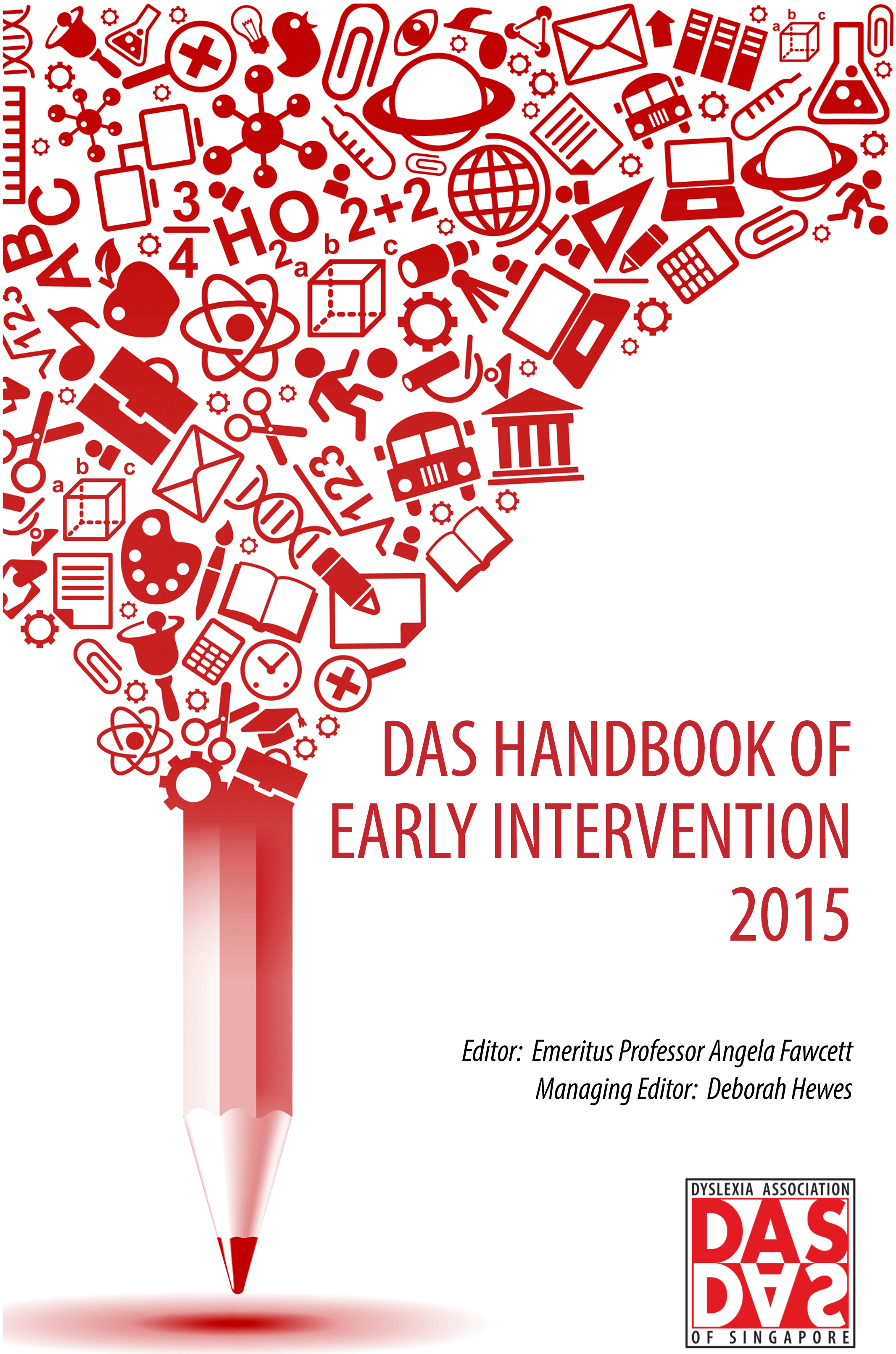

DAS HANDBOOK OF EARLY INTERVENTION 2015

Editor: Emeritus Professor Angela Fawcett

Managing Editor: Deborah Hewes

DYSLEXIA ASSOCIATION
DAS
OF SINGAPORE

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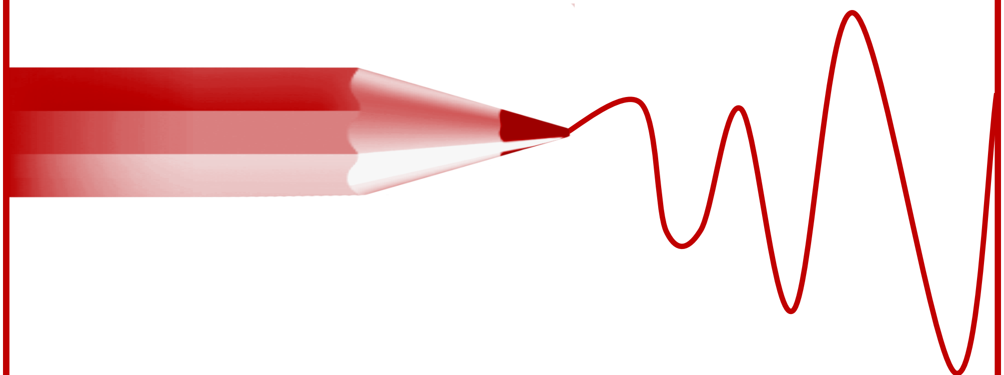

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EDITORIAL NOTE

The views expressed in this book are those of the individual contributors, and do not necessarily represent the policy of the Dyslexia Association of Singapore (DAS). Whilst every effort has been made to ensure the accuracy of information given in this handbook , DAS cannot accept responsibility of the consequences of any errors or omissions in that information. In certain articles a gender pronoun, eg. his/her, this is used purely for the sake of convenience by the author.

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DYSLEXIA ASSOCIATION OF SINGAPORE

DAS HANDBOOK OF EARLY INTERVENTION 2015

A collection of articles, research and practical information on early intervention to aid the support of children with specific learning differences, their families and for the professionals who work with them.

Editor: Emeritus Professor Angela Fawcett
Managing Editor: Deborah Hewes

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SECTION 3—About DAS

Preface

Hugh Catts

Professor and Director,
School of Communication Science and Disorders
Florida State University

Reading is a wonderful ability; it informs us, entertains us, and brings us great joy. With the appropriate opportunity and experience most children acquire the ability to read in the early school grades and go on to use their reading skills for educational and recreational purposes. A small portion of children, however, experience significant difficulties learning to read. These difficulties often lead to a host of negative consequences including academic failure, poor self-concept, truancy, or limited employment opportunity. Fortunately, research indicates that the severity of reading problems and the associated negative consequences can be significantly reduced with early intervention. However, for early intervention to take place, children must be identified in a timely fashion. Because the primary symptom of a reading disability is difficulty learning to read, practitioners and educators have typically waited until considerable reading instruction has been provided before a diagnosis could be made. This practice often has delayed identification until second grade or later. Fortunately, research has begun to uncover early factors related to a reading disability (RD) as well as educational practices that allow practitioners and educators to identify children at risk for RD prior to, or at the very least, the beginning of formal reading instruction.

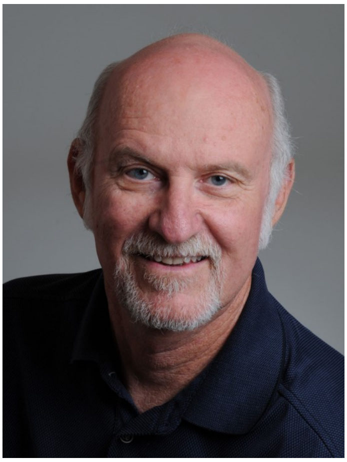
> "… research indicates that the severity of reading problems and the associated negative consequences can be significantly reduced with early intervention."

One of the earliest signs of risk for reading disability is a family history of RD. Children with a parent or sibling with RD have a 40-60% chance of having RD themselves. Early behavioral signs of risk for reading disability are delays in the development of oral language. Children who are late to speak or who show delays in the acquisition of spoken vocabulary or grammar often go on to have difficulties in learning to read. Other early language problems that may foretell later reading difficulties are poor verbal short-term memory and/or a lack of an awareness of the sounds in words (i.e., phonological awareness). The latter difficulties can lead to problems recognizing the relationship between how words are pronounced and how they are spelled, i.e., the alphabetic principle.

When family risk or early language problems are not apparent, universal screening can be used to identify children who are at risk for RD. This screening is often completed as early as the beginning of kindergarten and has been shown to be quite accurate in identifying children at risk. In addition to screening, progress monitoring in response to instruction/intervention has been used to improve accuracy even further. Measures of phonological awareness and oral language are frequently used in screening and progress monitoring. In addition, letter knowledge and/or sight word reading have been assessed. The latter assessment has proved to be particularly informative.

Research has shown that children who get off to a slow start learning the letters of the alphabet and/or initial sight words (after appropriate instruction) typically have subsequent difficulties in learning to read. Very few children appear to have what might be considered a developmental delay in which an initial slow start is followed by rapid growth and benchmark attainment. Because of this, intervention should not be delayed and should begin as early as possible to achieve the best outcomes. Early intervention cannot only accelerate the acquisition of reading skills but can limit the negative consequences associated with RD. Early intervention can also assure that children do not miss opportunities to acquire vocabulary and word knowledge through reading in the early school grades. Finally, timely intervention can prevent the acquisition of inaccurate and/or unreliable reading strategies often seen in struggling readers.

This volume includes a series of papers that are relevant to early intervention. Several articles address the nature of screening instruments, their effectiveness, and/or how screening tools should be evaluated. Other papers discuss strategies for early intervention as well as evidence for the importance of such intervention. Taken together, this volume demonstrates that through early identification and intervention we can better assure that all children experience the joy of reading.



ABOUT THE AUTHOR

HUGH CATTS
Professor and Director,
School of Communication Science and Disorders
Florida State University

Dr Catts' research interests include the early identification and prevention of language-based reading disabilities. He is currently a investigator on two projects funded by the Institute of Education Sciences. One project involves a five-year longitudinal study that is designed to increase our understanding of the role of language skills in reading comprehension, and knowledge of how to effectively increase reading comprehension through systematic classroom-based instruction. The project involves a consortium of researchers from the Florida State University, University of Kansas, Ohio State University, University of Nebraska, Lancaster University (England) and Arizona State University. In the other project, Dr. Catts and his research team at KU are examining the effectiveness of Response to Intervention as a framework for the identification of kindergarten children at risk for reading disabilities. Both of these projects provide excellent opportunities for student research experience and training.

Welcome

Nor Ashraf Bin Samsudin

Director, Specialised Educational Services
Dyslexia Association of Singapore

It is with great pleasure that I introduce the DAS Handbook of Early Intervention, a collection of recent and relevant articles relating to the topics of early childhood education and specific learning differences. This handbook is useful, in particular, for practitioners, who are looking for materials that are relevant to our context in the Asia Pacific.

Singapore is a multiracial, multireligious society that is heavily reliant on its manpower to fuel its GDP. It is well known for its high educational standards and good performance in international tests such as the Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS). One of the notable traits to highlight is that these good performances have been consistent since 2001. In the area of reading for example, Singapore has been consistently been improving on its overall score and managed to achieve 4th in the overall rankings of 45 educational institutions worldwide.

One of the key attributing factors to this good performance is the emphasis on "levelling up" the academically weaker once they have been identified. The Ministry of Education of Singapore has developed a programme called Focused Language and Assistance in Reading (FLAIR) to help preschool students, identified at PAP Community Foundation (PCF) centres, with learning difficulties develop their oral and aural abilities. In 2013, it was announced that MOE would be extending this programme to their K1 students. The Ministry for Social and Family Development, on the other hand, has also developed an early intervention programme called the Development Support Programme (DSP), which was piloted in 2012.

> "In the area of reading … Singapore has been consistently improving on its overall score and managed to achieve 4th in the overall rankings of 45 educational institutions worldwide."

The programme which costs approximately $4 million a year to run, aims to support students with mild developmental delay or learning differences so that they can have a smoother transition into primary school.

The DAS Preschool Early Intervention Programme (EIP) is part of the services provided by the Specialised Education Division of the Dyslexia Association of Singapore and aims to complement the content of these programmes, with what it currently has, to prepare a child to be school ready. Due to its emphasis on remediating students with a learning difference and its focus on building up key literacy skills, this is easily possible.

Due to Singapore's heavy emphasis and investment into education, a lot is expected of each child as they enter into Primary 1 at the age of 7. All subjects, with the exception of the student's mother tongue language are taught in English. To be school ready, a Singaporean child is expected not only to be able to recognise their alphabets but to be able to read, spell and write relatively proficiently. In Singapore, a child is expected to have already mastered their emergent literacy skills by the time they have entered Primary 1. Students with a learning difference may have difficulties with these expectations and this is where we hope that the DAS Preschool EIP is able to provide the necessary intensive and high quality support to help them to 'level up'.

The DAS EIP curriculum encapsulates the important emergent literacy skills (and knowledge) within our scope and sequence . To deliver a programme that caters to the student's needs, all children will have to go through a Comprehensive Literacy Assessment on their first lesson. Through that, an Individualised Intervention Plan (IIP) will be formulated and educational targets will be set. Lessons are conducted by qualified teachers using principles that have been proven effective for learners with a learning difference. It is heartening to note that the recent study conducted by the DAS Preschool Programme provided strong evidence that a multi-skill 2-hour a week DAS EIP is effective in helping our students acquire the necessary literacy skills required for school readiness.

DAS would also like to express our deepest gratitude to our kind sponsors, NTUC OrangeAid who have, to date, donated close to $730,000 in support of needy students attending our classes. Their generous sponsorship has certainly gone a long way in ensuring that finance does not become a barrier to a child receiving the necessary intervention before entering primary school.

It is my hope that you will find the contents of this handbook useful in enhancing your understanding of Specific Learning Differences in the early years which will in turn benefit the lives of many children in helping them to cope and transit into their formal schooling years smoothly.

ABOUT THE AUTHOR

NOR ASHRAF BIN SAMSUDIN
Director, Specialised Educational Services
Dyslexia Association of Singapore

Ashraf has spent the last 10 years teaching and coaching students with dyslexia and other learning differences and is now the Director of Specialised Educational Services of which the Preschool Early Intervention Programme (EIP) is one of many services provided by DAS in this division. Prior to this, he was appointed as the Assistant Director of Education, taking the lead in various curriculum development projects across the different programmes at DAS. During this time, he also presented numerous workshops and talks to parents, educators and professionals around the island to help spread the awareness of learning differences as well as to provide useful and practical strategies for them.

Ashraf has a Post Graduate Certificate in Learning and Teaching in Higher Education, London Metropolitan University and is currently undergoing his Masters in Education (Leadership, Policy and Change) with Monash University. With his training in dyslexia and in Neuro Linguistic Programming, he blends knowledge from these two fields to deliver programmes which emphasises importance on the acquisition of not only the hard skills but the soft skills as well.

SPECIALISED EDUCATIONAL SERVICES

OUR VISION:
Nurturing individuals with learning differences to achieve success and impact society positively

OUR MISSION:
Unlocking the potential of individuals with learning differences.

OUR SERVICE:
Specialised Education Services (SES) is a division of the Dyslexia Association of Singapore which aims to uncover the true strengths of individuals with learning differences and empower them with the necessary skills and strategies to succeed. SES has a dedicated team of professionals who are committed to delivering a quality service focusing on the needs of the individual and strives to bring out their very best.

Editor's Message

Emeritus Professor Angela Fawcett
Research Consultant
Dyslexia Association of Singapore

To celebrate the visit of Hugh Catts, an expert in the area of early intervention, and in recognition of the importance of the topic, we are drawing together a series of articles drawn from the first few issues of the Asia Pacific Journal of Developmental differences (APJDD) in conjunction with further research evidence in to this book, DAS Handbook of Early Intervention.

We have encouraged researchers with material pertinent to this issue to submit their work for review. This is an area of research very dear to my heart, through many years of experience working with children in the early school years. The articles presented report important results and highlight the need for continued provision of specialised support at this age level, in order to prevent reading failure and the subsequent damage to self-esteem and potential.

The handbook falls into two sections. The first section draws on preschool material largely from Singapore, and the second on the early school years, with material from the USA, UK and Europe and Asia more generally. Don't forget here that children start school at very different ages across countries, the September following their 4th birthday in the UK, age 6 in the US, and age 7 in Singapore and many European countries.

"The articles presented report important results and highlight the need for continued provision of specialised support at this age level, in order to prevent reading failure and the subsequent damage to self-esteem and potential"

Section 1: Singapore Preschool Landscape

Following the preface and welcomes, we start from a general perspective, with an introduction from me, on how to evaluate screening and intervention. Let me explain the plan here, as we move through the preschool years.

The next set of articles again move from general to specific on preschool provision for children at risk of dyslexia by the DAS in Singapore, outlining the types of support that can be provided for these children. The section starts with an article from Wong Kah Lai adapted from the DAS Handbook, 2014, including a case study with new material and examples of children's work and parent, children and teacher reflections. The children's ratings of smiley faces are particularly interesting here, and have inspired the development of the new Social and Emotional Learning kit, developed by Wong Kah Lai in conjunction with students from the Ngee Ann Polytechnic School of Humanities and Social Sciences. The article by Thomas Sim and colleagues from DAS focuses on the importance of early intervention for children at risk of dyslexia and is reprinted from the Asia Pacific Journal of Developmental Differences (APJDD). In this study, 56 children aged 5 to 6 undertook structured multi-sensory intervention over periods ranging from 10 to 70 weeks. The results indicated strong improvement in all aspects of the skills targeted, and revealed effect sizes that surpassed many of the findings from the National Reading Panel meta-analysis in 2001. Moreover, the improvements included striking increments in reading, which can be notoriously hard to improve even when phonological skills are remediated. The next article by Lois Lim examines the progress of 201 children on starting the MAP programme, and finds striking evidence of greater impact in reading and spelling for those children starting in P1, in line with international research on the benefits of early intervention.

DAS is interested in the development of the whole child, and so we also include here a section on drama at DAS, for 7-8 year old children that emphasises the whole child emotional development moving into the drama for literacy approach, a programme that many parents opt to join in addition to the MOE-aided DAS Literacy Programme (MAP) which is based on Orton Gillingham principles. An article from Shuet Lian Ho from DAS illustrates the effectiveness of speech therapy in working with young children at risk for dyslexia. Following on from this, a case study from Shuet Lian Ho shows the speech therapy approach in action with an 8 year-old boy over a 20 week period.

A section on the effectiveness of screening tools used by DAS in Singapore follows. The article by Brookes et al, reprinted from the Journal of Educational Psychology with permission, focuses on the usefulness of the CoPS Lucid screening tool. The article by See Shuhui Jacey and Koay Poay Sun reviews the impact of screening on the identification of children at risk for dyslexia within DAS, using the Dyslexia Early screening test (Nicolson and Fawcett, 2004). The 2nd article on this topic by Fawcett and colleagues 'Sustained benefits of a multi-skill intervention on preschool children at risk for reading difficulties' considers the value of screening and intervention with children in nursery in the UK and demonstrates lasting impact for a short-term intervention at age 4 years in comparison with controls. These two articles are again reprinted from the APJDD. Finally in this section Wong Kah Lai and her preschool teachers from DAS presents a series of practical solutions for preschool teachers – See, Say, Do! to enable teachers to apply the approach themselves.

Section 2. Early School Intervention

The second section of the Handbook moves on to consider the literature on early school intervention in the UK and USA, with my comparative review of the effectiveness of a range of interventions, drawn from the National Reading Panel, Brooks and Singleton's reviews and the What Works clearinghouse.

I am then proud to present an authoritative review from Professor Joe Torgesen and colleagues from the USA on the importance and value of early intervention. The evidence from Torgesen on the impact of intervention at an early age has been seminal in the move towards universal early screening and support which I have been advocating since the 1st edition of our early screening test, the Dyslexia Early Screening Test (DEST) for children aged 4.5-6.5, in 1996. It is clear that even a short-term intervention at this age, the early school years in the UK, can have lasting effects, on the principle 'a stitch in time saves nine'.

An important article from Hugh Catts considers whether or not it is possible to differentiate between children with Specific Language Impairment and Dyslexia, and is reprinted with permission from The Journal of Speech, Language and hearing research. The first experiment follows 527 children identifying specific language impairment in kindergarten and assessing continuity with diagnoses of dyslexia. The article concludes that despite the co-morbidity between the two conditions, these are separate conditions. A second experiment with a subset of participants identifies a continuum of impairments on phonological processing, with dyslexic children more affected than those children with Specific Language Impairment.

