, patient-centred approach as demonstrated in health policy and professional action.

Following on from the general strategic document 'Valuing People', the Department of Health (2007) published 'Valuing Oral Health: a good practice guide for improving the oral health of disabled children and adults'. This placed great importance on 'choice, rights and inclusion' for disabled people in relation to health care. The report recommended that:

1. Primary care should be the main provider of oral care for disabled people.
2. Disabled people should be enabled to access and make use of health information to promote choice and inclusion.
3. Disabled people have the same right to good quality health care as all other groups in the population.
4. Disabled people have an equal right to oral healthcare that is responsive to their specific needs.
5. Oral Healthcare should be an integral part of holistic care packages for disabled people.

(Department of Health, 2007)

The ethos behind these principles is a social approach, with acknowledgement that disabled people have the same rights in relation to their oral health care as their non-disabled peers. This echoes the earlier strategy on 'Valuing People' which stated that the main objective for

the NHS was to "enable people with learning disabilities to access a health service designed around their individual needs, with fast and convenient care delivered to a high standard, and with additional support where necessary." (Department of Health, 2001).

In addition to the Department of Health guidelines, dental practices in the UK are required to comply with the Disability Discrimination Act (Qureshi and Scambler, 2008). This Act was partly subsumed into the 2010 Equality Act which aims to protect disabled people and prevent discrimination and to provide legal protection in relation to education, employment, access to goods and services (UK Government, 2010); this requires dental practices as providers of healthcare to make 'reasonable adjustments to physical features'. In the context of the General Dental Service (Disability Rights Commission, 2003, Disability Rights Commission, 2004) physical features may be regarded as those 'structural/inanimate aspects' of a service which are used integrally as part of the service uptake and make the experience, or service, use acceptable. Such features may include: steps, stairways, kerbs, exterior surfaces, paving, parking bays, entrances and exits, internal doors, gates, toilets, washing facilities, public facilities (such as telephones, counters, service desks), lighting, ventilation, lifts and escalators. When combined with national guidelines, the Disability Discrimination and Equality Acts ensure that oral health care provision for disabled people should be accessible, both physically and philosophically, and of a high quality.

2.3 The challenges

There are three broad challenges associated with promoting oral health and the delivery of oral and dental healthcare; first, the challenge of preventing oral disease and maintaining oral health; second, the challenge of accessing appropriate dental care in a timely manner, and third, obtaining informed consent for care. Each of these topics will be dealt with in turn starting with 'oral health'.

2.3.1 Oral health

As already outlined, good oral health contributes to general health and wellbeing. There is relatively little epidemiological research on the oral health needs of people with a learning disability. Children and adults with a learning disability suffer from the same common oral diseases and conditions as the rest of society (Fig 1); however, there is evidence that they experience poorer outcomes and the impact of oral disease on quality of life can be profound as it impairs eating, speaking socialising and comfort.

Data on the oral health needs of adults with disabilities are limited. Overall within the UK oral health has improved considerably in the past three decades across the population; however, inequalities persist. Oral health surveys of adults with learning disabilities in the UK have found: poor oral hygiene and high prevalence of periodontal (gum) diseases; a wide range of prevalence estimates of tooth decay; more missing teeth than general population and more untreated disease for adults living in the community than those in institutions (British Society for Disability and Health et al., 2001).

Even where needs are not significantly different across settings, an Australian survey demonstrated a number of important trends: higher odds of 'dental caries experience' were associated with age and having no oral hygiene assistance; higher odds of 'missing teeth' were associated with the type of disability, requiring a general anaesthetic for dental

treatment, and both low and high carer-contact; finally, higher odds of having 'filled teeth' were associated with age, having no oral hygiene assistance and having high carer-contact (Pradhan et al., 2009). This underlines the importance of high quality daily care as well as regular dental care.

It is also recognised that trauma to teeth can present a challenge to some people with learning disabilities. Epileptic seizures and falls due to dyspraxia and impaired mobility increase the risk of traumatic dental injury, which is likely to require urgent assessment and treatment (Department of Health, 2007).

It is vitally important to ensure that children and adults with learning disabilities, and their carers, are sufficiently supported to care for their oral health and prevent disease as outlined in Section 3.1, rather than just treating disease once it has developed. The main diseases and conditions are outlined in Table 1.

Disease or condition	Description
Dental caries *Tooth decay*	one of the most prevalent conditions in adults and children worldwide, associated with a high sugar consumption (food/drink{
Periodontal diseases *Gum diseases*	affect most people to some extent. Moderate gum disease, demonstrated by bleeding gums and the presence of plaque and or calculus (calcified plaque), is much more prevalent, particularly in adults
Tooth wear: *attrition, erosion or abrasion of tooth surface*	a natural phenomena of ageing; however it becomes pathological when it is excessive either through erosion by means of acidic food, drink or acid reflux, attrition or tooth-wear through excessive grinding and abrasion by wear caused by devices such as a toothbrush
Oral cancer *Mouth cancer*	cancer of the mouth, the majority of which are squamous cell carcinoma; this is a particularly emotive cancer because of its impact on eating, speaking and socialising and poor outcomes including long term survival
Orthodontic need *Need for braces*	Significant need for orthodontic care is prevalent in just over one third of 12 year olds (35%) in the general population in the UK.
Trauma *Damage*	trauma to teeth is a greater risk for some people with learning and physical disabilities through falls or accidents

Table 1. Common oral diseases and conditions

2.3.2 Barriers to oral healthcare

There are a number of barriers to oral healthcare for people with learning disabilities that need to be overcome if their oral health needs are to be fully met (Alborz et al., 2004, Scully et al., 2007). Scully et al have categorised these as:

- Barriers with reference to the individual
- Barriers with reference to the dental profession
- Barriers with reference to society
- Barriers with reference to government.