The articles that follow all derive from the first three issues of the Asia Pacific Journal of Developmental Differences.

The next two articles address a key area for language learning in Asia, the difficulties encountered by dyslexic children in learning Chinese. The Lee and Poon article addresses, 'The impact of teaching methods on learning Chinese characters in bi-lingual children with dyslexia'. The authors show that the Stroke method is more effective than Hanyu Pinyin in teaching children Chinese characters in Primary 1.

The article from Kevin Chung at the Hong Kong Institute of Education represents a highly innovative approach to measuring the skills of poor and adequate readers of Chinese, focusing on differences in executive function as well as phonology. The approach adopted involved measuring performance across a broad range of skills in 78 children, including poor readers and matched controls. Interestingly, executive skills, in this case self-regulation measured by a test of inhibition, the Heads Toes Knees and shoulders test. In this novel test, children are required to inhibit a command to tough their head and instead touch their toes. This measure of self-regulation accounts for unique variance in reading comprehension after controlling for age and IQ. This may be either a causal factor or a consequence of difficulties in learning to read in Chinese. It would be extremely interesting to use tests of this type in evaluating readers in English, because it is clear that executive skills of this type contribute to readiness to read.

The final two articles in this section are drawn from Europe. The first considers one of the major theoretical contributions of recent years has been the recognition that naming speed may be a factor in deficits arising in dyslexia, with those children who experience both phonology and speed deficits the most difficult to remediate. This is based on the research of Professor Maryanne Wolf and her colleague Professor Pat Bowers. Naming speed is an interesting test, because it involves eye movements, keeping your place on the page, and retrieving names from your lexicon, while maintaining your speed of articulation. It has been called a compendium test with the ability to identify a range of different problems, particularly when there are difficulties in object naming. However, it is clear that this knowledge has not yet been widely disseminated across the Asia Pacific region. Therefore a review of the area provides a useful adjunct to our understanding of deficits in dyslexia, in this article by Dr Kadi Lukanenok from Taillin University.

It is important to recognise the many manifestations of dyslexia in different subtypes of dyslexia, while not denying the importance of the overarching phonological deficit. In the next article by Jost from the Czech Republic, the progress of a young child in developing literacy is followed, with a case study of the predictive value of eye movements, amongst other tests for learning differences. Over a five year period, a group of around 100 children were tested on eye movements, IQ, reading, motor skills, attention and self-esteem. The case study from this child provides some support for the use of eye movements as a possible prognostic indicator for dyslexia and other learning differences. This suggests that eye movement differences may be important in a small subset of children with dyslexia, and may be an additive factor for some other dyslexic children.

In conclusion, the DAS Handbook of Early Intervention provides a theoretical rationale for the need for early intervention based on evidence based practice from around the world, and illustrates the approach that DAS have adopted in order to fulfil this need. We hope that you will find this publication both interesting and useful!

EMERITUS PROFESSOR ANGELA FAWCETT
Research Consultant
Dyslexia Association of Singapore

Emeritus Professor Angela Fawcett is a leading international researcher into dyslexia and other developmental disabilities, encompassing a range of theoretical and applied contributions to this field. Angela is also an Honorary Professor at the University of Sheffield. Her approach is broad and interdisciplinary ranging from child and cognitive development to educational screening and intervention, as well as developmental cognitive neuroscience. She is the Vice President of the British Dyslexia Association and also the Former Chair and Director of the Centre for Child Research at the Swansea University, UK.

SECTION 1

SINGAPORE PRESCHOOL LANDSCAPE

Are you concerned about your child's **literacy** development?

Problems in learning to read and/or spell could be signs of specific learning challenges such as dyslexia. This applies when a child's overall progress seems at odds with his/her general ability level.

If your child has difficulty in these areas:

- Letter formation
- Letter sequencing
- Reading
- Spelling
- Learning of sight words
- Handwriting
- Following multi-step directions or routines

Our Preschool Early Literacy Intervention team will address your concerns about your child's literacy development and share with you help that is available.

For preschool children only.

FREE SCREENING AT DAS

Early Years Literacy Profiling Test for K1 - K2 children only.

DYSLEXIA ASSOCIATION OF SINGAPORE

HELPING DYSLEXIC PEOPLE ACHIEVE

For more information on our FREE screening dates

Please contact us at **6444 5700**

Screening and Intervention for Young Children: An Introduction and Case Study

Emeritus Professor Angela Fawcett
Research Consultant
Dyslexia Association of Singapore

It is never too early to seek further advice on assessment and interventions for your child, if you are concerned. In the case study below we show that problems, if left unsupported, develop further over time, but even short term targeted support linked to screening can not only be successful but also persist over time.

In the early years in school, and even before children start school they learn huge amounts of information. Parents should seek help if they notice that their child seems to be having difficulties. These may include speech, behaviour, concentration, clumsiness, eye contact, and listening. Parents can find a range of check-lists that will show them whether or not their child's behaviour is age appropriate. This is possible even for young babies.

We all know that there are individual differences in the speed of development, and that some children will focus on their motor skills, while others develop their language. However, if your child is missing their targets, it is important that this is followed up and they receive a check for sensory processing, amongst others.

If your child attends preschool you should receive detailed comments on their development and how this fits within the developmental stages. Even preschool and nursery now have criteria for successful development. They will alert you if they notice problems for your child.

"Parents should seek help if they notice that their child seems to be having difficulties. These may include speech, behaviour, concentration, clumsiness, eye contact, and listening."

Once your child reaches school, there are a number of key periods that should be monitored. Transitions, from preschool to school, infant to junior, primary to secondary and beyond, are all times when your child will be under additional stress in trying to get to grips with the demands of a new environment. It is particularly important that you liaise with the school at these stages to let them know if there are any problems. If there is a family history of dyslexia, schools should be informed, so that your child can be carefully monitored.

In order to ensure your child is ready for school, you need to check that they can follow simple instructions, dress themselves, sort out their toilet needs, and take part in all the activities that are expected of them. In order for a child to learn successfully, their spoken language, listening skills, memory, attention and all their executive functions need to be developed to the appropriate level. If they are not yet ready to learn, then they will experience problems in early schooling.

Some children with dyslexia will seem to learn well in the infant school and their problems become apparent in the juniors or at secondary level. It is important to seek help as soon as you are aware that there are difficulties.

BACKGROUND

Why is it so important that we identify children who are likely to struggle with learning to read? Children with Dyslexia will fail to progress in the early stages of learning, although they may seem to have the ability to achieve in line with their peers. This seems to be because they need to be taught very explicitly in order to pick-up and remember what they have been taught. Research evidence from the USA has shown that children who do not receive the support they need in the early years may need 67.5 hours of one-to-one support in order to catch up with their year group in junior school. This is an enormous amount of support and will inevitably be very expensive to deliver.

In order to identify children who need support in the early years the concept of screening and intervention must be introduced. Screening is a process that identifies children at risk of dyslexia, at a stage before they could formally be diagnosed. This is a method which can empower teachers to identify problems in the children they work with.

There are a number of screening tools, including DEST-2, DST-J from Fawcett and Nicolson, CoPs from Singleton, and the Dyslexia Profiler from Smythe. The first two tests were designed as pencil and paper tests to be administered individually. Screening tests by Singleton can be delivered as a group test by computer, and have been used by the DAS to screen children of concerned parents in group sessions. The Dyslexia Profiler is still under development for younger children and again is delivered by computer, and has recently been evaluated as a possible tool to be used by DAS.

There are also a number of tests that tap narrower aspects of dyslexia including tests for phonological difficulties; these include Phonological abilities test (PAT) from Muter, Snowling and Hulme, and Phonological assessment battery from Fredrickson, Frith and Reason. These are available from www.dyslexiaactionshop.co.uk.

SCREENING

What is screening? Screening is generally a quick and low cost test suitable for widespread use, which is administered by trained, but not specialist, personnel. Where a full diagnosis of dyslexia involves an educational psychologist, takes three to four hours, and generates a full report, a screening test should take no more than 30 minutes per person, and should generate a short report. Screening may be given to everyone, or to a subset identified by the teacher as having difficulties.

CHECK LISTS

This is a simple yes/ no check list of problems that have been associated with dyslexia and other learning difficulties. Usually there will be a cut off for the number of issues identified that generate further action, including those identified in the studies below. A key indicator is the presence of dyslexia in the family, given that there is a 50% chance of being dyslexic if your parent is dyslexic, although a number of protective factors such as good spoken vocabulary can prevent the expression of the difficulties. This approach is under further development for use by the DAS in Singapore.

EARLY SCREENING

Some excellent theoretical studies have been undertaken (e.g. Muter et al., 2004) investigating precursors of literacy in longitudinal studies, identifying in 6 and 7 year olds which skills at 4 and 5 are the best predictors of later success. These skills change over time, with rhyming and articulation in preschool children the best predictor of later phonological skills (Carroll et al., 2014). The crucial aspect of early screening is that it moves away from the 'wait to fail' approach that formerly characterised diagnosis in dyslexia, and tries to identify problems early on and provide appropriate intervention. This leads to an ethical dilemma. The most successful screening tests are those that accurately predict which children will have difficulties. From an experimental viewpoint, it would be ideal if schools were not made aware of any potential difficulties, so that none of the children identified as 'at risk' were supported in school. The best predictive validity would be found if results were sealed away, and experimenters waited for the children to fail as predicted. However, if a child is identified as being at risk at five years, from an applied perspective it is unethical not to provide the support needed to help the child to learn to read normally.

Although screening tests should be objective, reliable and valid, they also need to be quick, suitable for non-specialists, and provide a quantitative 'at risk' score. Two key aspects for any screening test are the 'hit' rate (the percentage of 'really at risk' individuals who are screened as 'at risk') and the 'false positive' rate (the percentage of 'really not at risk' individuals who are screened as 'at risk'). An ideal screening test would have 100% hit rate and 0% false positive rate, but a more realistic target would be more like 85% hits and only 20% false positives, there is a trade-off between hits and false positives, so that it is easy to increase the proportion of hits by relaxing the 'at risk' cutoff, but this will increase the proportion of false positives.

Interestingly, it is much easier to predict those who have strengths in literacy rather than those who are at risk. It is particularly important that tests used for screening are set at the right level for the age group, and normed on a representative population, with no more than around 20% coming out at-risk.

There are a number of advantages for computer based screening, which places fewer demands on teachers and teaching assistants than paper based tests. On the other hand, many teachers prefer to administer tests themselves because they gain so much information from how the test is completed, which itself forms part of the profile. Moreover, there is potential for error in work on computers, because participants may not understand the demands of the task, and the computer cannot identify this, whereas a teacher can.

Another approach to screening is to monitor performance on specific theoretical aspects of literacy that have been associated with dyslexia, and these include tests of phonological processing. Interesting recent work on computerised screening for visual stress in children diagnosed with dyslexia (Singleton and Henderson, 2007) shows that around 40% of dyslexic children had some evidence of problems with visual stress based on significant differences in speed of identification for 3 letter words presented against a stressful black and white striped background. The visually stressed dyslexic children showed an improvement in reading speed with a coloured overlay and reported more symptoms. However, it should be noted that the evidence for visual stress in this group was not very strong, nor was there significantly greater incidence of stress in the dyslexic children than the reading age controls. This suggests that visual stress may not be specifically linked to dyslexia, but that it is an added difficulty for those who have both dyslexia and visual stress.

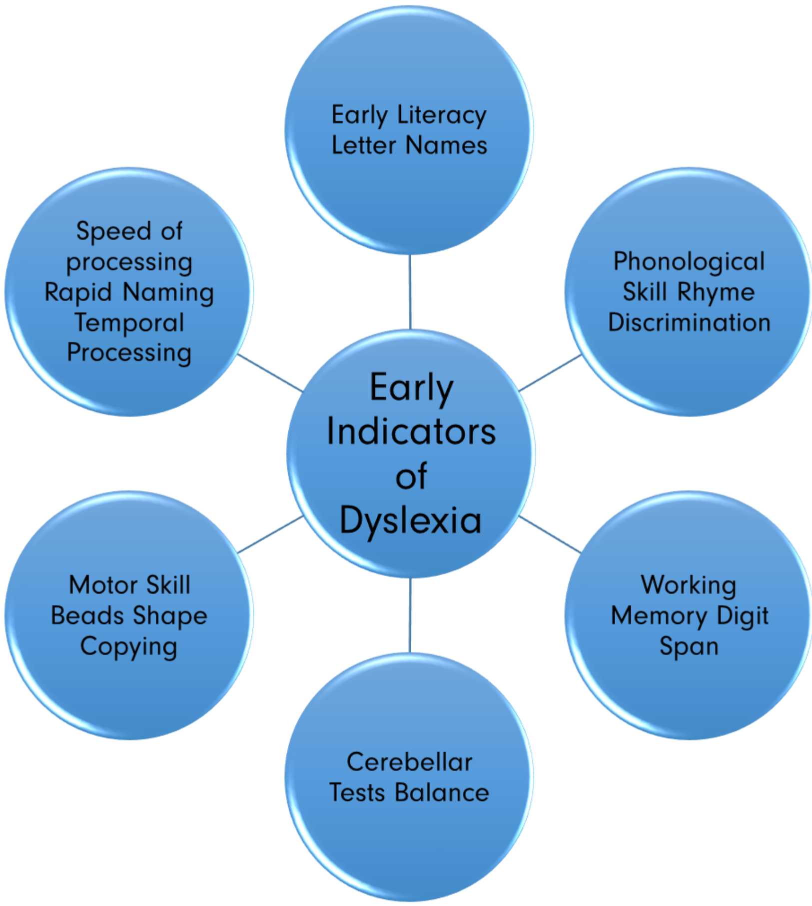
Screening young children empowers teachers to identify problems before they become entrenched, and enables them to use a profile of strengths and weaknesses to inform the development of an individual education plan. Furthermore, given the intended use of screening tests as the first stage in the support process, the most useful screening tests are designed to quantify strengths as well as weaknesses.

The DEST-2 is the broadest conceptually of the tests outlined above. It is a 30-minute nationally normed test intended for teachers to screen children from 4.5 to 6.5 years, and comprises a basket of sub-tests selected to give positive indicators of likely reading failure. The DEST leads to an 'at risk' index, together with a profile of strengths and weaknesses indicative of the appropriate types of support. Naturally the emphasis in designing the DEST was on the inclusion of tests on which there is a consensus in the research community. The intention was that the tests adopted would cover a sufficiently wide range of skills to give *positive* indicators of difficulty, and the tests selected were based on those with the greatest severity and highest incidence in the general population of children with dyslexia (Nicolson and Fawcett 1994). Tests of phonological skill were augmented with tests of clumsiness, on the basis of research (Fawcett, Nicolson and Dean 1996). The choice of tests was also tuned to the requirements of the UK Code of Practice, (§3.60-3.63). A key requirement is that *"... there is clear, recorded evidence of clumsiness, significant difficulties of sequencing or visual perception; deficiencies in working memory; or significant delays in language functioning"* (§3:61iii). – the statutory requirements for the initial stages in statementing.

The DEST was designed to screen for learning difficulties of all types, including language delay and general intellectual impairment, as well as specific learning difficulties, in particular dyslexia. Over 100 schools nationwide took part in the norm collection, feedback was given to all the schools involved, and with tests expressly designed for teacher interpretation, it is clear from the profiles which children have problems, and in which areas needed support. When a subset of 100 children were retested at age 8 a hit rate of 18/20 (90%) was obtained, with a false positive rate of 8/77 (12%). This means that the DEST identified the majority of children who later had difficulties, and by adding a category of 'mild risk' all the children with problems were identified.

ABOUT THE SCREENING TOOL

The Dyslexia Early Screening Test (Nicolson and Fawcett, 2004) uses early indicators of dyslexia, see the figure below, to identify children between the ages of 4.5 and 6.5 who may be at risk of failure. This enables preschool staff to identify pupils who may have difficulties with early literacy and/or motor difficulties. In the first instance a checklist can be administered to identify any teacher concerns.



Summary: The danger if screening tests are too narrow is that they identify only reading problems, not the more complex difficulties associated with dyslexia. There is considerable misunderstanding about screening tests, which are not meant to replace diagnosis but designed to aid the teacher in identifying problems and providing support, in line with best practice. The DEST is now the best-selling screening test for dyslexia in young children, it has been used successfully by the DAS, and the DEST-2 is now under development for use in Malaysia by NECIC.

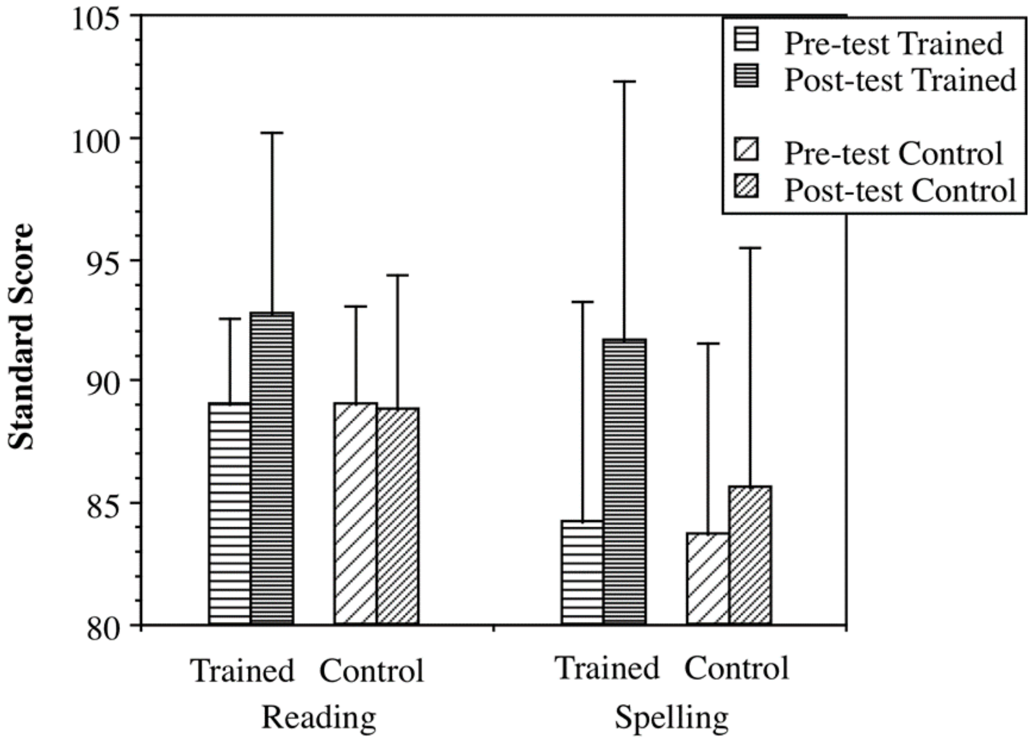
Although the screening tests are designed to take only 30 minutes to deliver, they need to be administered individually and could be demanding in terms of limited teacher time. However, the teachers themselves have noted how much they have gained from administering the tests themselves, because of the deeper understanding it can provide about children with Dyslexia. Overall, the teachers were agreed that it was useful to administer the test themselves, in order to see gaps in the children's knowledge, even in children who were not at risk overall, which were not easily identified in the course of their teaching. Schools had noticed how much difficulty the children experienced with rhyme, which they had not previously recognised. Schools can identify unexpected difficulties in children they had not previously suspected would struggle. This may be because many children with Dyslexia have good vocabulary, appear to be bright, and work out strategies to hide the fact that they are struggling.

LINKING SCREENING TO INTERVENTION

There are a number of different approaches that can be used to screening and intervention, and here we shall first consider some research conducted in the UK, which shows the effect of short-term intervention, just 10 weeks. In earlier research Angela Fawcett and her colleagues (e.g. Nicolson et al., 1999, Fawcett et al., 2000) showed that children aged between five and seven can make significant progress following a 10 week small group intervention, with support given three times a week for 20 minutes. The type of support was based on Reason and Boote (1994) and emphasises meaning, phonics and fluency.

These six year-old children showed mild problems in reading and spelling and after the 10 weeks, their performance had improved so they now fell into the average range. By contrast, children who did not receive explicit intervention, just the standard school support, fell back slightly in reading. The bar chart here is based on standard scores, which take into account the age of the child as well as the level of accuracy they can achieve, in reading or spelling single words.