(Scully et al., 2007)

Individual barriers include a lack of perception of need by individuals (Halberg & Klingberg 2004) or their carers (Cumella el al. 2001); difficulty following instructions (Bollard 2002); and access problems (Dougall & Fiske 2008). Barriers relating to the dental profession include a lack of training (Gallagher and Fiske, 2007, Scambler et al., 2011); poor communication skills (Sentell 2007); high staff turnover (Pratelli and Gelbier, 1998) (Scambler et al., 2011) and a lack of time and resources (Scambler et al., 2011). Societal barriers include a general lack of awareness of the importance of oral healthcare, and a lack of positive attitudes towards oral health promotion (Owens et al., 2011). Finally, governmental barriers include a lack of resources for oral health services (Dougall and Fiske, 2008a). This suggests that whilst the oral health needs of people with learning disabilities are broadly similar to their non-disabled peers, there are significantly more barriers to timely oral health care of good quality.

2.3.3 Consent for care

In addition to the barriers listed above, there is the issue of 'capacity to consent' to treatment to consider (Dougall and Fiske, 2008c). The Mental Capacity Act (UK Parliament, 2005) introduced a broad *diagnostic* threshold to determine whether a person has capacity to make a particular decision. The Act identified that a person lacks capacity where: '…at the material time, he is unable to make a decision for himself in relation to a matter because of an impairment of or disturbance in the functioning of the mind or brain' (section 2(1). 'The impairment may be temporary or permanent' (section 2(2)).

A person is considered unable to make a decision if (s)he is unable to:

- understand the information relevant to the decision
- retain that information
- use or weigh up that information as part of the process of making the decision
- communicate his/her decision.'

(UK Parliament, 2005)

The principles of consent remain the same whether or not people have full capacity to consent. Informed consent is based on freewill, capacity and knowledge (Dougall and Fiske, 2008c). This means that there are certain key stages which clinicians need to work through with patients, from an introduction of self and the purpose of the visit and establishing what is already understood, right through to giving and obtaining informed consent:

- Introduction
- Establishing what is already understood
- Explaining the nature of the clinical condition
- Outlining treatment options
- Explaining risks and benefits
- Checking what has been understood
- Inviting further questions
- Confirming the preferred treatment mode
- Giving and obtaining consent

(King, 2001, Dougall and Fiske, 2008c)

The legal framework and basis for obtaining consent will vary from country to country; however, the principles above should prove helpful whatever the context. The big challenge exists in relation to adults who are unable to provide informed consent. This clearly has implications for many people with moderate to severe learning disabilities and has led to the introduction of 'best interest meetings' to ensure that the patient is fully represented where they are not able to fully participate in their own right and the most appropriate care programme for the individual is agreed (Dougall and Fiske, 2008c).

3. Disability and oral care

'Valuing people's oral health' (Department of Health, 2007), is a national policy concerned with improving the oral health of children and adults with a disability. It is a good example of health promoting public health action in support of the oral health of people with a disability. The policy document recognises that disabled children and adults have the same right to good oral health as the rest of the population (Department of Health, 2007). Oral health may depend on a whole series of factors, some of which are relevant across the population, and which include the following which include oral care:

Personal predisposing factors

- Age
- Psychological status
- Socio-economic status
- Behavioural risk factors
- Nature and severity of the individual's learning disability
- Presence of co-morbidities
- Medications
- Ability to undertake regular oral hygiene procedures or receive care from others
- Importance placed on oral health by carers whether family or paid
- Previous dental history including attendance pattern

Health systems factors

- Capacity to consent to oral care
- Access to local dental services: regular, specialist and emergency dental care
- Nature of local dental services: willingness and skills of the dental team to treat people with learning disabilities
- Access to sedation or general anaesthetic services in conjunction with the provision of dental care (If required)
- Location and mode of delivery of care: domiciliary, mobile surgery, routine dental surgery/office, dental hospital
- Support to access care: transport, carers, etc
- Processes in place to achieve agreement on dental care plans where the individual is unable to provide informed consent

Sources: (BSDH et al., 2001, BSDOH, 2009, Dougall and Fiske, 2008a, Dougall and Fiske, 2008b, Dougall and Fiske, 2008c, Dougall and Fiske, 2008e, Dougall and Fiske, 2008f, Lewis et al., 2008a, Lewis et al., 2008b)

3.1 Evidence-based self care

Good oral health starts in infancy with a supportive environment including the active support of parents and/or carers. Personal care and a healthy lifestyle are fundamental to having and maintaining good oral health, but this can be more challenging to people with a disability. As already highlighted, the pathology of oral diseases is well understood, particularly in relation to tooth decay which is the most prevalent dental conditions in children worldwide; so too is the evidence base for prevention. Much of the contemporary evidence base is outlined in 'Delivering Better Oral Health: an evidence–based toolkit for prevention' (Department of Health and British Association for the Study of Community Dentistry, 2009). It outlines appropriate health behaviour at a population and an individual level from birth onwards. It highlights what is should be emphasised by the dental team for the population in general and what additional preventive care is appropriate for those of giving special concern. In all categories there is an emphasis on a healthy diet, good hygiene and the use of fluoride to strengthen teeth as shown in Table 2.

Tooth decay is prevented by minimising the volume and frequency of sweet food and drink. As soon as teeth appear, around the age of six months, they ought to be brushed regularly with a smear of fluoride toothpaste. It is really important to avoid non-milk extrinsic sugars - include adding sugar to bottles of milk and prolonged night time feeding. From the age of one year, it is good to progress to using a trainer cup; however children with learning disabilities may take longer to do so. Once children are old enough to begin brushing teeth themselves, parents should continue to supervise brushing until the child is able to undertake thorough cleaning themselves and a 'pea-sized' amount of toothpaste should be used. It is very important to clean teeth last thing at night and at one other time during the day with family-strength fluoride toothpaste (1450-1500ppm fluoride) and to spit out excess toothpaste without rinsing away the fluoride toothpaste. Many people are not aware that rinsing with lots of water after tooth-brushing dilutes the effect of fluoride in toothpaste and is not advised.

Where clients are cared for in institutions it is very important that there is an oral health assessment incorporated into their general assessment on entry to a care home to inform their daily regimen or 'care plan'. Standards for daily oral hygiene should be agreed and care givers trained in the provision of daily oral care (Fiske et al., 2000, BSDH et al., 2001). This will involve cleaning teeth and/or dentures effectively.

		Children 0-3 years
Dental caries	Diet	Breast feeding provides the best nutrition for babies From six months of age infants should be introduced to drinking from a cup and from age on year feeding from a bottle should be discouraged Sugar should not be added to weaning foods
	Fluoride	Use only a smear of fluoride toothpaste containing at least 1,000ppm fluoride
	Tooth brushing	As soon as teeth erupt in the mouth brush them twice daily Parents should brush or supervise brushing
	Medicines	Sugar-free medicines should be recommended

		Children over 3 years
Dental caries	Diet	Sugars should not be consumed more than four times per day Sugary food and drink should be reduced and when consumed, when limited to mealtimes
	Fluoride	Use a pea-sized amount of toothpaste containing 1,3500-1,500 ppm If over 7 years of age, and giving concern, use a fluoride mouth-rinse daily (0.05%NaF) at a different time to brushing
	Tooth brushing	Brush last thing at night and on one other occasion Brushing should be supervised by an adult Spit out after brushing and do not rinse
	Medication	Ensure medication is sugar-free
	Dietary supplements	Any supplements containing sugar and glucose polymers at mealtimes when possible unless clinically directed otherwise) and not last thing at night.
		Adults
Dental caries	Diet	Sugars should not be consumed more than four times per day Sugary food and drink should be reduced and when consumed, when limited to mealtimes
	Fluoride	Use a toothpaste containing at least 1,3500ppm fluoride If giving concern, use a fluoride mouth-rinse daily (0.05%NaF) at a different time to brushing
	Tooth brushing	Brush twice daily Brush last thing at night and on one other occasion Brushing should be supervised by an adult Spit out after brushing and do not rinse
Periodontal (gum) diseases	Tooth brushing	Brush teeth systematically with either a manual brush with a small head and round end filaments, a compact angled arrangement of long and short filaments and a comfortable handle OR A powered toothbrush with an oscillating/rotating head Clean interdentally using inter-dental brushes or floss
	Tobacco	Do not smoke
Oral (mouth) cancer	Tobacco	Do not smoke
	Alcohol	Limit alcohol to moderate levels (if drunk)
	Diet	Maintain balanced healthy diet with at least five portions of fruit or vegetables per day

Source: Delivering Better Oral Health (Dept of Health & BASCD, 2009)

Table 2. Prevention of oral disease for those at high risk of developing oral disease

3.2 Professional care through dental services

In looking at professional dental care it is important to understand that within the UK there has been a significant shift in the provision of social care for people with learning disabilities and this has had implications for oral healthcare. Tiller et al (2001) outline how adults with learning disabilities were largely cared for in residential establishments until the 1980's when a process of 'normalisation' resulted in adults with a learning disability moving from residential homes to live in the community over the subsequent decade or two. Many moved to live in residential homes in the community, supported by carers. Tiller et al (2001) undertook a study to compare the oral health of adults remaining in residential homes with those still living in the community. It provided dramatic insight to the fact that adults living in the community in the Sheffield area of the North of England were particularly disadvantaged. Despite the fact that people living in residential care were significantly older than those based in the community, both groups had similar levels of caries experience; however, adults living in the community had significantly more untreated decay and poorer oral hygiene than their counterparts in residential care. In contrast, adults in residential care had significantly more missing teeth. Stanfield in another study across settings demonstrated that compared with institutionalised people with learning disabilities, attendance patterns were less regular for residents in the community; furthermore, individuals in the community were also less likely to receive operative dental treatment (Stanfield et al., 2003). There is evidence from south east London that amongst adults with learning disabilities the prevalence of plaque, calculus and gingivitis were high, however those living in with their families had less untreated disease (Naidu et al., 2006). A study conducted about the same time involving structured interviews of 257 learning disabled adults and/or carers in Lambeth, Southwark & Lewisham (Pratelli and Gelbier, 2000). The majority (63%) reported no difficulty in obtaining dental care for people with learning disabilities, with general dental services (40%), community (36%) and hospital services (15%) being the main providers. Subjects with a history of difficulty in obtaining an appointment were more likely to perceive an unmet treatment need and have a greater professionally defined need for treatment at time of interview than their counterparts. This was also for case for those with higher levels of disability or requiring assistance with cleaning. Almost half of subjects perceived a need for care, only 30% of whom had obtained a dental appointment. Support systems to facilitate access to dental care, identified for and by this client group, were advocated including good information systems across health and social care (Pratelli and Gelbier, 2000).