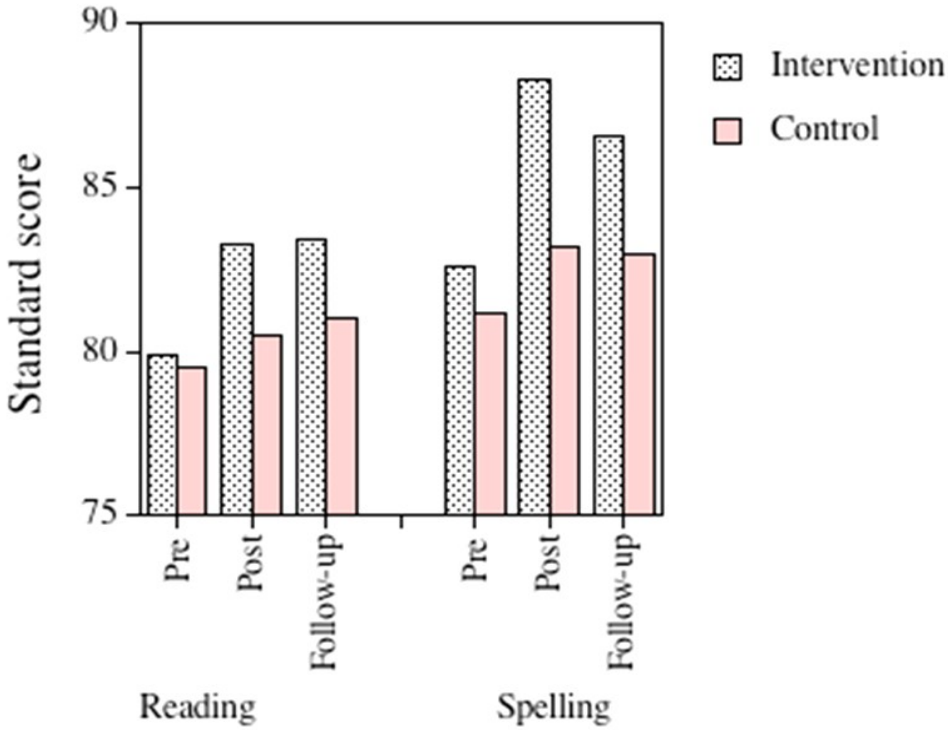
One of the difficulties with any type of intervention is that sometimes something called 'fade out' occurs. It may be that the extra interest shown in the child as well as the support provided, means that they improve. When support is withdrawn, they may simply fall aback to a lower score. So in our next study, with slightly older children aged seven, we also included a six month follow-up to check this didn't happen. Sure enough, the children who had received support maintained their progress, although they had only had a few weeks intervention. Looking at the figure, you can see that the intervention and control group had very similar scores at pre-test, when we started the intervention, but after the

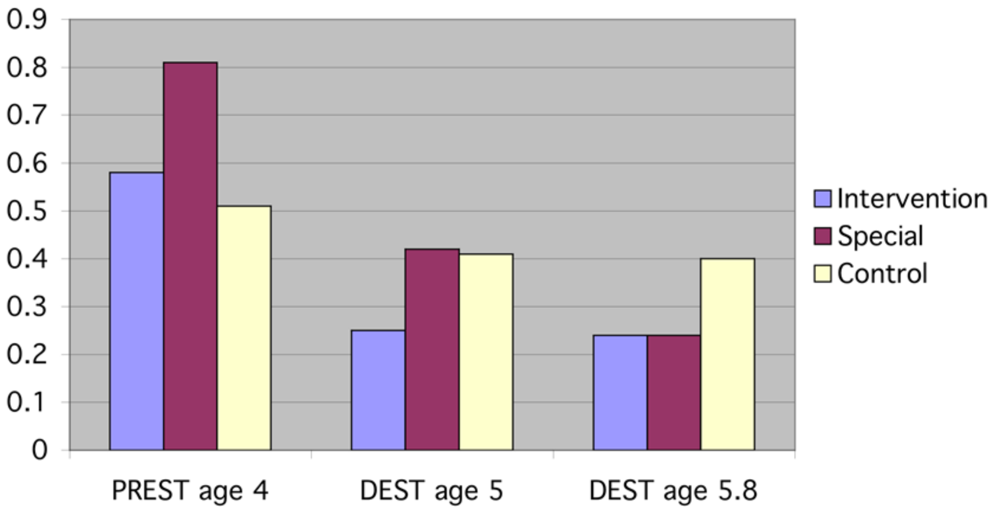


intervention (post-test) and at follow-up, the intervention group had made significantly more progress than the controls who had just ordinary classroom teaching.

This effective and cost-effective approach has also been used with even younger children, aged 4, using a combination of language, motor skill and pre-literacy games, and these effects have been shown to persist in longitudinal studies. In the figure below, the risk levels for the children are shown at age 4, and using the DEST at ages 5 and 5.8. The special group were those already identified at age 4 as having difficulties, including some with a family history of dyslexia, hearing impairment, attention problems, and mild autism. The special group also received intervention. It is interesting to see that this special group continued to have similar problems to the controls at age 5, although they had made tremendous improvements since their test at age 4. But by age 5.8, with further support at school, even the special group had caught up with the intervention group. It may be seen that children who had received intervention, again in small groups for about an hour a week for 10 weeks made striking improvements. So 85% of the intervention group were at risk at pre-test, and none were at risk in the later DEST tests (Fawcett, Lee and Nicolson, 2014). Where children are identified as falling behind their peers, the Dyslexia Early

Effects of intervention on reading and spelling





Screening Test (DEST-2) assesses the 6 key areas identified above. A test of receptive vocabulary was added for the 2nd edition, where the child must identify which word is represented in sets of 4 pictures, giving a rough measure of verbal ability/IQ. An analysis of the data provides the school with a report outlining the number of children likely to need support. From the assessment, appropriate interventions are suggested to scaffold and build areas of difficulties, whilst utilising areas of strength to build confidence and self esteem. The 'Hands on Literacy' pack provides schools with interventions for support staff to deliver, and was developed by Debbie Avington in conjunction with the Bridgend team, based on earlier research from Fawcett, Lee and Nicolson.

The Welsh assembly government recommended an early screening and intervention approach in their 2009 report. This approach has now been rolled out with 50 schools in South West Wales, including Bridgend and Pembrokeshire, working with children aged 5, and will also be used with children in Welsh cluster schools. The approach was first evaluated with experimental and control schools, and performance compared at pre and post-test. Criteria adopted for inclusion in the evaluation were an at risk score of 0.6 or more, indicating mild risk, with an at risk score of 0.9 or more indicating strong risk. Intervention was provided 2-3 times per week for 20 minutes for a 12-week period. Following the intervention, 75% of the intervention group were no longer at risk, reducing the risk factor by twice the amount of normal teaching, and there were significant improvements in identifying the first letter, a key skill in early phonological development.

One of the key issues here is how well it works for children with the greatest difficulties. It is relatively easy to help children with very mild problems, but often more severe problems are slow to respond to support. Here children with the greatest difficulties at pre-test made the most striking progress and only one child failed to progress. The feedback from teachers in schools taking part in the project was particularly pleasing overall, and the intervention is now in use in over 50 schools in South Wales.

The intervention was developed in consultation with the teachers who were to deliver it, following an introduction to the principles of structured multisensory teaching through games and activities that were based on five areas of development, phonological awareness, visual, spatial and auditory memory and sequencing. It also draws upon fine and gross motor skill development as documented in the publication 'Do and Discover - Fun activities to develop physical skills in the early years', which was prepared by Bridgend in collaboration with Sharon Drew. The approach here was linked to the Early years Foundation phase in Wales, which concentrates in pre-literacy skills delaying the introduction of reading until age 7. However, the more structured approach outlined in the section above is likely to be more useful to slightly older children.

In the picture above, the children are playing a naming game with a puppet, identifying the object by their first letters.

Staff asked for modelling of activities so that they could feel confident that they were giving children the best possible chance to develop appropriate skills. Recommendations for particular resources were requested and a detailed synopsis of ideas for developing multisensory boxes/ storage and display areas for the project. Progress was evaluated following the intervention in comparison with children who had not participated in the intervention in the control school. Following feedback from project teachers it was felt that it would be better to limit some of the activities introduced in the early stages of the programme so that there was more 'practice time' and that new activities should be introduced on a fortnightly basis to allow for assimilation and transference of skills.

Staff felt it was difficult to leave out any activities, however, as they were all popular with the children and appeared to have a positive effect. The intervention was extended to twelve weeks and more activities were added, honing the intervention programme to meet the continuing needs of the identified children in the pilot schools.

In the picture below, the children are practicing rhyming, a key skill in early learning and a predictor of success in reading. In order to make it more fun, the child must chose the two objects which rhyme, and then use the tongs to put the fish in the dish

In feedback interviews teachers felt they had gained knowledge and awareness of signs of Dyslexia. The experience had highlighted the importance of early intervention and they were now more confident in recognising and addressing the development of early literacy and movement skills. They appreciated the influence and support of specialist staff who contributed to the programme throughout the project.

The intervention therefore fulfilled its aims in enabling input from specialist staff that will contribute to the capacity, sustainability of knowledge and practice in participating schools.

All the children involved in the project enjoyed the multisensory activities and made progress but watching the children develop confidence and enthusiasm gave the greatest reward. The teachers thought that the project was interesting, informative and relevant and that the intervention programme could be transferred into good whole class practice. Evidence from teachers' and children's questionnaires, assessment results and overall statistical calculations point to an endorsement of the intervention programme in successfully facilitating accelerated development of early skills within the Foundation Phase classroom environment.

In terms of the intervention itself, therefore, universal satisfaction was expressed with the system developed, from the teachers, the children who had enjoyed taking part, and parents who were impressed with the outcomes. A number of schools had opted to use aspects of the screening, particularly the motor skills, and rhyming and phonology, as a whole school approach, even adopting some of the approaches in nursery so that future participants should have a good grounding in areas which had proved challenging to the current participants.

A short check-list has also been developed so that teachers can pinpoint those children they wish to screen with a view to providing intervention. The teachers were particularly impressed by some of the motor skill tasks, which they would not necessarily have included within their teaching.

In conclusion a short term targeted small group intervention proved effective and cost-effective in supporting children with difficulties in reception classes in South Wales. Records will be maintained on the children's progress up to the age of 10, so that we can see whether there are any long-term effects of the intervention, or whether as seems likely, further support will be needed over time.

CONCLUSIONS

Early screening and intervention can successfully impact on the development of the child in terms of readiness to learn, phonological skills and self-esteem. Research has shown that leaving children to fail can be particularly destructive in terms of self- concepts and progress, with children falling consistently further and further behind their peers over time. We have now have the opportunity and potential to provide support for young preschool children in Singapore, working through Kah Lai and other therapists at DAS to ensure that skills develop before the onset of formal schooling at age 7.

In the remainder of this book, we shall draw together a series of articles and chapters drawn from the Asia Pacific Journal of Developmental Differences and the DAS Handbook 2014, in conjunction with new materials, all of which highlight and emphasise the importance of early intervention.

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Emeritus Professor Angela Fawcett is a leading international researcher into dyslexia and other developmental disabilities, encompassing a range of theoretical and applied contributions to this field. Angela is also an Honorary Professor at the University of Sheffield. Her approach is broad and interdisciplinary ranging from child and cognitive development to educational screening and intervention, as well as developmental cognitive neuroscience. She is the Vice President of the British Dyslexia Association and also the Former Chair and Director of the Centre for Child Research at the Swansea University, UK.

Specialised
Educational
Services

UNLOCKING POTENTIAL

PRESCHOOL EARLY INTERVENTION

The aim of the programme is to help preschoolers who are potentially at risk of dyslexia, or has a developmental delay in early literacy, develop skills and strategies to become confident achievers when they enter primary school.

Our Approach

The SES Preschool programme helps preschoolers acquire a good foundation in alphabet knowledge and phonograms, leading up to learning sight words essential for reading. These abilities gear them towards reading and spelling readiness. In class, your child will be taught rules, facts and generalisations about the English language, enabling them to read and spell more effectively. They will also be taught strategies to cope with letter reversals. The programme follows a prescribed scope and sequence for systematic, sequential and cumulative teaching.

Components covered in a typical lesson

- Alphabet Knowledge
- Phonograms
- Learned Word Knowledge (e.g. said)
- Reading
- Spelling

Preschoolers will be advised to go for a Full Aged Psychological Assessment when they turn six. Children diagnosed with dyslexia has the option to continue with the MOE-aided DAS Literacy Programme.

Specialised Educational Services Preschool Early Intervention Programme

Wong Kah Lai
Preschool Programme Manager
Dyslexia Association of Singapore

There is now considerable evidence from research world-wide, that early intervention is the most effective approach to help children with dyslexia and other learning difficulties. Torgesen, (2001, 2014) has shown that 8 year old children need 67.5 hours of individual intervention to bring them to the level of their peers once they have fallen behind. However, evidence from studies with young children aged 4 and 5 in the UK have shown lasting benefits for early support (Fawcett et al., 2014; Nicolson et al., 1999). Moreover studies from Singapore (See & Poay, 2014) have shown that it is possible to identify preschool children at risk of failure.

Development is a continuum. In this developmental spectrum, young children achieve their cognitive, social, emotional and physical milestones at different rate and pace.

Although there is a general guideline, in the form of attainable developmental milestones, not all children progress at the same rate nor pace arising from nature / nurture factors and issues. 'Nature' factors and/or issues refers to in-born conditions that a child is born with, while 'nurture' refers to environmental factors that stimulate and help further shape the child's developmental growth. A key issue here is home background and stimulation of language.

Literacy delay is probably one of the most common developmental problems among preschool children. This happens when a child's language is developing in the right sequence, but at a slower rate. It could be a case of not having the language environment or stimulus, and amongst many other probable causes, a result of dyslexia.

As such, early outreach and intervention is crucial. The preschool service at DAS aims to identify and work with children identified as "at risk of dyslexia" so as to help them achieve in Primary One through our early literacy intervention programme. In the article below we outline the development and evaluation of a preschool literacy programme for early intervention in Singapore

ABOUT THE PROGRAMME

This programme is recommended for children at risk of dyslexia and those with learning differences in reading and spelling in Kindergarten 1 and 2. The preschool early literacy intervention programme framework comprises of literacy appreciation, letter knowledge, phonemic awareness, comprehension, sight words and fine motor skills acquisition within a suggested preschool scope and sequence.

Preschool education therapists formulate and devise an Individualised Intervention Plan (IIP) for students based on his/her specific learning needs obtained from the Pre-Informal Assessment at the beginning of the first remediation session with the therapist. No two learners are alike. In view of young learners with literacy delay, differentiated teaching is essential.

The lesson is delivered in an engaging and simultaneously multisensory manner based on the Orton-Gillingham (O-G) approach and principles. The O-G approach is a language-based approach where students are explicitly taught the rules, facts and generalisations about the English language.

SIX O-G PRINCIPLES GOVERN THE O-G APPROACH

Language based
It encompasses an awareness and appreciation of the features of the English language that includes reading, spelling, writing and learning strategies as appropriate to young learners' developmental needs.

Cognitive
It was noted that 85% of the English language can be made predictable with explicit instruction in rules and generalisations that govern its use. This tool enables young learners to read/spell more effectively.

Structured, sequential and cumulative
This is especially vital to a dyslexic learner. In order to achieve automaticity, content needs to be taught systematically in a sequential manner. Consistent review of previously taught/learned material fosters retention and enables the learning of new material to "spiral" upwards with each accumulation.

Simultaneously multisensory
Through visual, auditory, kinaesthetic and tactile activities, that builds a strong

and intense memory connection, young learners are more likely to be able to "retrace" and "retrieve" the memory of what-was-taught in the previous lesson/ session.

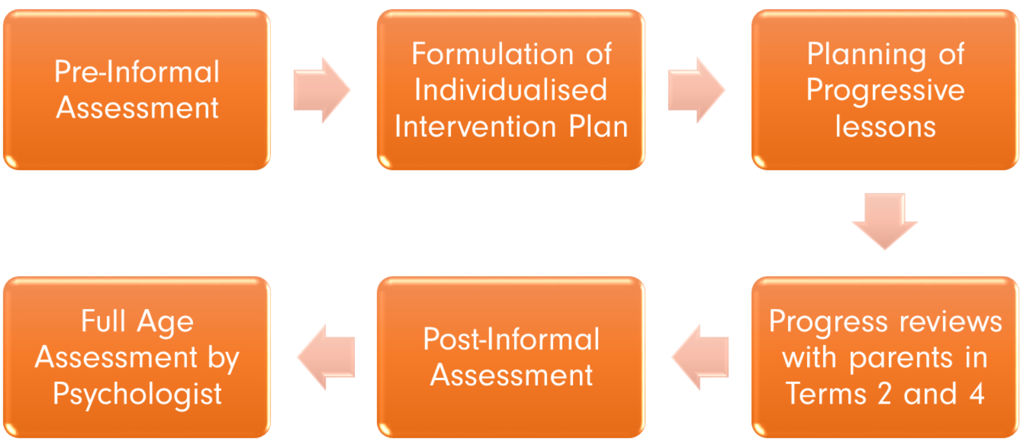
Diagnostic-prescriptive
No two learners are alike. In view of young learners with literacy delay, individualised teaching through IIP (Individualised Intervention Plan) is essential.

Emotionally-sound
Stress, anxiety and negative emotions can act as an affective filter that comes between learning and what-is-being-taught. Emotionally-sound delivery fosters and promotes learning and acquisition.

The programme was carried out in three tiers. Remediation by Educational Therapists and both the Preschool Screening Assessment (at point of admission into programme) and the Full Age Psychological Assessment (point of exit of the programme) by our qualified DAS psychologists. Children were grouped according to Assessment results/profiles. Each class consisted of 2 to 4 children, each having their own individualised educational plan. Children who completed the programme and were diagnosed as dyslexic may continue on with DAS in its main literacy programme at Primary One.

MEASUREMENT OF STUDENT ATTAINMENT

The process of measuring student attainment is summarised as follows:
Student progress is carefully monitored through observations made during each intervention session as appropriate. Based on the diagnostic-prescriptive nature of the O-G principle, the education therapist adjusts the lesson content for the



next session by addressing the areas of uncertainty, weakness and strength. Thereby, shoring up against weaknesses in foundation concepts, addressing gaps in foundation knowledge and leveraging on student's achievement and strength, promoting further interest and progress in learning.

THE PROGRAMME AIM

To help preschoolers potentially at risk of dyslexia achieve school readiness through our early intervention programme.

Outcomes of/Key takeaways from Preschool Programme

- Confidence to execute skills without fear, worry and anxiety
- Ability to self-regulate, self-motivate and self-discipline
- Ability to use literacy skills as an active tool in real time

STUDENT ACHIEVEMENT

Overview

This was based on the results of 40 bursary students whose learning progress was formally tracked since the beginning of the school year. According to research studies, if a dyslexic child is identified and given effective teaching before 7 years old, he/she may improve to a point where there is little disadvantage. After 7 years old, a sharp fall in the effectiveness of teaching interventions. After 9 years old, the effects of intervention seems to stabilise rather than remedy the relative deficit in reading skill. As such, the Preschool Programme views and celebrates the individual success of children "Assessed and no longer showing signs of dyslexia".

Success Indicators of student achievement

Success indicators were based on a child's improvement in one of five categories:

- Alphabet knowledge – able to sequence the alphabet, write lower case letters and write upper case letters
- Phonogram knowledge – letter to sound correspondence
- Learnt word knowledge – able to read learned words
- Reading – cvc, ccvc, cvcc, th, ch, and wh
- Spelling – as above

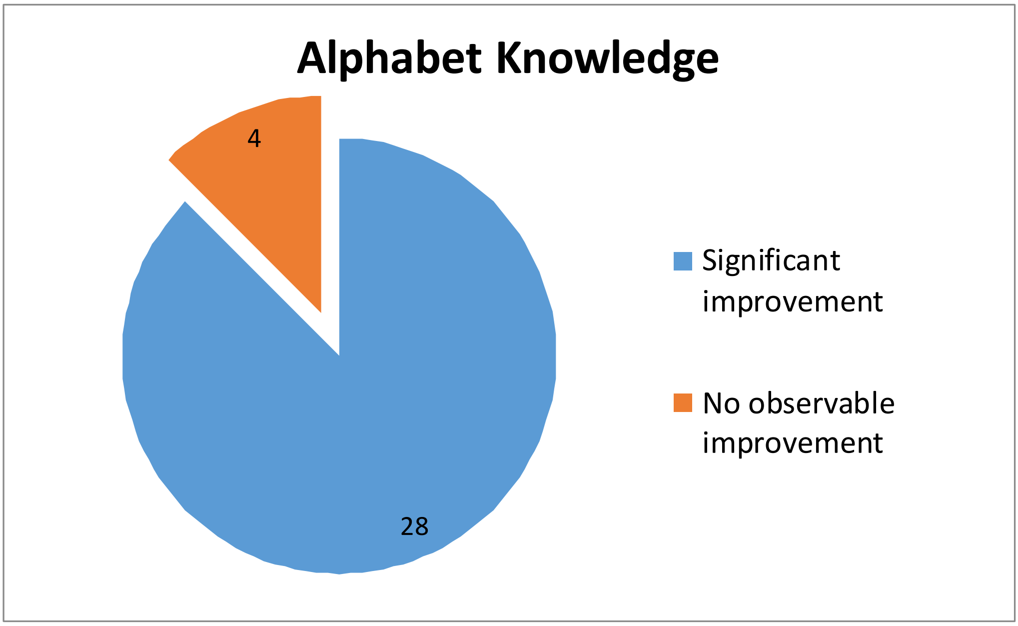


Figure 1.1 – Pie Chart of Student Improvement in Alphabet Knowledge

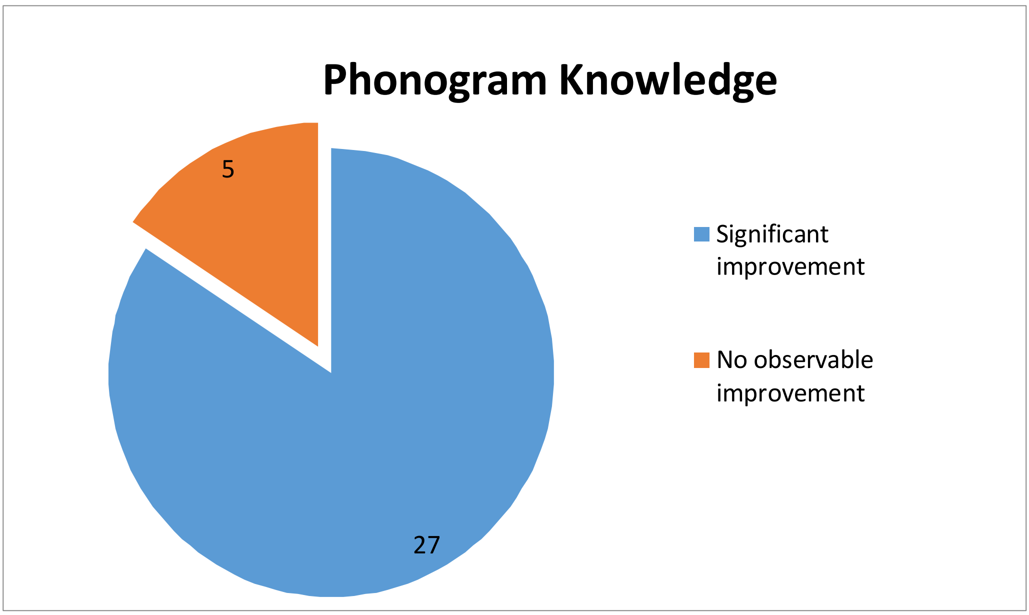


Figure 1.2 – Pie Chart of Student Improvement in Phonogram Knowledge

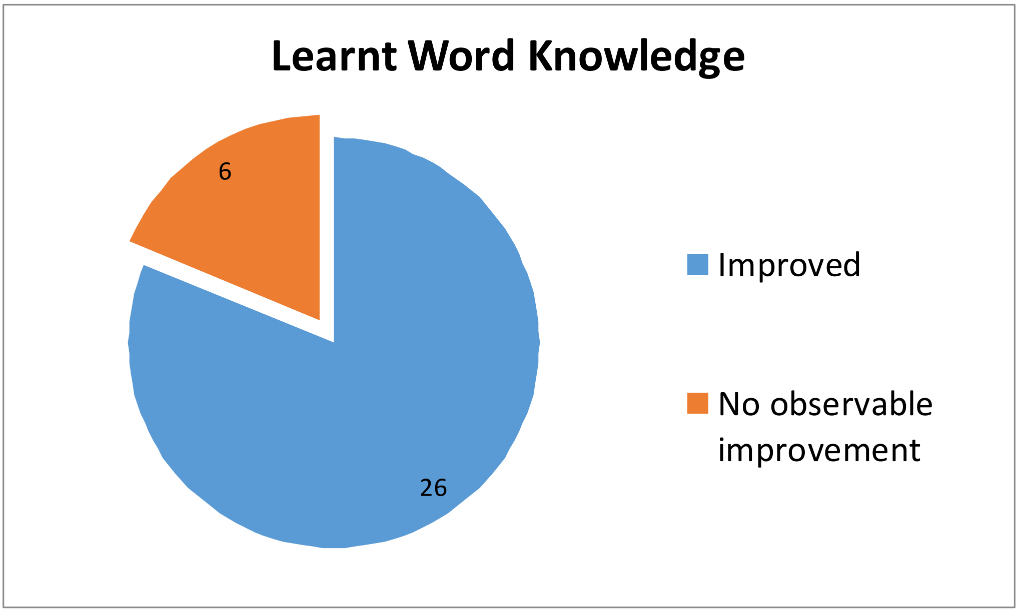


Figure 1.3 – Pie Chart of Student Improvement in Learnt Word Knowledge

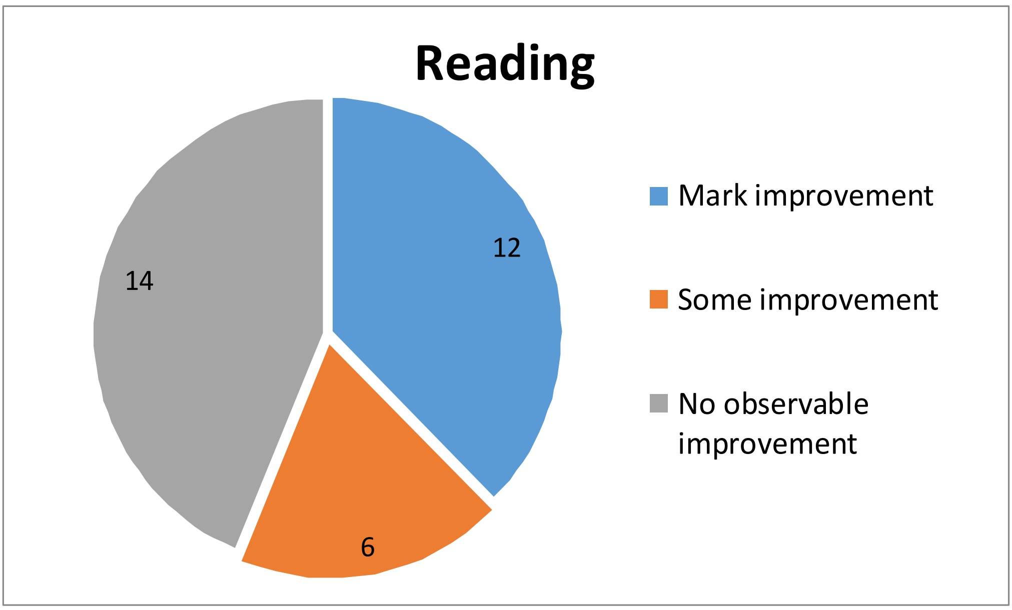


Figure 1.4 – Pie Chart of Student Improvement in Reading

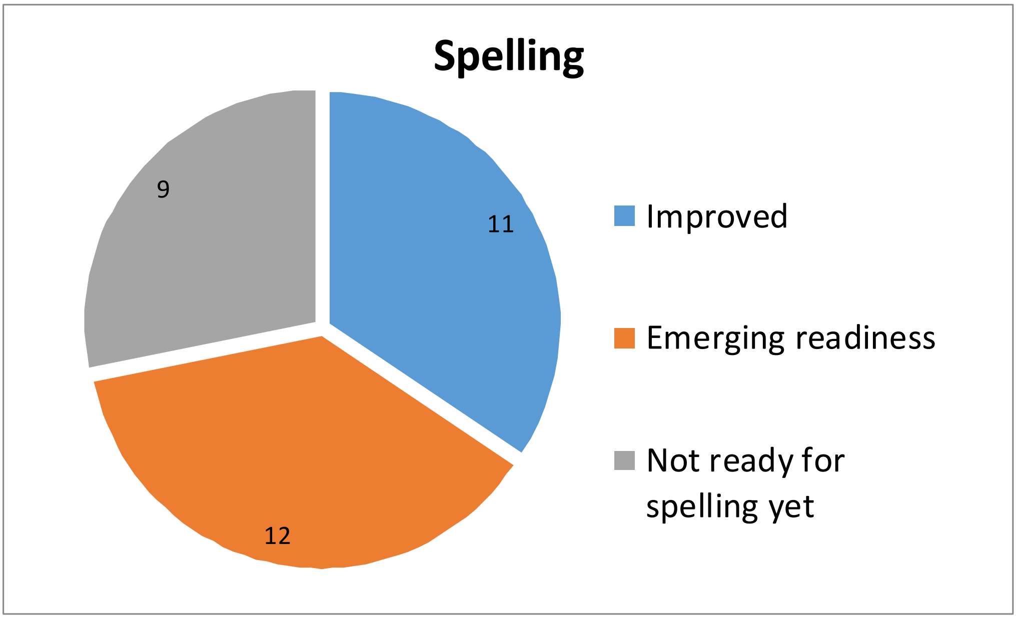


Figure 1.5 – Pie Chart of Student Improvement in Spelling

Results from the pre and post-assessment worksheets were used as the basis for comparison. A child was considered to have made an improvement if he/she achieves their Individualised Education Plan (IEP) or shows an improvement in their weak areas as listed above. Figures 1.1 to 1.5 above show the percentage of pupils showing an improvement in each aspect (statistics based only on students who have completed 20 hours or more of intervention):

Knowledge is progression based, with alphabet knowledge and phonograms being one of the cornerstones of early literacy, leading up to proficiency in reading and spelling. In early childhood education, development is viewed as a spectrum and the focus is always on **the process** and the gains along the journey of learning, not the product which is usually represented in a form of an assessment at the end. It is through **the process** that young children gain the tools and skills necessary to decipher printed text and craft writing at later stages.

As such, findings represented in Figures 1.1 to 1.5 suggested that most students had acquired a good foundation in alphabet knowledge and phonogram, leading up to learning sight words essential for reading, building a foundation towards reading and spelling readiness.

Although children may show improvement in their learning, those diagnosed as dyslexic will continue to remain on the DAS programme as they enter P1. One of the success indicators here is that we continue to enrol and diagnose dyslexic children correctly at their young age.

THE PRESCHOOL PROGRAMME: MOVING FORWARD INTO 2014

In the course of programme evaluation, several challenges came to light. Preschoolers joining our intervention classes came with the following problems.

1. Very little or a poor grasp of spoken English to begin with. This has a direct impact on our lesson delivery as English is our medium of instruction. It also impact upon children's learning through the inability to comprehend the concept taught

2. Weak fine motor skills – not deliberately targeted nor addressed through explicit teaching

3. Weak executive functioning – somewhat lacking and in need of explicit teaching of specific strategies that promote memory, and activities that stimulate memory development

4. Noticeable disparity in developmental levels e.g. Global Developmental Delay

5. Social-emotional development lagging behind their peers

In response to the above concerns, we plan to:

1. Consider incorporating a deliberate oracy element/component into our existing programme. Perhaps developing some sort of oracy package, consisting of a teacher's resource guide book, complete with picture cards and suggested activities that busy educational therapists can simply grab-and-use with students. Language is a tool for communication (Vygotsky cited in Bodrova & Leong 1996). In a pragmatic sense, the content should be contextualised to our Singaporean setting, and its lesson delivery adapt some ESL/EFL (English as a second or foreign language) approaches to expedite learning
2. Consider having fine motor skills activity integrated more firmly into our programme, executed with deliberation and purpose. Students' poor handwriting should attain a level that is close to, if not better than, their peers in readiness for P1

3. Consider equipping teachers/therapists with teaching resources necessary to carry out activities that target and foster executive functioning issues. This may include INSETs on the creative use of teaching resources
4. Course leaders should be available (alongside the SPD team) to counsel and support teachers/therapists with children who may need short term, intensive, one-to-one remediation
5. Consider blending in elements of SEL (Social Emotional Learning) into the existing preschool curriculum so that children are better equipped to meet their challenges ahead, building resilience

Prime Minister Lee Hsien Loong recently emphasised, in the news, the importance of education and the need for our children to grow up and be capable of critical and creative thinking. Our students are capable of that and more. Let us level our students' playing field through the preschool's early intervention programme.

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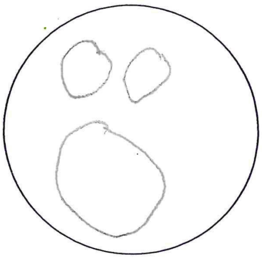
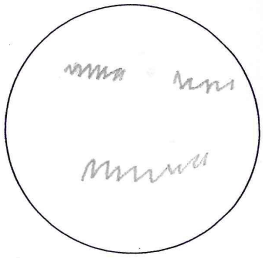
ACKNOWLEDGEMENT

Sincere appreciation to all preschool teachers for their contribution towards making this programme evaluation possible. Special thanks to Lynette Ong for collating all the pre-and-post test results.

Name. Date: 11 September

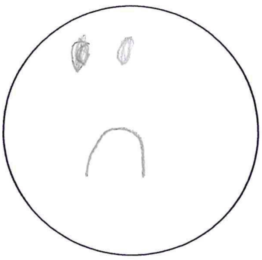
Draw a face in the circle that shows the emotion.

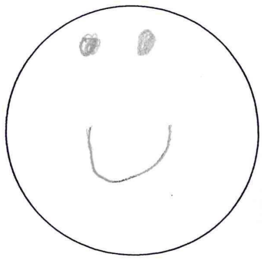




Shock

Frighten

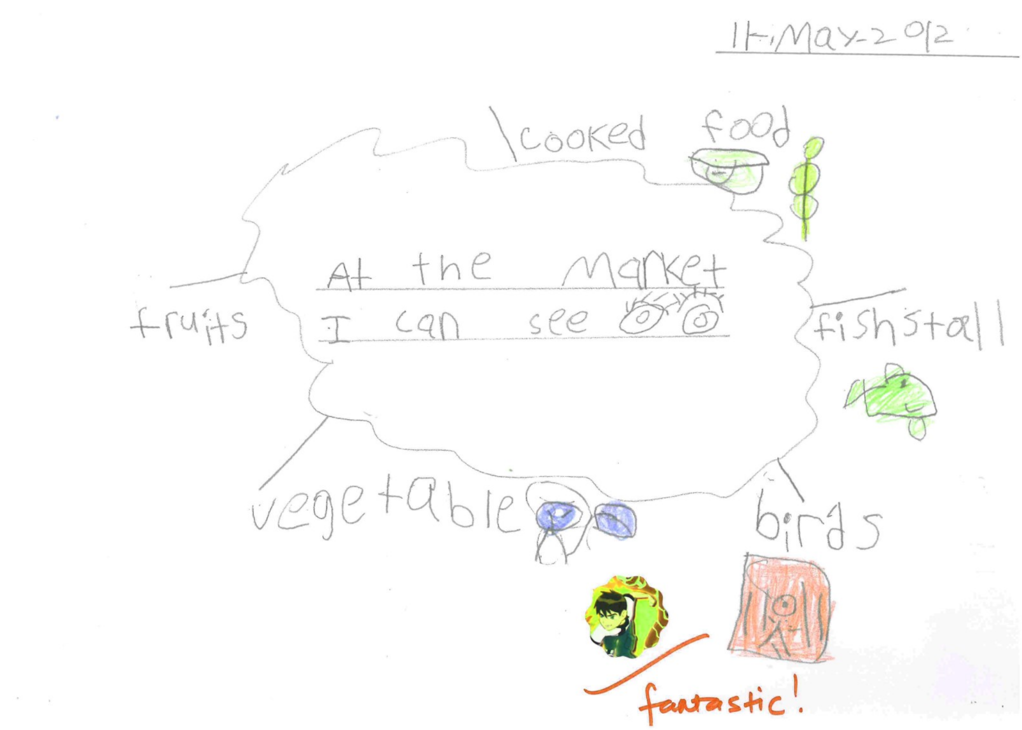




Upset

Happy


7 November 2012
It is not box. It is an ambulance
well done !!


11 May 2012
cooked food
At the market
I can see
fruits
fishstall
vegetable
birds
fantastic!


15/2/2013
Flaffy
feathers
f, f, f

The house on the hill.

Finish the picture and colour it in.

The house has a red door and a brown roof.
The curtains are pink.
There are two chimneys.
A big, black bird is on the roof.
In the garden there are yellow flowers.
There is a tree next to the house.

superb!!

Photocopy Master 1989 LEARNING MATERIALS LTD., Dixon Street, Wolverhampton, WV2 2BX.

FEEDBACK ON THE PROGRAMME

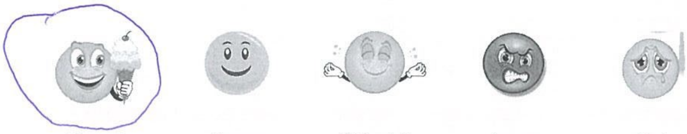
DYSLEXIA ASSOCIATION OF SINGAPORE
PRESCHOOL PROGRAMME EVALUATION 2013

Student's Feedback

Name : ______________________ EdT Joanne

Question 1:....How do you feel about coming to DAS Preschool Programme for classes?

Rating



I love it | Happy | "It's ok" (neutral) | Angry | Sad

Question 2:......How easy is it for you to sequence of the alphabet?

Rating

I love it | Happy | "It's ok" (neutral) | Angry | Sad

Question 3:......How easy is it for you when you write (e.g. your name, copy writing)?

Rating

I love it | Happy | "It's ok" (neutral) | Angry | Sad

Question 4:......How much do you enjoy doing "words-to-read"?

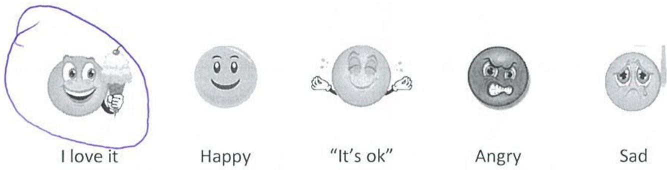
Rating

I love it | Happy | "It's ok" (neutral) | Angry | Sad

DYSLEXIA ASSOCIATION OF SINGAPORE
PRESCHOOL PROGRAMME EVALUATION 2013

Question 5:........ How much do you enjoy doing "words-to-spell"?

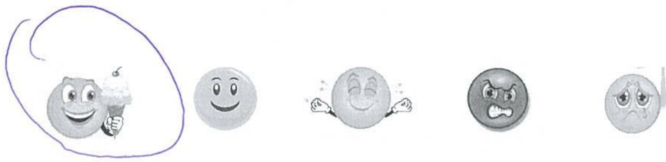
Rating



I love it | Happy | "It's ok" (neutral) | Angry | Sad

Question 6:........ How much do you enjoy doing "card drill" (letter-sound review)

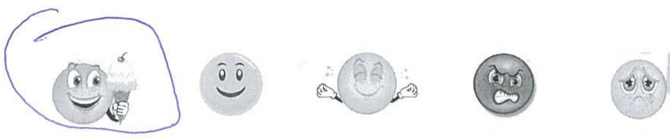
Rating



I love it | Happy | "It's ok" (neutral) | Angry | Sad

Question 7:........ How easy is learning in school now or is it a "struggle" (i.e. I-don't-know-what-teacher-teaches)

Rating



I love it | Happy | "It's ok" (neutral) | Angry | Sad

Question 8:........ Other comments, suggestions, or feedback, if any. (e.g. What do you like most about coming DAS class? What do you like least? What is your favourite activity?)

I get to play and learn

DYSLEXIA ASSOCIATION OF SINGAPORE
PRESCHOOL PROGRAMME EVALUATION 2013

Parent Feedback Form

Name of Child: ______________________ **Level :** ~~K1~~/K2

Indicate your response by shading the circle that which most corresponds to your evaluation.