It is salutary to note that a review of access to healthcare across the lifespan of people with learning disabilities (Alborz et al., 2004) highlighted the dearth of research on access to dental care and that the published material at that time, which only related to first line services, did not include access to specialist care. In a review of the five studies available Alborz et al (2004) also reported that adults with learning disabilities living in informal family settings in the community were found to have higher levels of tooth decay than those living in more formal residential settings. They were reported as less likely to see a dentist regularly, or to have no dentist, and only seek care when experiencing pain.

All of the above research raises two key questions. First, how often should people attend for dental care; and, second, where should they seek care? Guidance, from the National Institute for Clinical Excellence on dental recalls recommends that children should attend a

dentist for a check-up at least once a year and that the equivalent period for adults is at least once every two years (NICE, 2004). The recommendation is based on assessment of an individual's risk of developing further disease and should ideally be discussed, and agreed, by the patient and health professional. It is recognised the some people with learning disabilities may be at higher 'risk' of oral disease and may therefore need to be seen more frequently by the dental team. Exactly, 'where patients with a learning disability may most appropriately seek care' will vary depending on a number of factors including their oral health needs and the complexity of their condition as outlined in the following sections.

3.2.1 Primary dental care

Within the UK, the majority of dental care is provided by general dental practitioners in their 'dental practice' or 'office'. This is the case for dental care in general and for people with learning disabilities. Primary dental care practitioner's act as the 'gatekeeper' to specialist services, which are only used when required. Historically a much smaller salaried dental service, known as the 'community dental service' played an important role in providing primary dental care for hard to reach groups such as people with learning disabilities. As outlined in Sections 3.2.2 and 4, much of this service is becoming more specialised with the emergency of a new specialty of 'Special Care Dentistry'.

The policy documents on learning disabilities (Department of Health, 2001; 2007) advocate 'choice' and 'inclusion'; however, this may require further work on the part of clinicians in line with principles for holistic care and ensuring patient empowerment (Owens et al., 2010).

Contemporary evidence-based oral health care, where-ever it is received, involves much more than just treating disease. There are many interventions for children and adults who give cause for concern and are at higher risk of developing oral disease. Following an in-depth case history and examination, this includes:

- Regular application of a small amount of fluoride varnish to susceptible tooth surfaces
- Prescription of high fluoride toothpaste, fluoride supplements or fluoride mouthwash
- Providing fissure sealants on newly erupted teeth to reduce the risk of tooth decay
- Ensuring timely and appropriate advice and support on diet and other health behaviours such as tooth-brushing.

(Department of Health and British Association for the Study of Community Dentistry, 2009)

Much of the above preventive care can be effectively provided by other members of the dental team such as dental therapists and dental hygienists on prescription from a dentist. There is evidence that dental hygienists could make a greater contribution to the care of people with a disability (Christensen et al., 2005). Carers play such an important role in healthcare and require regular support from the dental team. Valuing people's oral health recognises that it is good practice for personnel involved in the care of disabled children and adults to receive appropriate training and for them to be provided with information about services available and preventive actions that work (Department of Health, 2007). It is therefore important for carers to ensure that they receive the appropriate information and guidance to help support and maintain oral health (Dougall and Fiske, 2008d).

Several reviews and policy documents have identified issues relating to physical access to dental care, issues relating to clinicians' understanding of people with a disability and how

care is delivered and the information needs of patients and carers (BSDH et al., 2001, Gallagher and Fiske, 2007, Department of Health, 2007). One of the challenges for dental practitioners in providing dental care for people with disabilities relates to the physical setting. Many dental practices were established in buildings which are not ideal in relation to the disability legislation outlined in Section 2.2 and they may not have appropriate car parking facilities (Baird et al., 2008). Whilst some modifications can be made, it is important for carers to find the practices in an area which are easily physically accessible. This is where local planners and policymakers, together with professional leaders, can ensure that there is good local information on the availability of dental services and how best they may be accessed.

Although general dentists are the main providers of dental care, not all care can, or should, be provided by general dentists or even in a primary care setting. Patients and carers may also need to negotiate their way through to specialist services, and possibility hospital specialist services either as a one-off process, because of a particular need or condition, or on an ongoing basis if their needs and/or management are complex.

3.2.2 Specialist care

In the UK, patients do not normally have direct access to specialist services and primary dental care practitioners refer those patients who are beyond their skill and competence to manage. There are now 13 dental specialties including Paediatric Dentistry and Special Care Dentistry (see Section 4 below). Paediatric Dentistry is concerned with the care of children who require specialist care and this includes children with learning difficulties. Special Care Dentistry (SCD) is concerned with the improvement in oral health of individuals and groups in society who have a physical, sensory, intellectual, mental, medical, emotional or social impairment or disability or, more often, a combination of a number of these factors (JACSCD, 2003). The focus on providing care for adults and ideally often take over the care of teenagers with a learning disability from their paediatric colleagues, particularly when patients require additional skill and expertise which is beyond the competence of a general dental practitioner.