Since/After attending the preschool intervention program:

1. My child appears more confident, happier.

Strongly Disagree — Disagree — Neutral — Agree — Strongly Agree

2. My child's school teacher(s) tells me that my child is generally doing much better in class.

Strongly Disagree — Disagree — Neutral — Agree — Strongly Agree

3. I can see and/or my child's school teacher(s) tells me that my child's most significant/observable improvement is in **alphabet knowledge**

Strongly Disagree — Disagree — Neutral — Agree — Strongly Agree

4. I can see and/or my child's school teacher(s) tells me that my child's most significant/observable improvement is in **sight word recognition**

Strongly Disagree — Disagree — Neutral — Agree — Strongly Agree

5. I can see and/or my child's school teacher(s) tells me that my child's most significant/observable improvement is in **reading** phonetically

Strongly Disagree — Disagree — Neutral — Agree — Strongly Agree

Pilot form 1

DYSLEXIA ASSOCIATION OF SINGAPORE
PRESCHOOL PROGRAMME EVALUATION 2013

6. I can see and/or my child's school teacher(s) tells me that my child's most significant/observable improvement is in **writing** – less laboriously as compared to before

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

7. My child is able to apply what he has learned.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

8. My child has benefitted from the preschool programme.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

9. I am happy with the Preschool intervention programme.

Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

10. Other comments, suggestions, or feedback, if any.

DYSLEXIA ASSOCIATION OF SINGAPORE
PRESCHOOL PROGRAMME EVALUATION 2013

Teacher Feedback Form

in 2013

Name of Child: ______________________ **Level : K1/K2** ____________ **Date:**

Using the zero-to-ten rating scale, indicate your response by shading the circle that which most corresponds to your evaluation.

Question 1:.....How would you rate your student's general confidence level now?

Rating 0 1 2 3 4 5 6 7 8 9 10

Question 2:......How would you rate the progress made by your student in terms of **alphabet knowledge?**

Rating 0 1 2 3 4 5 6 7 8 9 10

Question 3:......How would you rate the progress made by your student in terms of **writing**?

Rating 0 1 2 3 4 5 6 7 8 9 10

Question 4:......How would you rate the progress made by your student in terms of **sight word knowledge**?

Rating 0 1 2 3 4 5 6 7 8 9 10

Question 5:......How would you rate the progress made by your student in terms of **reading**?

Rating 0 1 2 3 4 5 6 7 8 9 10

Question 6:......How would you rate your student's overall achievement?

Rating 0 1 2 3 4 5 6 7 8 9 10

Question 7: Other comments, suggestions, or feedback, if any.

____

____

ABOUT THE AUTHOR

WONG KAH LAI
Preschool Programme Manager

Wong Kah Lai is the Preschool Programme Manager at DAS. An enthusiastic and passionate educator with more than twenty years' experience in the field of early childhood education, Kah Lai taught young children, mentored teachers, supported parents and caregivers in a wide range of setting, from within the classroom to community outreach, while juggling her Diploma in Early Childhood Education from Wheelock College, and subsequent Bachelor of Education in ECCE from the University of South Australia. She completed her Masters in Teaching English to Young Learners from the University of York through distance learning whilst working full time as head teacher of a bilingual kindergarten in China.

NTUC INCOME ORANGEAID FUND
Supporter of SES Preschool Programme

Through the support of NTUC Income OrangeAid Fund, DAS has been providing preschool bursaries to families in need of financial assistance since 2011. Unlike bursaries for other programmes, the OrangeAid bursary ensures that your child receives all of the necessary support at the preschool level in preparation for Primary One.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Effectiveness of an Early Intervention Programme for Preschool Children at Risk of Dyslexia in Singapore

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2 DAS Academy Ltd, Singapore

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www.das.org.sg/publications/research-journal/volume-2-no-1-january-2015

Abstract

An investigation of the effectiveness of an early intervention programme for children at risk of dyslexia in Singapore was conducted with 56 children aged five to six years old identified to be at risk of dyslexia. After risk-identification, the children undertook a pre-test of literacy ability that measured alphabet knowledge, phonogram knowledge, sight word knowledge, reading ability, and spelling ability. The children then received intervention in the form of an early intervention programme at the Dyslexia Association of Singapore. After which, the children were post-tested for their literacy ability to measure literacy gains. The results showed that literacy scores at post-test were significantly higher than at pre-test and that overall literacy gain was significantly positively correlated with length of intervention. These results indicated that early intervention was effective and that the longer the intervention the greater the gain in literacy ability.

Keywords: early intervention, kindergarten, preschool, children, dyslexia, at-risk of dyslexia, reading, spelling, Orton-Gillingham, Singapore

There is now considerable evidence from research worldwide that early intervention is the most effective approach to help children with dyslexia and other learning difficulties (Rose, 2009). Research by Torgesen (2001) indicated that one hour of individual intervention at 8 years of age led to an increase of between 0.2 to 0.3 standard score improvements and can lead to improvement of these children to a typical reading age.

Evidence from studies with young children aged 4 and 5 in the UK have shown lasting benefits for early support (Fawcett, Lee, & Nicolson, 2014; Nicolson et al., 1999). Moreover studies from Singapore (See & Poay, 2014) have shown that it is possible to identify preschool children at risk of failure before the formal age of diagnosis for dyslexia. The Dyslexia Association of Singapore (DAS) runs an early intervention programme (EIP)[1] in literacy for preschool children younger than seven years old identified as being at risk of dyslexia.

Singapore is a multi-ethnic and multilingual society noted worldwide for its high educational outcomes in international tests such as the OECD's Programme for International Student Assessment (PISA) tests (OECD, 2011). Perhaps part of the reason for Singapore's success in the PISA test is due to its focus on early intervention for children with learning difficulties. One of these early intervention programmes is the Development Support Programme (DSP). A sum of S$30 million was put aside in the Singapore budget in 2011 for this new programme (MOF, 2012). In addition, $4 million has been set aside for the DSP annually. The Ministry for Social and Family Development aims to cater to 2,000 children in the DSP. The DSP provides learning support and therapy interventions to children with mild speech, language and learning delays (MSF, 2013). DAS's EIP aims to supplement the DSP and focuses on literacy development[1]

In Singapore, children start Primary One (P1 for short, the equivalent of Grade 1) in the year that they turn seven years old. Primary education is mandatory. English is the language of instruction for all subjects - math, science, art, etc., except for a second language which is taught in the children's mother tongue. As such, it is expected of young Singaporean children to be equipped with rudimentary English literacy skills prior to starting P1.

Most children would have done so by attending two years of kindergarten education. Scarborough (2009) noted that the process of reading acquisition began before elementary school, a case that holds true in the Singapore context. Piasta and Wagner (2010) noted that children who started school with a weak grasp of letter names and sounds would likely have difficulty in learning to read. Singaporean children, at P1, are expected to have attained a certain level of reading, copying and writing ability (e.g. the ability to read and spell the word "neighbourhood"). This presents a significant challenge for children at risk of dyslexia, with specific learning differences and developmental delays in literacy.

There is unanimous agreement that problems with phonological processing are associated with dyslexia and associated reading and spelling difficulties. Research by Byrne (1998) and Hulme et al. (2002) indicate that awareness of individual speech sounds (phonemes) is the skill most crucially related to emergent literacy. The positive impact of phonological awareness training on literacy development was also confirmed by the National Reading Panel's (NRP) (2001) meta-analysis of 96 studies carried out in the United States of America. The NRP (2001) research indicated an improvement on reading (d = 0.53) and spelling (d = 0.59) from early intervention.

Phonemic awareness training was also shown to be most effective when associations between sounds and letters are explicitly taught (NRP, 2001). Children's literacy skills can thus be improved with phoneme awareness and phonological skills training and that the benefits are greatest for younger children. Torgesen (1998) argued strongly on the need for early intervention, catching children before they fail/fall. The EIP offered by DAS shares this passionate belief. The programme takes a literal leaf out of Torgesen's research and provides early literacy intervention to preschool children ages five to six at risk of dyslexia, targeting their areas of literacy weakness with a focused contextualised programme.

THE DYSLEXIA ASSOCIATION OF SINGAPORE EARLY INTERVENTION PROGRAMME

The DAS early intervention programme (EIP) is based on evidence from research as reviewed. The DAS EIP targets the knowledge and skills required for letter knowledge, phonemic awareness, comprehension, sight words and fine motor skills acquisition within a suggested preschool scope and sequence (see Appendix 1).

Education therapists formulate and devise Individualised Intervention Plans (IIP) for students based on their specific learning needs obtained from Pre-Informal Assessment at the beginning of the first remediation session with the educational therapist. Lessons are delivered in an engaging and simultaneously multisensory manner based on Orton-Gillingham (OG) approach and principles.

The OG approach is a language-based approach where students are explicitly taught the rules, facts and generalisations about the English language. Six principles govern the OG approach:

1. **Language based**
   It encompasses an awareness and appreciation of the features of the English language that includes reading, spelling, writing and learning strategies as appropriate to young learners' developmental needs.

2. **Cognitive**
   It was noted that 85% of the English language can be made predictable with explicit instruction in rules and generalisations that govern its use. This tool enables young learners to read/spell more effectively.

3. **Structured, sequential and cumulative**
   This is especially vital to a dyslexic learner. In order to achieve automaticity, content needs to be taught systematically in a sequential manner. Consistent review of previously taught/learned material fosters retention and enables the learning of new material to "spiral" upwards with each accumulation.

4. **Simultaneously multisensory**
   Through visual, auditory, kinaesthetic and tactile activities, that builds a strong and intense memory connection, young learners are more likely able to "retrace" and "retrieve" the memory of what-was-taught in previous lesson/session.

5. **Diagnostic-prescriptive**
   No two learners are alike. In view of young learners with literacy delay, individualised teaching through IIP (Individualised Intervention Plan) is essential.

6. **Emotionally-sound**
   Stress, anxiety and negative emotions can act as an affective filter that comes between learning and what-is-being-taught. Emotionally-sound delivery fosters and promotes learning and acquisition.

The EIP is carried out in three tiers. A Preschool Screening Assessment at the point of admission into programme, intervention by Educational Therapists and a Full Age Psychological Assessment (point of exit of the programme) by our qualified DAS psychologists. Children are grouped according to Assessment results/Profiles. Each class consists of 2 to 4 children, each having their own IIP. Children who complete the programme and are diagnosed as dyslexic may continue on with DAS in its main literacy programme at Primary One.

Student progress is carefully monitored through observation made during each intervention session as appropriate. Based on the diagnostic-prescriptive nature of the OG principle, education therapists adjust the lesson content for the next session by addressing the areas of uncertainty, weakness and strength. Thereby, shoring up against weaknesses in foundation concepts, addressing gaps in foundation knowledge and leveraging on student achievement and strength, promoting further interest and progress in learning.

RESEARCH QUESTIONS AND HYPOTHESES

This research aims to evaluate the effectiveness of the DAS EIP programme. The research questions and hypotheses are firstly, does the DAS EIP improve overall literacy ability? And secondly, is the length of intervention correlated to overall Literacy Gain?

It was hypothesised that children at post-test would have significantly higher literacy scores than at pre-test and that there would be a significant positive correlation between length of intervention and overall literacy gain.

METHOD

Participants

Fifty-six children (37 boys and 19 girls) aged five to six years old were selected for this study. Parents' informed consents were obtained before the research was conducted.

Materials

The literacy score on a Comprehensive Literacy Assessment was used as the pre-test and post-test measure. There were five areas of assessment: alphabet knowledge (ability to sequence the alphabet, write lowercase letters, and write uppercase letters), phonogram knowledge (ability to identify basic consonants and short vowels, i.e. letter to sound correspondence), sight word knowledge (ability to read sight words), reading ability (ability to read cvc, ccvc, cvcc, and ccvcc words, where c=consonant and v=vowel), and spelling ability (ability to spell cvc, ccvc, cvcc, ccvcc words). Scores were converted into percentages for easy comparison.

Procedure

The children were pre-tested before going on an intensive two-hour per week literacy intervention based on Orton-Gillingham principles (see Appendix 1 for lesson outline). Students were then post-tested to measure their overall gain. The intervention length ranged from 10 to 70 hours (M = 48.7, SD = 24.0). There was no control group as it was deemed that withholding or delaying intervention was unethical. Instead, as children entered the EIP at different times of the year and hence received differing intervention lengths, a correlation between length of intervention and overall literacy gain was conducted.

RESULTS

There was a significant improvement in Overall Literacy Ability from pre-test (M = 26.44, SD = 16.90) to post-test (M = 51.16, SD = 19.77), $t(55) = 12.791$, $p < .001$, Cohen's $d = 1.34$. In addition, there were significant improvements in all five areas (see Figure 1):

Alphabet Knowledge: pre-test (M = 56.04, SD = 31.34) to post-test (M = 80.43, SD = 21.35), $t(55) = 7.519$, $p < .001$, Cohen's $d = 0.91$;

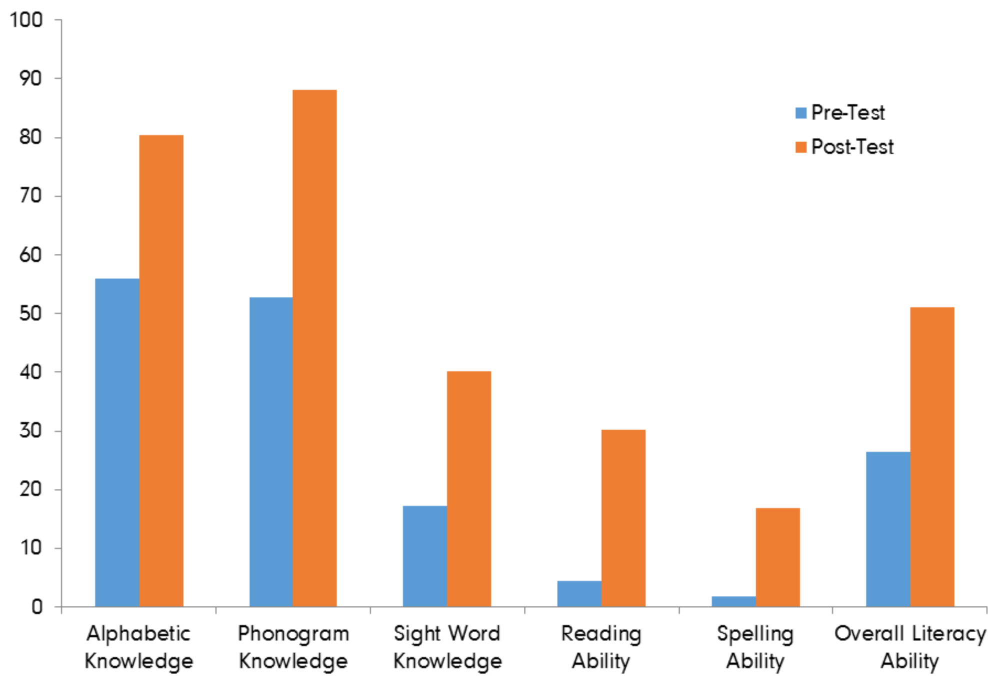

Figure 1. Mean Pre-Test and Post-Test Literacy Scores (in percentages)

Phonogram Knowledge: pre-test (M = 52.68, SD = 34.43) to post-test (M = 88.19, SD = 20.47), $t(55) = 8.661$, $p < .001$, Cohen's d = 1.25;

Sight Word Knowledge: pre-test (M = 17.32, SD = 22.69) to post-test (M = 40.14, SD = 30.95), $t(55) = 8.366$, $p < .001$, Cohen's d = 0.84;

Reading Ability: pre-test (M = 4.38, SD = 11.60) to post-test (M = 30.27, SD = 31.28), $t(55) = 6.714$, $p < .001$, Cohen's d = 1.10; and

Spelling Ability: pre-test (M = 1.79, SD = 5.17) to post-test (M = 16.79, SD = 25.05), $t(55) = 4.790$, $p < .001$, Cohen's d = 0.83.

In addition, no child had a lower score at post-test than at pre-test (i.e. all children showed improvement in all five areas and in overall literacy score).

There was a significant positive correlation between Hours of Intervention and Overall Literacy Ability Gain, $r(54) = .347$, $p = .009$. (see Figure 2).

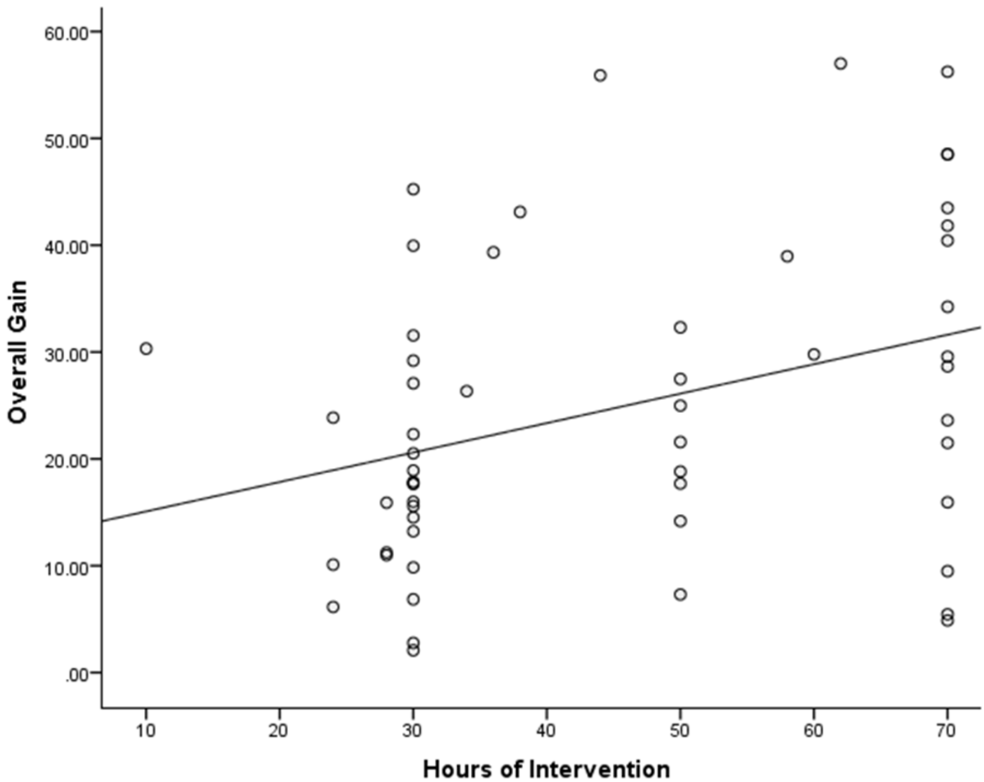

Figure 2. Scatter-Plot of Length of Intervention and Overall Literacy Gain.

DISCUSSION AND CONCLUSION

The results supported both hypotheses that children at post-test would have significantly higher literacy scores than at pre-test and that there would be a significant positive correlation between length of intervention and overall literacy gain. These results indicated that the DAS EIP was effective and that the longer the intervention the greater the gain in literacy ability. The results of this research parallel research conducted by Fawcett et al., (2014); Nicolson et al., (1999); and Torgesen (2001).

Fawcett et al.'s (2014) research indicate that children with intervention as little as 15 minute sessions twice weekly for 10 weeks (5 hours in total) would show a good improvement versus a control group. The length of intervention in this research ranged from 10 to 70 hours with all children showing a literacy improvement. The child that received 10 hours of intervention received this intervention over 10 weeks (one Singapore school term), whereas children that received 70 hours of intervention received intervention over 40 weeks (four Singapore school terms comprising one school year). All this seems to indicate that length of intervention may not be as important as frequency of intervention and the effectiveness of sustained intervention versus intensive intervention.

Torgesen (2001) concluded that 70 hours of intervention would be sufficient to return a child to a typical reading age. However, the results of this study supports the idea that any amount of intervention (as low as 10 hours) would be useful to help children at risk of dyslexia. The results also indicate that more hours of intervention would be more effective than lesser hours. However, the lack of a control group limits this conclusion. Ethical considerations suggest that it would be difficult to conduct control group versus intervention group research in this area and that investigating correlations with length of intervention would be a good compromise in terms of scientific knowledge versus ethical concerns.

The effect sizes of the improvement in overall literacy scores achieved by the DAS EIP was $d = 1.34$ with effect sizes of the five individual areas ranging from $d = 0.83$ to $d = 1.25$. An effect size is a statistic used to estimate improvements in intervention studies. This allows for comparisons to be made between different studies, and to assess the magnitudes of improvements resulting from different interventions. An effect size of 0 means that there was no improvement. An effect size of 1 means an improvement of 1 standard deviation. In terms of the statistical significance of effects sizes (expressed as d), $d = 0.20$ is considered low, $d = 0.50$ is moderate and d = 0.80 is high (Cohen, 1988). The NRP's (2001) meta-analysis showed that effect sizes greater than 0.80 were found in only 32% of studies and effect sizes of 2.0 and above were rare (6%). The DAS EIP overall improvement of $d = 1.34$ is thus a very great achievement and the improvements of the five individual areas from *d* = 0.83 to *d* = 1.25 was also remarkable. This in turns validates the effectiveness of the DAS EIP. It is particularly important in this context to highlight the striking and significant improvements in reading ability, with mean score accelerating from 4.38 to 30.27, plus the significant increase in sight word reading. One of the key findings of the National Reading panel was that although intervention improved phonology, it was more difficult to impact on reading ability. It may be seen from these results that the DAS EIP was able to improve not just the phonology but also the overall literacy ability, including reading and spelling.

Although this study showed that more hours of intervention would be more effective than lesser hours, due to limited resources, it is not feasible to have unlimited hours of intervention for every child. Future research could be focused on whether there was an optimum number of hours of intervention so as to make better use of manpower and other resources available for intervention.

In conclusion, the results provided strong evidence for an OG-based early literacy intervention approach and validates the effectiveness of the DAS Early Literacy Intervention Programme. The scope and sequence used at DAS may thus be useful for adoption by other providers of early intervention programmes.

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ABOUT THE AUTHORS

WONG KAH LAI

Preschool Programme Manager
Dyslexia Association of Singapore

Wong Kah Lai is the Preschool Programme Manager at DAS. An enthusiastic and passionate educator with more than twenty years' experience in the field of early childhood education, Kah Lai taught young children, mentored teachers, supported parents and caregivers in a wide range of setting, from within the classroom to community outreach, while juggling her Diploma in Early Childhood Education from Wheelock College, and subsequent Bachelor of Education in ECCE from the University of South Australia. She completed her Masters in Teaching English to Young Learners from the University of York through distance learning whilst working full time as head teacher of a bilingual kindergarten in China.

NOR ASHRAF SAMSUDIN

Director, Specialised Educational Services
Dyslexia Association of Singapore

Ashraf has spent the last 10 years teaching and coaching dyslexics and students with learning differences and is now the Director of Specialised Educational Services. Prior to this, he was appointed as the Assistant Director of Education, taking the lead in various curriculum development projects across the different programmes at DAS. During this time, he also presented numerous workshops and talks to parents, educators and professionals around the island to help spread the awareness of learning differences as well as to provide useful and practical strategies for them.

Ashraf has a Post Graduate Certificate in Learning and Teaching in Higher Education, London Metropolitan University and is currently undergoing his Masters in Education (Leadership, Policy and Change) with Monash University. With his training in dyslexia and in Neuro Linguistic Programming, he blends knowledge from these two fields to deliver programmes which emphasises importance on the acquisition of not only the hard skills but the soft skills as well.

DR TIM BUNN

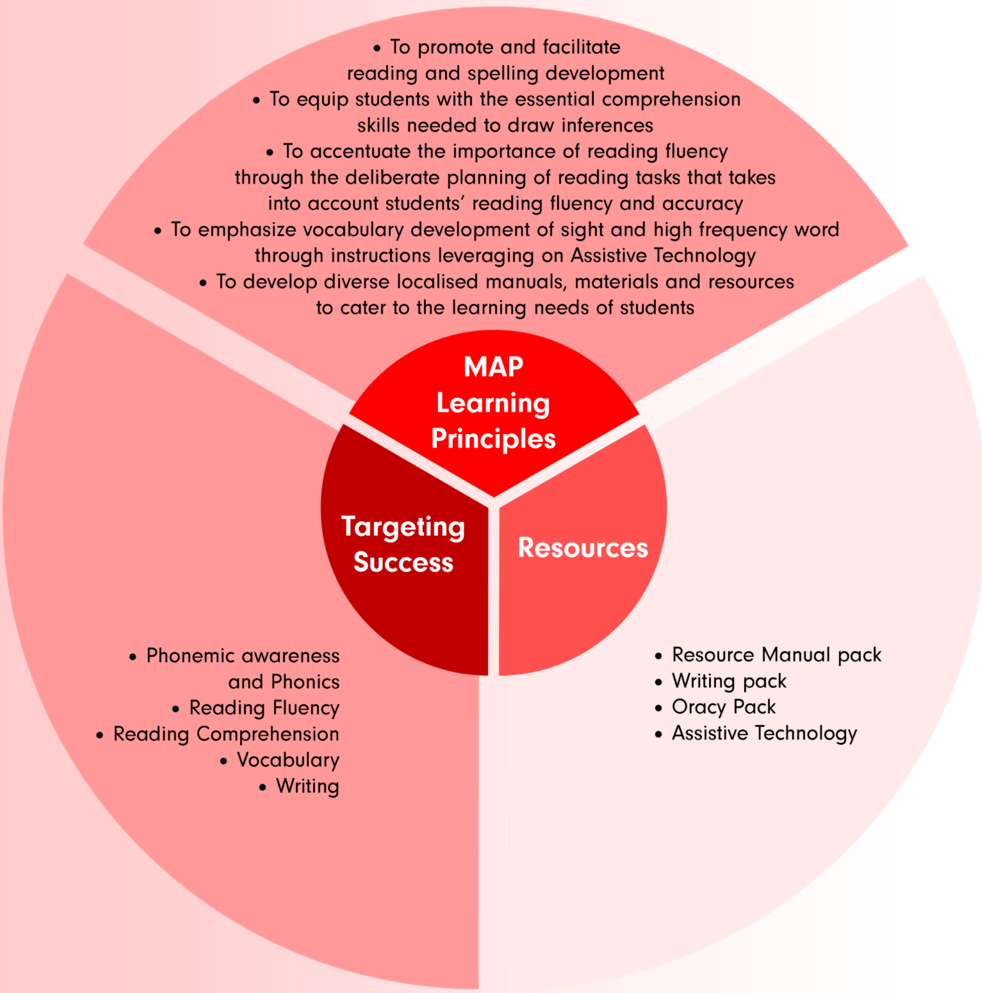
Consulting Educational Psychologist

Tim has a BA in Psychology & Philosophy from Oxford University, a PGCE from Redland College, and an MSc in Educational Psychology from University College, London. He worked as a teacher in primary, secondary and special settings for 9 years, and as an educational psychologist mainly for English Local authorities for 20+ years. He also served as SEN Officer for Northampton for 8 years, administering the area's statutory SEN procedures. He worked for 3 years in a private dyslexia specialist school (Egerton-Rothesay) as its in-house psychologist, and for a while he lead the DAS research team in Singapore. His own doctoral research was on literacy interventions in the middle primary years, and was particularly interested in the roles of teachers and teaching assistants in helping children with literacy difficulties. He is now a Consultant Educational Psychologist for Special Education Services, DAS.

MOE-aided DAS Literacy Programme MAP

"To Map the way for young dyslexics to live a life of beauty and promise through a comprehensive, high quality service provided by inspired professionals"

Curriculum Framework - Map provides a comprehensive and quality curriculum to support dyslexic students facing literacy challenges.



MOE-aided DAS Literacy Programme (MAP) Early Intervention

Lois Lim
Assistant Director, Admissions, MAP
Dyslexia Association of Singapore

The identification of dyslexia at an early age is an important task (Snowling, 2012). The negative repercussions of repeated failure in reading are often more entrenched in older students and it is generally agreed that the earlier symptoms are identified, the better the student's chances of success (Rose, 2009). This is likely very much so, if early identification is followed closely by early intervention that is rigorous and appropriate to the child's needs.

In Singapore, academic expectations are often high. Parents are generally enthusiastic to support their children in learning and are consequently becoming more aware of learning difficulties. It is not uncommon for parents to bring their children to hospitals, clinics and therapy centres for early checks on their children's development when they notice that they are starting to fall behind at a young age, typically during kindergarten to lower primary years. In Singapore, children may attend two years of nursery, starting at three years old, and two years of kindergarten, starting at five years old. Most enter primary school in January of the year they turn seven.

Taken together, both the repercussions of late identification and intervention as well as growing parental awareness of learning needs provide impetus for organisations such as the Dyslexia Association of Singapore to seek ways to support learners with dyslexia as early as possible.

EARLY INTERVENTION MATTERS

Research suggests that for those at risk for dyslexia, large gains in reading tend to be made in intervention programmes that emphasise explicit, structured, systematic phonics that is embedded in vocabulary/fluency/comprehension work and delivered before the age of 7 to 8 (Griffiths & Stuart, 2013). This suggests that it is critical for intervention to be delivered in a timely and rigorous manner.

In general, it is evident from research that the earlier one intervenes in the development of literacy skills, the better the outcomes. The meta-analysis[1] of previous research by the National Reading Panel in the United States suggest that systematic phonics training resulted in larger effect sizes[2] prior to first grade (d= 0.55) than after (d = 0.27) (Ehri et al., 2001). In fact, Ehri and colleagues (2001) found that phonemic awareness training resulted in larger gains in reading in preschool (d = 1.25) as compared to those in kindergarten (d = 0.48), first grade (d = 0.49) and second-sixth grade (d = 0.49). This trend was also similarly noted in spelling development, where they found effect sizes in spelling to be the highest in kindergarten (d = 0.97), in comparison to first grade (d = 0.52) and second-sixth grade (d = 0.14). Likewise, a meta-analysis by Bus and van Ijzendoorn (1999) showed that effect sizes for phonological intervention on phonological awareness for primary school children (d = 0.50) were lower than preschool (d = 1.10) and kindergarten (d = 1.26).

Wanzek and Vaughn's (2007) review of 18 early reading interventions for children who are at risk or have been diagnosed with a learning disability also indicated that higher effect sizes were obtained when intervention is provided early, at the beginning of first grade, than when it is provided at second or third grades. In addition, Alexander and Slinger-Constant (2004) reported that second to sixth grade children respond significantly less to similar phonics-based instruction as compared to their younger counterparts. Moreover, more intensive instruction in a one-to-one or small group instruction over a longer period was needed to produce gains, which were less robust. Therefore, while older children may respond to intervention at later ages, it appears that the earlier the intervention, the better the outcomes.

Furthermore, delaying intervention may lead to unnecessary accumulation of negative experiences for the child. By a later age, the cycle of failure might have already set in and undesirable repercussions of having an unrecognised learning difficulty such as poor self esteem, misconceptions of oneself being unable to learn, would likely be hard to reverse.

1. Meta-analyses include data from independent studies conducted in different countries. School ages might vary slightly across countries, with those attending preschool generally between 3 to 4 years and those in kindergarten generally between 5 to 7 years.

2. Effect size indicate the magnitude of the treatment effect. Effect sizes of 0.2, 0.5, and 0.8 represent small, medium and large effects respectively.

RESULTS FROM FIRST YEAR OF INTERVENTION

To investigate the early effects of intervention, the first year of MAP students' progress were examined. The data came from MAP's records of student profiles from 2003 to 2009.

Given the varied nature of the dataset (i.e., different students taking different cognitive and literacy tests or different versions of tests), it was necessary to focus on a sample of a group of students within the MAP population whose profiles come from the same tests and participated in annual testing over a period of a year.

METHOD

N = 202 (151 males)

Criteria for inclusion:

- General Conceptual Ability within 2 SD of population mean (76 – 129)
- Verbal scores ≥ 70
- Assessed by DAS psychologist using British Ability Scales – Second Edition (BAS-II)
- ≥ 1 year in DAS remediation
- Reading achievement < 115
- Spelling achievement < 115

RESULTS

Reading gains across school level (P1- P6)

T-tests indicate that reading gains from start of intervention to first year are primarily driven by those admitted into the programme from Primary One, $t(43) = 6.34$, $p < .001$. Importantly, this statistically significant gain in reading by Primary One children was accompanied by a large effect size (Cohen's d = 0.96[3]). Change in reading scores for all levels post P1 was not statistically different (all ps > .12; see Figure 1).

3. Cohen's d is a measure of effect size. Effect sizes of 0.2, 0.5, and 0.8 represent small, medium and large effects respectively.

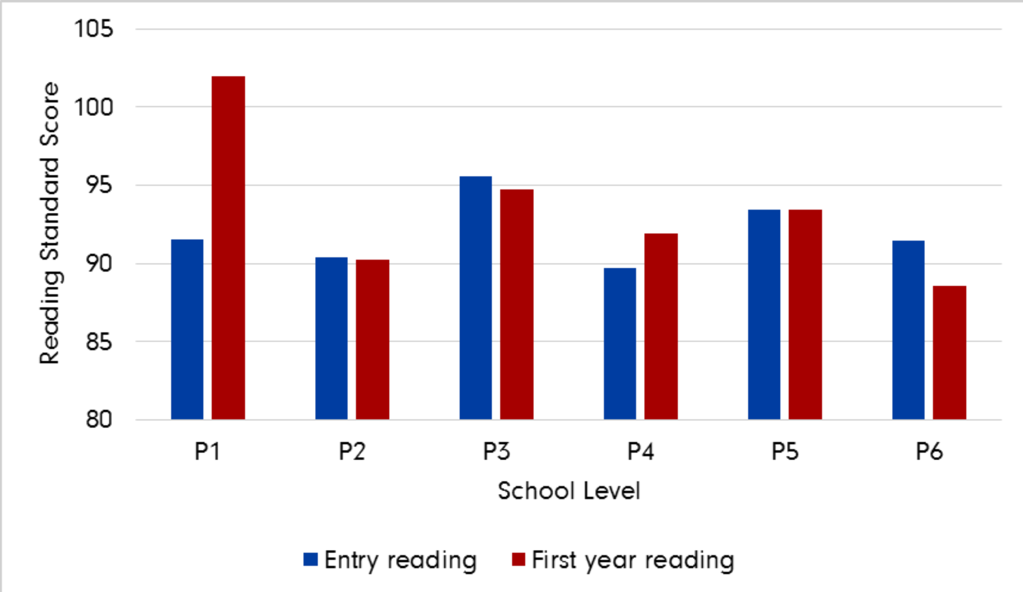


Figure 1. Reading achievement from baseline to first year across Primary 1 to Primary 6.

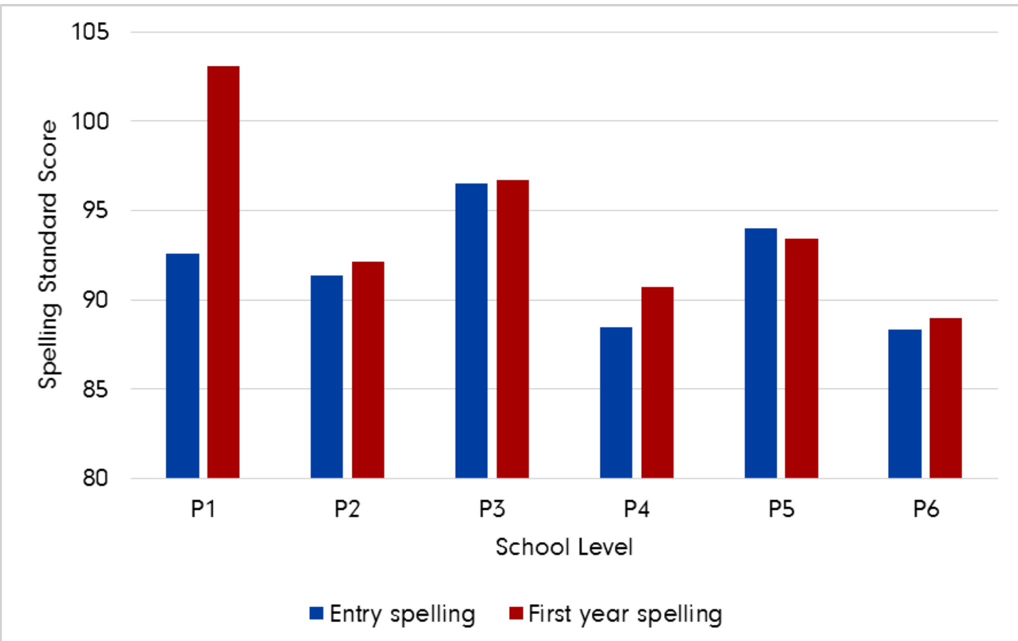


Figure 2. Spelling achievement from baseline to first year across Primary 1 to Primary 6.

Spelling gains across school level (P1- P6)

Consistent with reading gains, t-tests show that spelling gains from start of intervention to first year are primarily driven by those admitted from Primary One, $t(43) = 6.27$, $p < .001$. Similarly but crucially, these spelling gains were accompanied by large effect sizes (Cohen's $d = 0.95$). Change in spelling scores for all levels post P1 was not statistically different (all $ps > .12$; see Figure 2).

As such, the collective results from above analyses from the first year of intervention at the DAS suggest that significant improvements in reading and spelling are made by younger students. This echoes what was previously shown in a meta-analysis from the National Reading Panel, which showed that the younger the child (Kindergarten through first grade) the better the outcome of intervention (Ehri et al., 2001).

Apart from the focus of actual achievement gains in early intervention, which are important in influencing how well a child might cope with academic demands, it is important to consider the emotional impact of having prolonged difficulties in learning to read. It is essential to bear in mind that the first two years of primary education as the child is forming his impressions of school and that of his reading experience may be critical to his future success as a learner. Furthermore, reading dysfluency may be hard to restore when young poor readers lose out on the amount of reading practice they would have had compared to their more competent peers (Torgesen, 2000). As such, there are obvious benefits to providing intensive intervention as early as possible.

CONCLUSIONS

It has been generally found that early intervention is important and beneficial (Bus and van Ijzendoorn, 1999; Ehri et al., 2001). In order for early intervention to occur, it is important to identify signs of difficulties early on. Research has shown that there are early variables related to a child's phonological awareness and letter knowledge that may reliably predict reading and spelling difficulties later on. For these children at higher risk of failure who are identified at an early age, it would be important to put in place specific forms of support for their learning before negative repercussions of reading failure set in. This is particularly so in view of research findings showing that older children's unsuccessful coping with their learning difficulties may be associated with poorer self esteem, higher anxiety and other feelings of disappointment, frustration, anger and embarrassment of their inability to do what appears to come easy to their peers (Alexander-Passe, 2006).

The cut-off for when the identification and intervention occurs may be quite arbitrary and may differ from child to child. Every child's learning journey is different as the interplay between biological, cognitive, behavioural and environmental factors can often be complex. Where concerns are raised and needs are identified, it would be important to address these sooner than later in accordance to each individual child's profile to enable him to achieve the best possible learning outcomes.

ABOUT THE AUTHOR

LOIS LIM
Assistant Director, Admissions, MAP

Lois has worked at DAS since 2005 as a psychologist. She graduated with a Bachelor of Social Sciences (2nd upper honours) from the National University of Singapore and later with a Master of Arts in Applied Psychology from the National Institute of Education, Nanyang Technological University. In addition to her interest in specific learning difficulties, she has developed a specialisation in the assessment of dyslexia and is actively involved in the training and supervision of psychologists at the DAS as well as in enhancing DAS' intervention efforts.

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SPEECH AND DRAMA ARTS PROGRAMME

Specialised Educational Services

UNLOCKING POTENTIAL

The aim of the SES Speech and Drama Arts Programme is to develop literacy, communication and presentation skills and boost the self-esteem of learners with dyslexia. Drama can be a powerful tool to help students with learning differences.

OUR APPROACH

Using drama activities, students have the opportunity to enhance their persuasiveness and confidence in communication and is designed to help:

- Freedom of expression
- Use of imagination and creativity
- Communication skills
- Role-playing and stage performances
- Learn to understand, interpret and process script
- Exercise their working memory and processing speed

The students will also learn the fundamentals of stage directions, character dialogues, music and light cues. Class sizes are kept to a maximum of 10 students and are conducted once a week in a 1.5 hour session.

DYSLEXIA ASSOCIATION OF SINGAPORE

RECOMMENDED FOR
Students with low self-esteem or low self-confidence, students who have difficulties expressing themselves as well as students who enjoy drama.

ENTRY CRITERIA
All primary school students are welcome to enrol.

Find out more:
www.ses.org.sg
6444 5700

Specialised Educational Services (SES) is a division of the Dyslexia Association of Singapore.