Management of people with disabilities may range from simple care in a complex patient through to complex care in patients who do not find it a challenge to receive care. Specialists are able to manage the medical, legal, social and clinical health issues that arise in patient care. They also have access to a range of facilities and agencies to support care. Special Care Dentistry is often provided across community and hospital settings so that care may be provided in the location most appropriate for the patient. For example if general anaesthetic is required this must be done in hospital, whereas the use of sedation as well as local anaesthetic for clinical care may be provided in a community setting, providing it is equipped and staffed to do so. Careful assessment and treatment planning are crucial for patients. A cross-sectional study of 210 children, with varying degrees of disability and attending special schools in three inner London boroughs, provides insight to treatment planning and patient management. It revealed that 67% required treatment and amongst the 52% of children who required a combination of treatment procedures, 64% could be treated in a primary care setting without sedation and the remaining 36% would require sedation (27%), or a general anaesthetic (9%), because of inability to comply with care (Taylor et al., 2001).

In addition to the above, oral healthcare may be delivered to people with learning disabilities on a domiciliary basis, i.e. carried out in an environment where a patient is resident, either permanently or temporarily, because of frailty, dementia, or disorientation (BSDOH, 2009). It may be provided in an individual's home, a care home or community house or in a day centre or hospital. The type of care that may be provided on this basis and in these settings is often more limited than can be provided in a normal dental surgery; however, with medical advances increasingly sophisticated care is possible. The British Society for Disability and (oral) Health (2009) provide publically accessible guidelines on the provision of domiciliary care. Another option is to provide dental care in a mobile caravan, which is fully equipped as a dental surgery and this provides the opportunity to treat groups of individuals at a school, day centre or residential home and reduces barriers to care.

3.2.3 Integrated Care pathways

Access may be defined as the 'fit between clients and services' (Penchansky and Thomas, 1981). There are five key areas for practical action to facilitate access and reduce barriers to care outlined in Table 3. It is important that people with a disability are facilitated to access oral healthcare and therefore greater work is required by planners and providers to make services more accessible to patients, thus 'improving the fit'. Bringing services to patients in a mobile or domiciliary service outlined above are good examples of practical action to improve availability and accessibility of services; however, it is important that mainstream services are similarly accessible.

5As	Descriptor
Available	in a geographic area, both real and perceived (Where do dentists like to set up practices? Low availability may suppress demand)
Accessible	Location, eg transport/walking/parking, physical, e.g. disabled access
Acceptable	feel welcome, treated professionally, treated as an individual, language, waiting areas, quality of care appropriate (posh/shabby)
Affordable	costs of care (direct) and cost of attending (indirect), information on costs/ understanding of costs
Accommodating	opening hours: evenings, weekends, drop-in service vs appointments

Adapted from Penchansky & Thomas, 1981

Table 3. Access: 5 As

In addition to the above practical issues, psychosocial barriers to care must also be recognised as fear is a general barrier to dental care (Finch et al., 1988, Kelly et al., 2000), and thus anxiety management must be part of care provision. Adjuncts to behavioural management include sedation and general anaesthetic for anxious or restless patients (Boyle et al., 2000, Manley et al., 2008, Department of Health and Faculty of GDPUK, 2008, Glassman et al., 2009).

As already intimated, carers have an important role in initiating dental treatment whether routine or emergency. It may not always be clear that an individual client has a dental problem but it should be one of the considerations when someone is out of sorts and there is no obvious cause, particularly in clients who have difficulty in expressing their needs. Carers need to have easily accessible information on the range of local services and how they may be accessed (Frenkel, 1999).

Increasingly there needs to be clear pathways to care which are easily understood and widely available to inform access to dental care. Care should also be seamless across the years, where possible (Dougall and Fiske, 2008f, Lewis et al., 2008b, Lewis et al., 2008a, Dougall and Fiske, 2008g). Care pathways should build on the principles outlined in 'Valuing Peoples Oral Health', outlined in Section 2.2, whereby primary dental care practitioners provide the majority of dental care, mainly in their dental surgery but they may also undertake domiciliary care in people's own homes or in residential institutions. Some interested dental practitioners are now commissioned to provide dental care in this way and they may well, over time, become Dentists with a Special Interest in Special Care Dentistry in future (Department of Health et al., 2009). All institutions which have the care of people with learning disabilities whether care homes or homes within the community should have access to both emergency and routine dental care for their clients. Furthermore, it may be appropriate to have regular screening sessions or dental checkups on site.