Specialised Educational Services Speech and Drama Programme

Evaluation Report 2015

Pushpaa Arumugam
Assistant Director, SES Enrichment Programmes
Dyslexia Association of Singapore

BACKGROUND OF PROGRAMME

Speech and Drama Arts is an effective means of developing our students' talents and self-confidence, which in turn can lead to a more positive self-concept for a student. Our goal is to provide an outlet specifically for DAS students to express themselves, their inner feelings and emotions and to demonstrate their talents in a fun and artistic way.

In our observation, dyslexia does not only affect the academic component of learning, which is literacy but also emotional well-being of a student. Hence, we recognise that Drama is a powerful tool for self-development and we wanted to give students with dyslexia the opportunity to improve their self-esteem through our structured drama classes focusing on:

- language development,
- communication skills and
- personal development

PROGRAMME DESCRIPTION

Understanding the background and characteristics of our dyslexic students has allowed the team to develop a programme that would enhance their learning journey and discover their potentials.

OUR OBJECTIVES

- Identifying their inner strengths and hidden talents to boost self-esteem
- Developing literacy skills
- Develop effective communication and presentation skills
- Enhancing students' listening and concentration skill
- Drama For Personal Growth

We recognise that Drama is a powerful tool for building self-confidence, which in turn can lead to a more positive self-concept for our students. They are then able to express themselves, their inner feelings and demonstrate their talents in an entertaining and artistic way without inhibition.

Some of the activities in our drama classes help our students to enunciate words clearly and effectively to convey their intended message. For example, activities such as role-play provide~~s~~ stimulation in learning conversational interactions. This is a language-based activity where learners are given the freedom to express themselves freely with the use of the language while incorporating imaginative skills.

For our dyslexic students, shyness and fear of using English very often blocks learning. We recognise that Speech and Drama Arts as an effective means for developing our students' language skills such as reading, writing, speaking and listening. Hence, we provide an outlet for our students to use language in a fun, creative and engaging setting.

Listening and concentration skills are vital for an actor. Ranging from classroom lessons such as role plays to stage performances, students are required to understand the fundamental of stage directions, character dialogues, music and light cues.. Thus, our drama program will, with no doubt help dyslexic students to enhance their listening and concentration skills

Personal Development - We create opportunities for students to discover their strengths and weaknesses, organise their thoughts, attitudes and their feelings in the light of shared experience with their peers. Furthermore, they also learn to work together, to cooperate, to contribute, and to listen to and accept the viewpoints and contributions of others.

CURRICULUM DEVELOPMENT

The curriculum and lesson deliveries are influenced by **Multiple Intelligence (MI) Theory** that has a profound impact on thinking and practice in drama education and the **Orton-Gillingham (OG) approach** which is practiced by our Educational Therapist in the literacy teaching delivered under the MOE-aided DAS Literacy Programme (MAP). The SDA programme combines both approaches.

When the programme was first launched, we worked on a curriculum that had three stages; namely, Foundation, Intermediate and Advanced.

- ♦ Young Artiste (Foundation 20 sessions)
- ♦ Growing Artiste (Intermediate 20 sessions)
- ♦ Theatre Artiste (Advanced 20 sessions)

The Revised New Curriculum:

Moving forward, in 2014, the team revised the curriculum into a modular format. We planned a one year programme that will consist of 40 lessons. (Please see below the revised, new curriculum). There were two reasons for this change:

Student numbers: We were not able to accept new students on a termly basis, unless we have sufficient number of students to start the foundation level. The change in curriculum allows us to accept new students with the existing group and regroup them according to the age group.

Manpower: Secondly, there was a need for more teachers as the current teachers have to follow through the students moving to the Intermediate and Advanced levels.

CURRICULUM DEVELOPMENT 2015

Creative Drama & Literacy Through Drama Curriculum

With a whole range of highly interactive and enriching modules, SDA team planned to develop **a new curriculum - "Literacy Through Drama"** to meet the changing needs of our students. Literacy is one of the essential 21st century competencies, therefore, the SDA team has will step into the new year addressing this through our specialised Drama curriculum for the Upper Primary students and students who have completed the Speech and Drama Programme.

CREATIVE DRAMA CURRICULUM - DESCRIPTION OF THE 4 MODULES

MODULE 1: EXPLORING VOICE AND EMOTIONS THROUGH CORAL READING

This module provides an opportunity for students to develop fluency through reading of poems, using vocal and physical expression. Students will learn how to perform a choral reading text in 4 different styles such as Refrain, Antiphonal, Line-a-child and Unison. The main emphasis will be on learning how to express one's feelings through body language and developing speaking skills such as projection, clarity, expression and speaking in harmony which are needed in Choral Speaking Presentations

MODULE 2: DRAMATIC STORYTELLING

Our story telling program is designed to give students the chance to develop ways to tell stories in an interesting and exciting way using, masks, pictures and props. Based on a given story, students will learn how to create character voices, express emotions, facial expressions, body movements, eye contact with audience and most importantly, performance discipline.

MODULE 3: ROLE PLAY AND IMPROVISATION

Role play is the basis of all dramatic activity. In this module, students are encouraged to step into another character's shoes using improvisation techniques that promote creative expression, physicalising of thoughts, collaboration and teamwork. During the drama lesson, this can be used to great effect, challenging children to develop a more sensitive understanding of a variety of viewpoints whilst sharpening their language and movement skills. It helps children to acquire social skills, problem solving skills and also provide opportunities to be imaginative and creative.

MODULE 4: PLAYBUILDING TOWARDS PERFORMANCE

In this module students will create a short performance from practically nothing. Ideas are generated from issues, events, pictures, poems and themes. What they start out as and what the ideas finally become is part of the playbuilding process. In the process, students, will select a starting point and move on to a lot of discussion, brainstorming and even some improvisation. They will find the spine by collating the information as a group and work on scenes and physically act them out. Finally, students will reflect on their performance both individually and as a group. The process in the playbuilding skills allows students to experiment, discuss, collaborate, refine, choose and evaluate.

A Certificate of Participation will be presented to all students upon completion of each module.

CREATIVE DRAMA CURRICULUM FOR 7—8 YEAR OLDS

Term 1 - Module 1: Exploring Voice & Emotions through Choral Reading	**NO. OF LESSONS**
What is Drama & Pictures Alive! (Tableux)	2
Exploring Voice Production - PPPPIT	1
Emotions (Vocal & Physical Delivery)	2
Expressive Voice Through 4 styles of Choral Reading	2
Preparation for Performance	2
Short Performance for Parents: Choral Recitation	1
Total No. of Lessons	10
Term 2- Module 2: Dramatic Storytelling	**NO. OF LESSONS**
Expressing Emotions through Voice	1
Whose Story? (Skills: Verbal Expression)	2
Story Web (Skills: Speaking & Listening)	2
Tell it Again (Skills: Speaking & Listening)	2
Preparation for Performance	2
Dramatising Stories - Short Performance for parents	1
Total No. of Lessons	10
Term 3 - Module 3: Role Play and Improvisation	**NO. OF LESSONS**
Role Play: based on Stimuli	2
Role Play: Theme based	2
Role Play: Characterisation	3
Preparation for Performance	2
Short Performance for parents	1
Total No. of Lessons	10
Term 4, Module 4: Playbuilding Towards Performance	**NO. OF LESSONS**
Introduction to play scripts	2
Exploring Characters through Voice & Emotions	2
Introduction to Poetry Theatre	2
Preparation for Performance	3
Final Performance for parents	1
Total No. of Lessons	10
Total Number of lessons per Year	**40**

LITERACY THROUGH DRAMA - DESCRIPTION OF THE 4 MODULES

MODULE 1: LET IDIOMS AND PHRASES DO THE TALKING

IDIOMS AND PHRASES

In this module, students explore the use of idioms and phrases in the English language. Through drama tools such as dialogues, tableaux, story crafting and reader's theatre, students learn to make meaning and apply idioms and phrases in appropriate areas of language usage.

MODULE 2: BETWEEN THE LINES

COMPREHENSION

Comprehension implies understanding a given article. In this module, through the exploration of various stimuli such as posters, articles, poems and story passages, students learn the art of constructing thought processes to read between the lines and make meaning.

MODULE 3: TRICKS OF THE TRADE

VOCABULARY AND ORAL COMMUNICATION

In language usage, choosing the right word and using the right tense play an integral part. In this module, students actively learn the nuances of using vocabulary and grammar effectively through drama games and activities.

MODULE 4: GET THE SHOW ON THE ROAD

SCRIPTING A PLAY

The last module for this year, is a culmination of all the literacy skills acquired through the year. Students apply their language skills to create and deliver an original story through forms of drama.

A Certificate of Participation will be presented to all students upon completion of each module.

LITERACY THROUGH DRAMA CURRICULUM FOR 9-12 YEAR OLDS

Term 1 - Module 1: Let Idioms And Phrases Do The Talking	**NO. OF LESSONS**
Class Lesson	4
Script Reading and Casting	1
Preparation for Performance	4
Short Performance for Parents:	1
Total No. of Lessons	10
Term 2- Module 2: Between The Lines	**NO. OF LESSONS**
Class Lesson	4
Script Reading and Casting	1
Preparation for Performance	4
Short Performance for Parents:	1
Total No. of Lessons	10
Term 3 - Module 3: Tricks Of The Trade	**NO. OF LESSONS**
Class Lesson	10
NO FINAL PERFORMANCE	
Total No. of Lessons	10
Term 4, Module 4: Get The Show On The Road	**NO. OF LESSONS**
Playbuilding Skills: Script Analysis and Characterisation	1
Playbuilding Skills: Stage Directions	3
Playbuilding Skills: Exploring Props and Costume Ideas	1
Preparation for Performance	4
Final Performance for parents: Short Drama	1
Total No. of Lessons	10
Total number of lessons per year:	**40**

EVALUATING STUDENTS' PROGRESS

The SDA team has planned to use two different methods to evaluate the students.

Overall skills learned in the specific module.

This method evaluates students after each drama component is covered. Students will be evaluated on the last day of the specific lesson / topics skills. Students will be evaluated on overall skills learned in the specific level. For example:

- Tableaux - on 3rd lesson,
- Miming - on 2nd lesson,
- Voice – on 3rd lesson... etc

A progress report will be given to their parents upon completion of each module.

Students' Evaluation method:

- Use rubrics to evaluate for skills taught by the 10th lesson (1 module)
- Observations by teachers during class for lesson 1 - 5 and the final performance.
- Student Evaluation Form (Annex 1)
- How is the score tabulated? Rubrics (Annex 2)
- Finally scores are tabulated for individual students (Annex 3)

Southampton Emotional Literacy Scale (SELS) Survey

Being a programme which promises to heighten self-esteem and self-confidence level of its students, SDA needs a tool to measure the efficacy of its objectives. The Southampton Emotional Literacy Scale was selected in Term 4 2014 to be the tool to measure our students' emotional literacy level. There is an increased awareness to discover students' strengths and weaknesses in the area of emotional literacy.

SELS touches two components;

i) personal competence and
ii) social competence.

There are three types of checklists designed to assess the emotional literacy of our students;

i. parent's checklist,
ii. student's checklist and
iii. teacher's checklist.

The checklists contain statements that seeks the views of the student, parents or care-giver and teacher on the emotional literacy of the student.

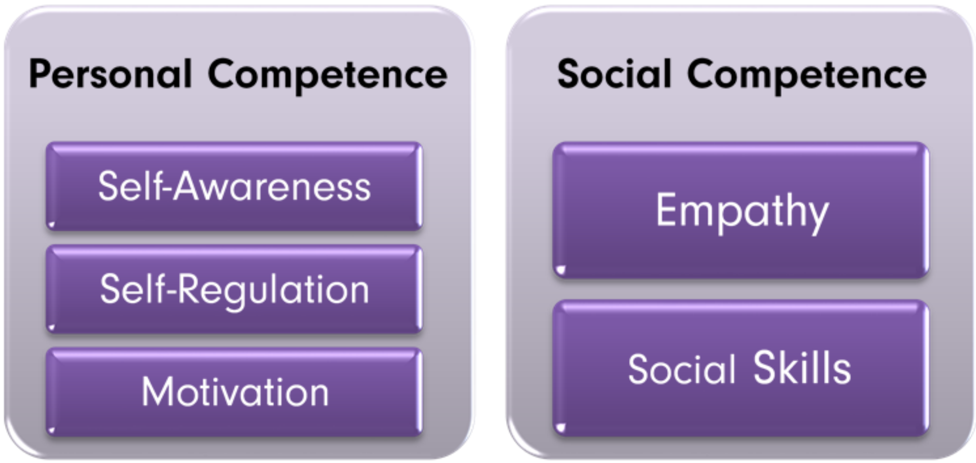


Figure1: Components covered in SELS

In Term 4 2014, SDA team approached 27 parents of our students to participate in SELS but we were not able to carry out the survey with those affected students. As there were few responses and some of the students were almost completing the Speech and Drama Programme, the SDA team decided to collect data from our fresh students in Term 1 2015.

Moving forward, we strive to provide a programme that will improve the social-emotional competencies and the literacy skills of our SDA students. The SDA team is committed towards the continuous improvement of our specialised Drama programme catering to the specific needs of students with dyslexia.

ENROLMENT

As of end 2014, there are a total of 28 students enrolled on the programme with an estimate of 5 of them receiving bursary support from the DAS.

With an expansion plan, SDA team is aiming to increase its total intake to 40 students in the coming year.

New Initiatives to increase the student enrolment - Trial Classes

To Increase the Enrolment the SDA Team conducted trial lessons for prospective students in Bedok, Bishan and Jurong Point Learning Centres. The response from the parents was good. There was a total of 22 sign ups and 18 attendees for the trial lessons.

The team has intended to continue this new initiatives in the coming year too.

TEACHERS TRAINING

To meet the increasing demands of the new year, 5 trainee drama teachers completed a Professional Certification Course (PCC) in Speech and Drama Arts in 2014. With the addition of our new teachers, we are now able to open new classes in other centres like Bedok Learning Centre and also utilise their knowledge and training experience during drama holiday workshops.

About The Training Programme

The Personal Certification Course (PCC) was designed for Educational Therapists who wished to hold dual-specialisation in Speech and Drama Arts. The course provided the knowledge and skills required to teach Speech and Drama lessons.

Course Duration:

Total of 20 hours over seven Fridays from 1 August 2014 to 23 September 2014 (there were some breaks during this period)

At the end of the course, there was a summative assessment lead to awarding competent learner with a PCC Certificate.

The assessment was based on:

1. Teaching Practicum - 25 minutes
2. Submission of a 1-hour lesson Plan
3. 500 words Written Journal

To further develop our SDA instructors professional qualification in the field, two Educational Therapists completed their Diploma in Educational Studies (Speech and Drama) in 2014.

In July 2014, Ms Aishwariyah (Asha), a Drama and Theatre Educator with 10 years experience in the field joined the team as a consultant. She has extensive work experience with many cultural, arts and media organisations locally and overseas. Asha is currently working towards a Master of Education (Drama) at Nanyang Technological University (NTU). She has since written lesson plans for two modules, planned and executed the above-mentioned PCC for the new SDA teachers. In addition, she also started looking into creating a resource pack for the SDA programme.

WIDENING OUR REACH

In term 2, 3 and 4 of 2014, we conducted three "Things I can do to Provide Support for my child (TIPS)" talks at our Tampines, Bishan and Rex Learning Centres. The topic covered "Effective Ways to Read with Your Child to Encourage Literacy Learning" was targeted for the parents of Primary School going children. The interactive and activity based talk was conducted for 90 minutes, ending with the question and answer session. The objectives and outline of the talk is as follows:

Objectives:

To enable parents of preschool and primary school going children to use effective storytelling and drama tools at home to address literacy development by improving oral language, reading and comprehension.

Outline:

- Discovering storytelling through drama as a powerful tool for literacy development
- Techniques to encourage children to appreciate good children’s literature

- Learning how to select stories to interest and empower children
- Learning how to craft and tell stories using Drama as tool
- Encouraging children to re-tell stories
- Learning dramatic storytelling techniques

- We have also opened up the SDA programme at our Jurong Point Learning Centre in term 3, 2014, with the intention of catering to our students residing in the west.

SDA Newsletter

The team came up with a new Initiative to reach out to our DAS parents and Internal Staff - The SDA Newsletter.

CLOSING THE YEAR 2014

Closing the year with a bang, SDA Staged a Final Year Performance with a total of 28 SDA students for 'Embrace Dyslexia Seminar' on the 20th of November 2014, at the NTUC Auditorium.

The performance titled "Castaway" was the original story created by our students in Term 3 through improvisation and story building activities. The performance was then scripted, devised and directed by the SDA team. After many hours of rehearsal, planning and preparation, our students made the SDA team proud with their wonderful performance. The experience provided our SDA students with a platform to prove their ability and showcase their unique talents.

SDA students then restaged the performance for an intimate audience of family and friends as a term end showcase on 22nd November 2014.

Finally, to conclude the year, the SDA team conducted a 10 hour Drama Holiday Workshop at Bishan Learning Centre, for a total of 18 students from both lower primary and upper primary levels from 24th to 27th November 2014.

FEEDBACK FROM TEACHERS

Amrit Kaur Gill
Educational Therapist & Drama Instructor

“I am extremely delighted to share that majority of the students in the Speech and Drama Arts programme have shown great improvement in their communication and presentation skills. When they initially step into our program, they experienced difficulties in expressing themselves, managing their emotions and working together as a team. However, over the terms with our active learning approach in classrooms have proven to be beneficial to these students. They now demonstrate better articulation skills, and work well as a team. Credit goes to our teaching methodology that allows the students to express their thoughts and ideas confidently in a safe environment without any inhibitions. This positive change is indeed commendable.”

Muzdalifah Hamzah
Educational Therapist & Drama Instructor

"Reminiscing the time when the SDA Team had its first meeting back then in November 2012, our passion and dedication was focused towards building the social-emotional development of our students so that they would be 'bold and courageous' to pursue more successes in life. Today, our programme has developed further and groomed students in line with our initial objectives.

Through the non-intimidating nature of Drama, our students experiment with roles and values, while gaining self-awareness and discovering their own voice. Infused with stimulating activities, our programme promotes the active learning of literacy skills which benefits our students in different areas of development. Honing their skills and being able to grade their progression each term is truly a privilege for me. Undeniably, it was not an overnight success story for these children. Our students had put in a lot of effort and hard work every lesson, alongside with their Drama Instructors. Kudos to their parents for being so supportive!

FEEDBACK FROM PARENTS - TESTIMONIALS

"Andie is more confident now. It is fun for the children."

"Andrew is more animated at home. Great way to build his self-esteem and confidence."

"My children are always excited to come for the Speech & Drama Arts class. Good Job Teachers!"

"My son is happy and enthusiastic to attend every drama lesson. He is gaining confidence".

"The programme has improved her memory and attention span".

"My son can express himself better now".

"Saturday is the day he will wake up early all by himself and look forward to the drama class"

"Her self-confidence is improving".

" He is more expressive now. It shows that the programme has positive improvement in my child".

" Alan wants to go for the drama class even if he is sleepy because he is enthusiastic about the programme"

" Cheryl is now more confident and better able to take turns"

"The programme has helped Albert's reading and pronunciation"

"I am impressed that the kids came up with their own 'play' ...so wonderful!!

"Andy looks forward to the next term of FUN"

"We can see confidence level has improved compared to last time"

"My son, attended the Speech and Drama Arts (SDA) programme since it first started in August 2013. He enjoys the interactions with other children, learnt language in creative ways and improved communications. I am pleased that DAS has started the SDA programme last year. Thank you for the initiative."

"The stage is Awesome but today's performance is Super Awesome!

The children have practiced very hard; Despites of the challenges they have, they managed to perform very well with confidence! Love it!

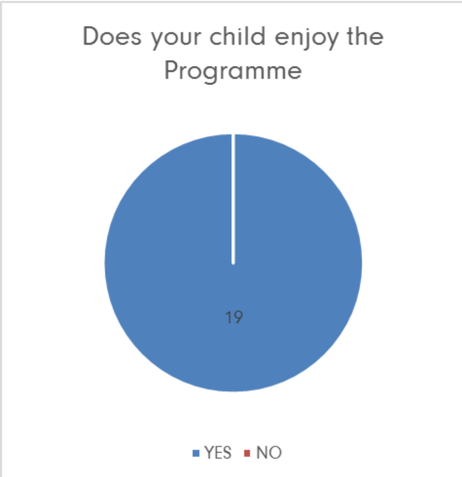
The teachers' seriousness, passion, patience and dedication are admirable too.