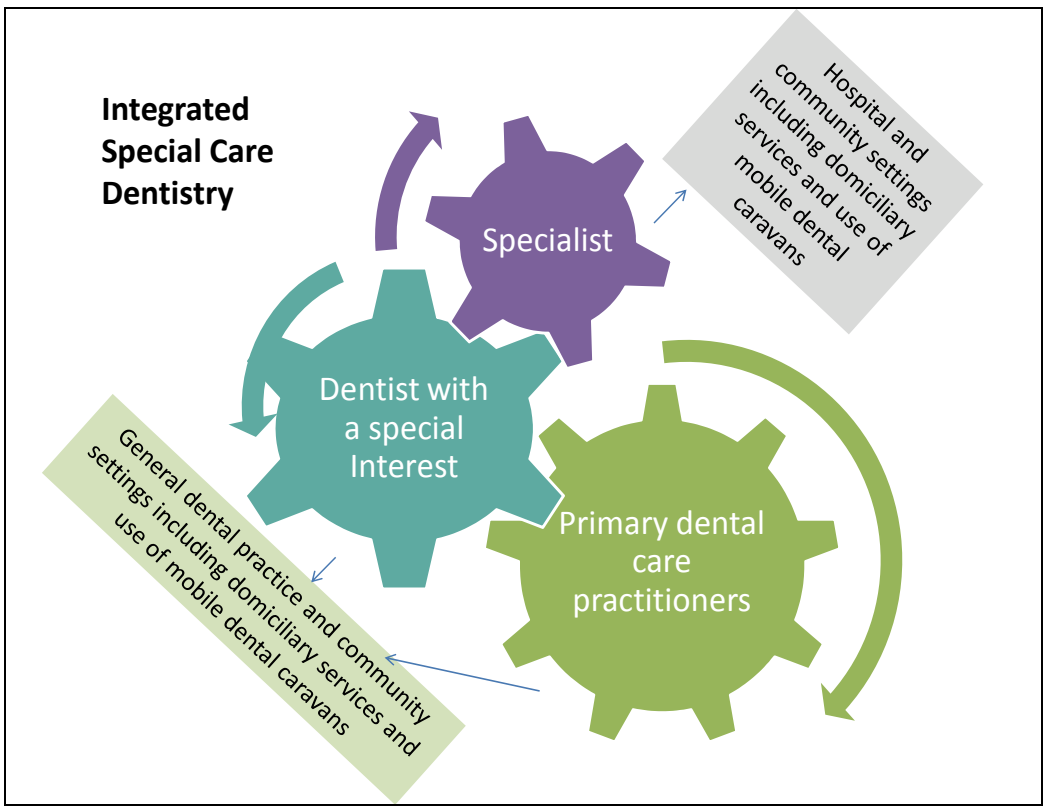


Fig. 1. Integrated network of care

3.2.4 Monitoring care for people with special needs

One of the challenges for a service providing care for people with impairment or disability is the time that is required to plan, organise and deliver care for patients. In a health care system where there is increasing emphasis on 'value for money' and understanding the cost of care, if is necessary to be able to explain the time and costs involved in patient management to commissioners of care. Therefore, a case mix toolkit has been developed and piloted by Sheffield working with a number of other dental services in England and Wales (British Dental Association, 2008). It provides a tool for measuring the level of impairment and disability, of patients in conjunction with the volume of service activity. This should provide meaningful activity data for commissioners about the patient base and reflect the additional time, and resources, required to provide care for many patients with special needs. The toolkit measures:

- Ability to communicate
- Ability to co-operate
- Medical status
- Oral risk factors
- Access to oral care
- Legal and ethical barriers to care.

Together with recommended 'weightings' these provide an overall patient 'complexity score'. This does not include any score for the complexity of the dental care, but rather time and patient management which should therefore explain the time involve and thus the cost of their management.

3.3 Oral health promotion

Promoting oral health includes, but goes beyond, health education for individual patients and their parents/guardians/carers. The Ottawa Charter principles for Oral Health Promotion (World Health Organization, 1986) are fundamental pillars in underpinning oral health promotion. They emphasise the importance of a population approach to health rather than just an individual approach which includes:

1. building healthy public policy
2. creating supportive environments
3. strengthening community action
4. developing personal skills and
5. re-orientating health services

(WHO, 1986)

We have seen greater emphasis on the care of vulnerable groups influencing health policy and action over the past decade, which includes the creation of the new specialty and the beginnings of a reorientation of health services towards prevention. However, action needs to occur on all of the above levels. For example, the environment in residential homes and community homes should be health enhancing with a low sugar diet and policies which promote regular effective oral hygiene. It is important to work with community groups and develop the personal skills of people with learning disabilities and their parents/guardians/carers. Furthermore, oral diseases share common risk factors with many

leading chronic diseases which are the major cause of death in high income countries: cardiovascular diseases, cancer, chronic respiratory diseases and diabetes. The risk factors include unhealthy diet, tobacco, and alcohol. Poor oral hygiene is also a risk factor. This highlights the importance of working on these common risk factors in support of health in general.

4. Special Care Dentistry - how UK addressed this professional challenge

4.1 A Needs-led specialty

Within the past decade in the UK, the dental specialty of 'Special Care Dentistry' came into being. It is an interesting example of a public health approach to planning and implementation of a new specialty. In the early decades of the UK National health Service, i.e. from 1948 onwards, dental surgeons and then oral surgeons, provided extraction services for people with a disability in hospitals. From the 1980's onwards interested dentists in the community and salaried dental services, began to provide care for people with learning disabilities in community clinics as health policy expanded their remit beyond merely treating children.

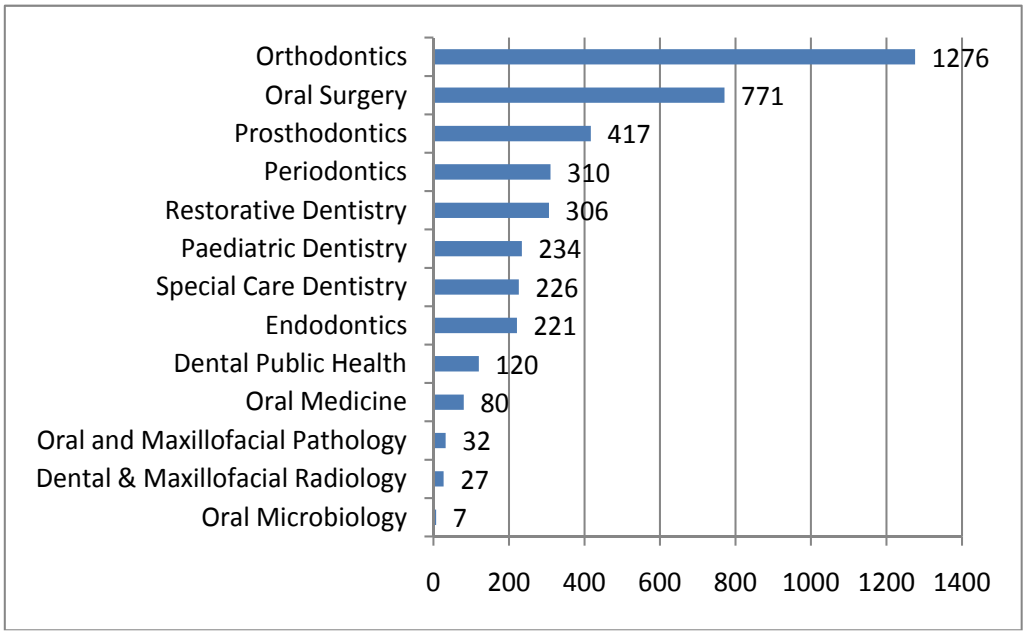
A Working Group for Special Care Dentistry was established by the Dean of the Faculty of Dental Surgery in one of the Royal Colleges to explore the need for a specialty of Special Care Dentistry in the UK and reported in 1999. They wrestled with both the arguments for creation of a specialty and with the process for achieving change. The need to formalise the care for more vulnerable sections of society that had traditionally been provided by a relatively small number of socially committed dentists was overwhelming. Furthermore, there was clear evidence that services for disabled children within the UK were much better than those for adults and that that the transition to adult care was a particular challenge for healthcare in general (JACSCD, 2003). Children with more extreme disabilities tended to have been managed by paediatric consultants and thus got into difficulties when they had to move to routine services as they reached 16 or 18 years of age and were no longer under the remit of paediatric services. The process of achieving change involved the establishment of a 'Joint Advisory Committee for Special Care Dentistry' in 2000 to build a case, lobby for change, and commence formal training for a new specialty. The case of need for the specialty was used to influence key players such as the Department of Health and the General Dental Council (JACSCD, 2003, Gallagher and Fiske, 2007); it examined the demography of the patient base, oral health inequalities, inequalities in access and models of good practice including how the specialty would work with primary care practitioners in providing care for the spectrum of disabilities. Existing models of good practice reveal that established clinicians working in this field have a patient base of between 850 and 1,500 patients per year and work across primary care and hospital settings, liaising with colleagues in health, social services and the voluntary sector to ensure integrated health care planning. The arguments outlined in a paper in the British Dental Journal focused on it being a professional challenge to ensure better access, outcomes and oral health of individuals and groups who have a physical, sensory, intellectual, medical, emotional or social impairment or disability (Gallagher and Fiske, 2007). On this basis, a conservative estimate of 133 specialists was suggested for the future, working in networks with Dentists with a Special Interest in Special Care Dentistry and primary dental care practitioners.

The new specialty was approved by the General Dental Council in 2007 and the specialist list opened in 2008 (General Dental Council, 2008). Initially dentists with relevant expertise were 'grand-parented' onto the specialist list on the basis of their competence.

Impairment and disability were defined in the broadest of terms, thus Special Care Dentistry is concerned with providing and enabling the delivery of oral care for a diverse client-group with a range of disabilities and complex additional needs and includes people living at home, in long stay residential care and secure units, as well as homeless people. Interestingly, in parallel with the creation of the specialty there has been significant emphasis nationally on meeting the needs of *vulnerable* groups such as people with a disability.

4.2 A growing specialty

In only a few years, Special Care Dentistry has grown to be the seventh largest specialty out of 13 in the United Kingdom, It has achieved this success by recognising the knowledge, skills, and experience of dentists working in the field and accrediting their specialist status. As of December 2010 there were 226 specialists on the dental register (Figure 2) and a number of junior dentists in training to become future specialists(General Dental Council, 2010).



Source: General Dental Council (2010)

Fig. 2. Number of Dental Specialists Registered with the UK General Dental Council, December 2010

A growing body of knowledge on the management and care of patients across their life course is emerging through the specialty of Special Care Dentistry. The specialty association 'The British Society for Disability and Oral Health', has developed a series of relevant

guidelines for the care and management of people with a disability (http://www.bsdh.org.uk/guidelines.html). Furthermore, through the journal of the association the 'Journal of Disability and Oral health' and helpful publications such as in the British Dental Journal in 2008 (Dougall and Fiske, 2008d, Dougall and Fiske, 2008f, Dougall and Fiske, 2008e, Dougall and Fiske, 2008a, Dougall and Fiske, 2008g, Dougall and Fiske, 2008c, Dougall and Fiske, 2008b, Lewis et al., 2008b, Lewis et al., 2008a), they provide a really helpful basis for practical care of people with learning disabilities. The underlying ethos has a number of key themes and is worth reiterating. First, that people providing care share common values, a commitment to adhere to accepted clinical and professional standards and above all operate within the best interests of the service user. Second, that all individuals have a right to autonomy as far as possible in relation to decisions made about them. Third, good oral health has positive benefits for health, dignity and self-esteem, social integration and general nutrition as the impact of poor oral health can be profound.

4.3 Future challenges

Whilst it is recognised that the advances in Special Care Dentistry are significant, there is much action required to promote oral health of people with learning disabilities, build capacity of the dental team and ensure that there is access to high quality evidence-baed care provided in a timely manner as outlined below.

4.3.1 Research

Dental and oral research amongst people with learning disabilities is much needed to improve our evidence base in promoting oral health and the delivery of patient care, but it is sadly lacking. There is little published evaluation of actions to improve service delivery, patient satisfaction and outcomes. Lack of funding for dental research is a general problem and the challenges of undertaking research, particularly amongst adults because of the challenge of obtaining informed consent. The Mental Capacity Act (UK Parliament, 2005) and subsequent guidance (Department of Health, 2008), provide the opportunity for consultees to be identified for research involving adults who lack the capacity to consent; this can either be a 'personal consultee' or a 'nominated consultee'. Local informants will be identified via local organisations. They will be chosen to reflect the diversity of the local disabled population in relation to sex, cultural and ethnic diversity, age and social status. The consultee may act in place of the person alongside a person with a learning disability or as a substitute. This approach requires high level ethics committee scrutiny and research governance approval and is likely to further add to the time, cost and complexity of the research process. Nevertheless it is very important in supporting people with a learning disability that high quality research is undertaken.

4.3.2 Monitoring oral health

There is clear need for methods of assessing the levels of need in this section of the population whether through dental and epidemiological surveys, dental information systems in practices or other means. As dental practice management software becomes more adept at capturing epidemiological data, clinicians should become adept in recording these data during clinical consultations, thus possibly avoiding the need to invest in specific surveys and providing ongoing monitoring data on oral health (Gallagher, 2005).

4.3.3 Networks of care

Gallagher and Fiske (2007) highlighted the importance of developing networks of care to ensure that primary dental care practitioners are supported in their provision of routine care and have access to specialist support and advice as required for their patients. These networks must actively be developed to ensure that dental care for people with a disability does not just become the preserve of specialists. There is not sufficient workforce capacity for this to be undertaken. Whereas there had been substantive progress to building specialists in special care dentistry and train future consultants, and some progress towards building the skills of generalists in the care of special care patients, there has been little action on creating Dentists with a Special Interest in Special Care Dentistry (Department of Health et al., 2009); this is an important step to be considered in reshaping dental services into care pathways.

4.3.4 Information for the public

One area where there has been little action is on information for the public at local level with a few notable exceptions. BSDOH has information for the public on its website (http://www.bsdh.org.uk/public_information.html) which includes a very helpful patient booklet (Manchester PCT, 2011). Further work is required to provide information to the public, health and social care professionals on pathways of care at local level. Information should be provided in places and in media that will reach the local community. (NHS West Midlands, 2008).

4.3.5 Education and training

Education of the dental team to provide mainstream care for people with learning disabilities is much needed. Greater training within the undergraduate or basic curriculum would build capacity within the breadth of services to manage the routine dental care of people with a disability with confidence, only referring on necessary patients to those with specialist or other expertise. The nature and scope of dentists training in the management of patients with learning disabilities may vary depending on when, and where, their qualified. Increasingly it should be part of the undergraduate curriculum and the curricula of other members of the dental team and postgraduate education for qualified dental professionals. As the new specialists in this field contribute to the teaching and training of undergraduates, postgraduates and the wider dental team, this will enable more care to be mainstreamed over time, in line with the strategy and policy recommendations for people with disability (Gallagher and Fiske, 2007, Department of Health, 2007). Many undergraduate programmes are exploring how they provide education and training in special care dentistry for dental students and the wider dental team such as dental nurses, therapists and hygienists.

4.3.6 Finance

It is important that the financial system for remuneration of dental care supports the provision of care for people with minor and moderate disabilities in primary dental care, recognising that they may require more time than the average patient. There is no point in building skills and expertise within the dental team if they are not used and inequalities in

the oral health of people with learning disabilities are not actively addressed. This will most probably require the support of information systems to patient complexity and the time involved in care provision. Improving oral health treatment services may have significant financial implications, thus it is important that there is a strong emphasis on prevention throughout life, with a view to reducing the need for hospital admissions and expensive care under general anaesthetic.

5. Conclusion

Oral health is fundamental to wellbeing and this is particularly the case for people with learning disabilities for whom dental treatment may prove challenging. Good oral health begins from birth with a healthy diet, good mouth hygiene and access to fluoride products which strengthen teeth against decay. It may require the active support of parents and carers in assisting with tooth brushing. Regular dental checkups, at least once per year, are advised to monitor oral health and identify disease at an early stage when it may more easily be treated. There should be access to dental services with specialised support for those with more profound learning disabilities of for whom dental care presents a challenge. In the UK the specialty of special care dentistry provides such care normally on referral from dental practitioners. It is important that dedicated oral health services are established to serve the needs of patients with disabilities or conditions which mean that they require 'special care'.

6. Acknowledgments

This chapter has arisen out of work with UK dental professionals, policy makers, researchers, clinicians and most importantly people with a disability. It is hoped that this chapter will inform the future of oral health care for many who experience disabilities and they will benefit from good oral health.

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Learning disability is a classification that includes several disorders in which a person has difficulty learning in a typical manner. Depending on the type and severity of the disability, interventions may be used to help the individual learn strategies that will foster future success. Some interventions can be quite simplistic, while others are intricate and complex. This book deserves a wide audience; it will be beneficial not only for teachers and parents struggling with attachment or behavior issues, but it will also benefit health care professionals and therapists working directly with special needs such as sensory integration dysfunction.

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