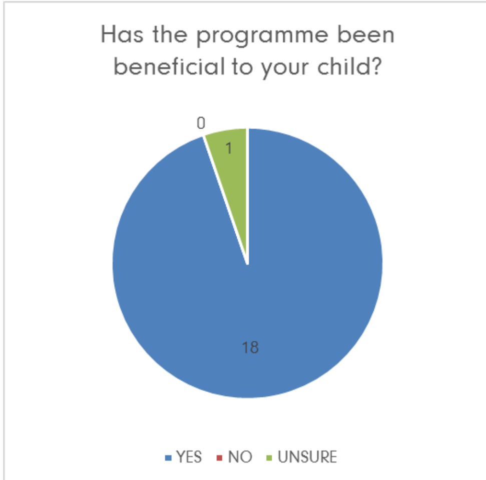
So proud of all of you! Salute! Thank you for your hard work and guidance to the children."

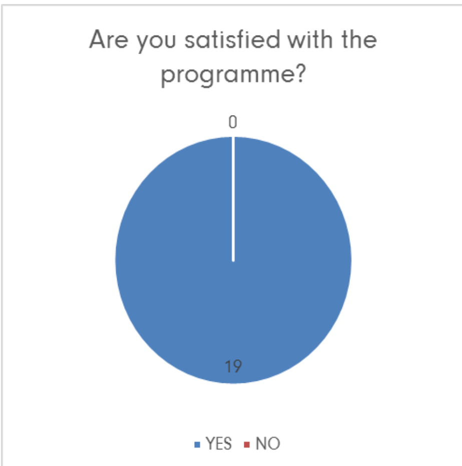
"Interestingly, since he started the Drama program, Daniel's school teacher noticed his positive change in his attitude; he has become more cheerful and he is happy to learn. Daniel has since improved extensively in his overall result this year and he will be receiving the Edusave Good Progress Award this year. Thank you very much for all the encouragements and positive notes flown to Daniel."

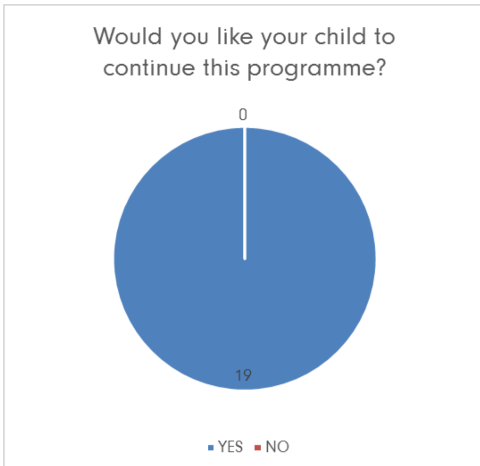
"In 2013 he had the opportunity to act in a Tamil drama aired in the local television creating awareness about dyslexia supported by DAS. Last year he acted in a drama presented at the Embrace Dyslexia Event. These opportunities provided by DAS have definitely boosted his self-esteem and discover his talents."

CREATIVE DRAMA PROGRAMME—PARENT SURVEY TERM 1—2015









PARENT COMMENTS ABOUT THE PROGRAMME:

Parents from the Creative Drama Programme were surveyed in for Term 1 and 19 feedback forms were received. Their comments about the programme are listed below:

How has the programme benefitted your child?

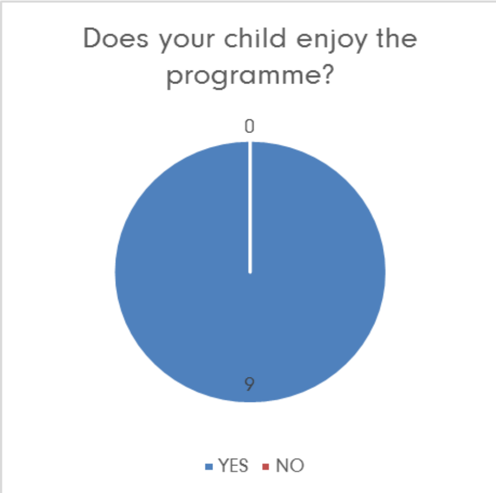
1. She can speak and express more.
2. Improving in confidence level.
3. Find her more confident and improve in her English.

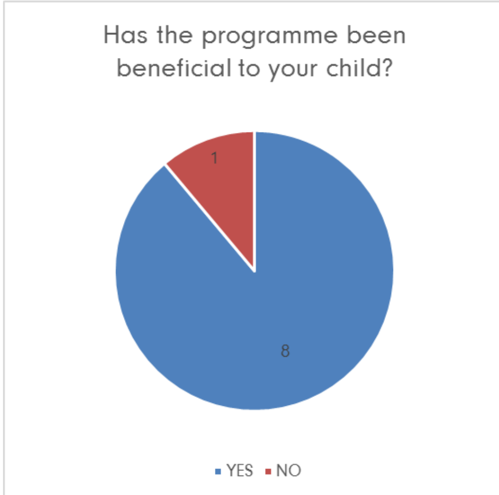
4. Able to express himself and concentrate.
5. Able to stay focus for a longer period of time. Increased self-esteem.
6. Tries reading more (Road names, lables).
7. He has improved in his reading skills.
8. More confident, Reading better, put acting in his daily life (quite animated at times)
9. Confidence and Expression. She is able to express herself.
10. Confidence level has gone up. Can really see any specific improvement in other areas.
11. Confidence level. Reading ability.
12. Improved in confidence level. Reading ability. Able to understand instructions.
13. Confidence level.
14. Actually not sure but he seems to enjoy it. This is the only extra class he requests from me.

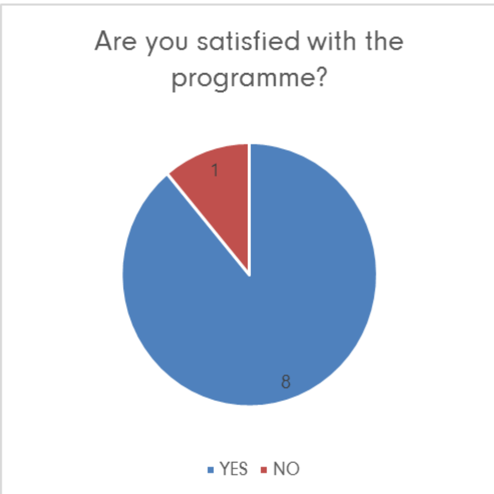
Which is the part of the programme you are most satisfied with?

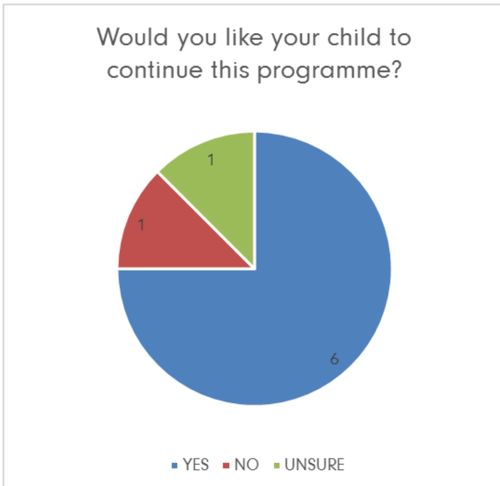
1. The programme and the script given. She makes an effort to look through.
2. Developed a liking to perform.
3. My son's ability to stay focus and my daughter's ability to work independently.
4. The programme has build my son's confidence and concentration level.
5. More open in speech but confidence level remains low.
6. I am satisfied in the area of performance.
7. He is enjoying himself.
8. She is able to articulate very clearly.
9. Helps Ian in describing. Confidence in speaking aloud. Satisfied with small group session.

LITERACY THROUGH DRAMA PROGRAMME—PARENT SURVEY TERM 1—2015









PARENT COMMENTS ABOUT THE PROGRAMME:

Parents from the Literacy through Drama Programme were surveyed in for Term 1 and 9 feedback forms were received. Their comments about the programme are listed below:

How has the programme benefitted your child?

1. Reading Ability. Understanding Instructions.

2. Confidence Level, Reading Ability, Understanding Instructions
3. My daughter has gained confidence and able to read lines. Most importantly, she likes and enjoys the programme, which she shows interest in learning.
4. He is more dramatic at home. He likes coming for this class. I can see confidence.
5. She is more confident in front of people. Able to take instructions.
6. Confidence level
7. We didn't see any improvement.

Which is the part of the programme you are most satisfied with?

1. He managed to get his lines correctly and managed to play the lead role.
2. Communication.

FUTURE DEVELOPMENT

1) Building new curriculum for new 'Literacy Through Drama' programme

'Literacy Through Drama' (LTD) programme is an extension after the Creative Drama programme. This curriculum infuses the learning of the English language such as idioms and phrases, comprehension, vocabulary and writing with Drama instructions.

Our Drama Instructors are not only trained to facilitate high energy drama classes but also professionally trained to provide literacy remediation to children with dyslexia. With the knowledge and experience of teaching literacy to dyslexic children, our teachers are actively involved in building this new curriculum. Lessons in each module are thought out carefully to meet the diverse group of students who learn differently.

Objectives:

- to equip students with essential literacy skills
- to expand students' vocabulary bank
- to discover concrete meaning of words or phrases

It is very important not to confuse both Speech and Drama programme and Literacy Through Drama (LTD) programme, despite both programmes involve the learning of the English language through Drama. The former focuses on drama and theatre skills, reading fluency, building self-confidence and self discoveries such as expressions and emotions, while the latter heavily emphasises on the usage of the language using Drama activities as a tool

2) Expanding SDA & LTD programme to more DAS centres.

Currently, SDA & LTD classes are offered in these Learning Centres; Bishan and Jurong Point Learning centres. In the year 2015, we will be offering it in Bedok Learning Centre as well.

3) Continuing with SELS survey and collation of data

From parents' feedback, it is clear that SDA programme does bring positive change in our students. That is not sufficient to evaluate how well our students fare in emotional literacy. The team will continue to collect data from parents, students and Drama Instructors. With the data collected, the team hope it would provide purposeful information for us to support, encourage and intervene, where appropriate, in the social and emotional development of our students.

ABOUT THE AUTHOR

PUSHPAA ARUMUGAM

Assistant Director, SES Enrichment Programmes

Pushpaa is the Assistant Director for SES Enrichment Programmes. She has years of experience conducting enrichment courses for Kindergarten, Primary, Secondary, Junior College and Tertiary students. Pushpaa has obtained her Bachelor of Performing Arts majoring in Drama & Theatre Studies at Monash University, Australia in 2004. She is a National Arts Council Theatre Grant Award Recipient for the years 2001 – 2003. She has also obtained a Diploma in Educational Studies (Enrichment Education), accredited by The College of Teachers, UK.

Here at DAS, we recognise Speech and Drama Arts as an effective means of developing our students' talents, and self-confidence. Pushpaa's objective is to provide a channel specifically for our dyslexic students to develop their language skills, express their inner feelings, and demonstrate their talents in a fun and artistic way.

OUR VISION

Nurturing individuals with learning differences to achieve success and impact society positively.

OUR MISSION

Unlocking the potential of individuals with learning differences.

The Specialised Educational Services (SES) is a division of the Dyslexia Association of Singapore which aims to uncover the true strengths of individuals with learning differences and empower them with the necessary skills and strategies to succeed.

We are a dedicated team of professionals who are committed to delivering a quality service focusing on the needs of the individual and striving to bring out their very best.

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UNLOCKING POTENTIAL

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www.ses.org.sg

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DYSLEXIA ASSOCIATION OF SINGAPORE

Specialised Educational Services (SES) is a division of the Dyslexia Association of Singapore.

PROGRAMMES

1. Preschool
2. Chinese
3. Essential Maths
4. English Exam Skills
5. Specialist Tutoring
6. Speech and Drama Arts
7. Bridging

THERAPY

1. Play
2. Speech and Language

ASSESSMENTS

1. Multi-Professional Team
2. Psycho-educational
3. Speech and Language Therapy

WORKSHOP & OTHER SERVICES

1. Holiday Workshops
2. Professional Support Service

Specialised Educational Services
Speech and Language Therapy

Shuet Lian Ho
Senior Specialist Speech and Language Therapist
Dyslexia Association of Singapore

INTRODUCTION

The Dyslexia Association of Singapore (DAS) recognises the importance of Speech and Language therapy for the diagnosis and intervention of specific learning differences in the Singapore mainstream school population. Currently, DAS has five Speech and Language Therapists (SLTs) of which two are senior therapists. They work across seven learning centres to serve a percentage of the student population who are diagnosed with dyslexia and attending DAS classes across Singapore.

At the DAS, SLTs work on improving listening, understanding and speaking skills which are critical components in the development of language in children whereas the Educational Therapists work on improving the children's reading and writing (literacy) skills which are critical in the development of written language.

Several studies (Bishop & Adams, 1990; Lombardino, Riccio, Hynd, & Pinheiro, 1997; Scarborough & Dobrich, 1990; Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998; Tallal, Curtiss, & Kaplan, 1989) have found evidence to explain the association between language impairment and reading disability. Catts and Kamhi, 1999 pointed out that language problems are a major component of almost all cases of reading disabilities, while Catts, Fey, Zhang & Tomblin, 1999 found that language problems are sometimes the cause of reading disabilities. Snow, Burns & Griffin, 1998 reported that language problems are a consequence of reading disabilities.

In 2010, the American Speech-Language-Hearing Association (ASHA) issued an official policy statement addressing the roles and responsibilities of speech-language therapists. The statement has highlighted the interrelationship between language and literacy. It states that "Current research supports the interrelationships across the language processes of listening, speaking, reading, and writing. SLPs contribute significantly to the literacy achievement of students with communication disorders, as well as other learners who are at risk for school failure, or those who struggle in school settings."

Hence, without remediating their speech, language and communication needs (SLCN), these students may not be reaching their full potential in accessing the MOE Aided Literacy programme (MAP) at DAS as well as the mainstream curriculum at school.

DAS SLTs also work with children who are diagnosed with other learning difficulties such as dyspraxia, speech and language impairment and/or autism spectrum disorder.

OBJECTIVES

Children with language and literacy needs require speech and language therapy to enable them to:

1. access the MAP and other SES programmes at the DAS
2. access the MOE mainstream curriculum
3. achieve functional communication

HOW TO DETERMINE THAT A CHILD NEEDS SUPPORT FROM THE SLT?

Studies have shown that speech, language and communication disorder can co-exist with dyslexia, in particular Specific Language Impairment (SLI). Many students with SLI meet the diagnostic criteria for dyslexia (Bishop & Snowling 2004).

Specific Language Impairment is diagnosed where a student has an average intelligence but the verbal scores fall below average. This profile is consistent with that of a student with dyslexia. Therefore a referral from the MOE/DAS Psychologists to a SLT may be required for further investigation. Formal and/or informal assessments are administered by the SLT to diagnose speech, language and communication disorder as well as to determine whether speech and language intervention is required. The latest categories of speech, language and communication disorders in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) which a fully qualified Speech and Language Therapist can diagnose and treat include Phonological disorder, Stuttering, Specific Language Impairment, Speech-sound disorder, Childhood onset fluency disorder and Social (pragmatic) communication disorder. At DAS, we take a multidisciplinary approach to assessment as it is widely accepted as proper practice.

SPEECH AND LANGUAGE THERAPY

Speech and language therapy is conducted individually or in small groups of two to three students. It is tailored to meet the SLCN of a child so that the child will be motivated to learn. SMART therapy targets are set to enable the child to succeed.

Specific	Tailor made to your child's needs
Meaningful	Useful and functional targets
Agreed upon	By parents and child
Realistic	Achievable within the block of therapy
Time	Therapy can be evaluated and progress is measured

EVALUATION OF STUDENTS' PROGRESS

To determine if students had benefited from attending speech and language therapy, a pre-intervention test and a post-intervention test were done to measure each student's progress. Two subtests were selected from the widely used standardised assessment tool known as Clinical Evaluation of Language Fundamentals 4th Edition UK (CELF-4UK) to get an overview of each student's ability to understand and use spoken language.

Concepts and Following Directions subtest was used to measure the student's ability to understand spoken language (receptive language skills). This subtest requires the child to comprehend and follow increasingly complex instructions that include language-based concepts, such as coordinating conjunctions (and, or, but), time (when, after, before), quantity (one, none) and sequence (first, middle, last). An example would be "Point to all but one of the shoes." These abilities are needed for following classroom instructions, activities and interaction.

Formulated Sentences subtest was used to measure the student's ability to use spoken language (expressive language skills). This subtest requires the child to plan and make sentences using given words with reference to a picture. This ability to use words in a precise manner is required in story-telling, writing compositions, sentence completion tasks and other literacy activities.

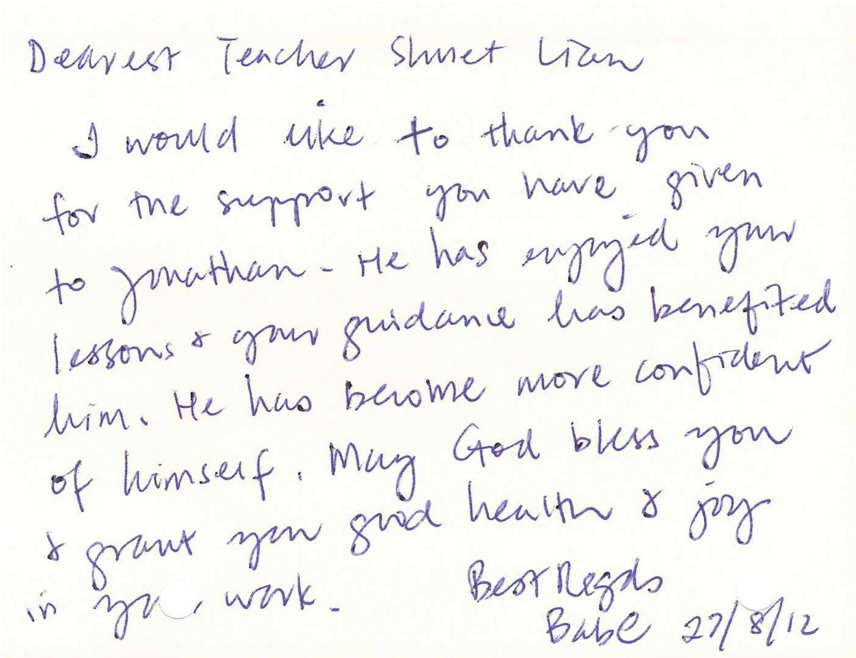
The pre-intervention test was conducted during the first therapy session and the post-intervention test was conducted after 20 hours of intervention. One student was tested at a time. The same subtests, namely Concepts and Following Directions and Formulated Sentences were used in the pre- and post-intervention tests. In addition, pre- and post-intervention Student Questionnaires, pre- and post -intervention Parent Questionnaires as well as pre- and post-intervention Educational Therapist Questionnaires were administrated. A copy of the questionnaire is shown in Appendix A, B and C respectively. When parents were not able to understand the questionnaire, the SLT would explain or translate the questionnaire to a language which the parents could understand to ensure that the questionnaires were completed meaningfully.

A total of 42 students were tested. 40 students attended one hour of speech and language therapy weekly over 20 weeks and two students attended two hours of speech and language therapy weekly over 10 weeks. While these students were attending speech and language therapy, 36 of them also attended a 2-hour weekly literacy programme which was taught by the Educational Therapists at the DAS. The remaining 6 students attended only speech and language therapy during the 20 weeks of intervention.

TEST RESULTS

	Percentage of students who showed improvement (%)
Concepts and Following Directions	78
Formulated Sentences	73
Student Questionnaire	61
Parent Questionnaire	86
Educational Therapist Questionnaire	67

SUCCESS STORIES FROM PARENTS



Dearest Teacher Shuet Lian
I would like to thank you
for the support you have given
to Jonathan - He has enjoyed your
lessons & your guidance has benefited
him. He has become more confident
of himself. May God bless you
& grant you good health & joy
in your work. Best Regds
Babe 27/8/12

"I would like to share a piece of good news with you. Zach has passed his PSLE with grade B for his English which is totally unexpected. Overall aggregates is 180 which is much higher than his set target. He was so surprised with his results and so do I.

Thank you once again. He enjoyed you class very much and has gained more confidence since."

Mrs Ho—Parent of Primary 6 student

"He seems more confident and now he talks more clearly. He thinks as he talks. Slowly but surely he has improved in the way he communicates in school and with his friends."

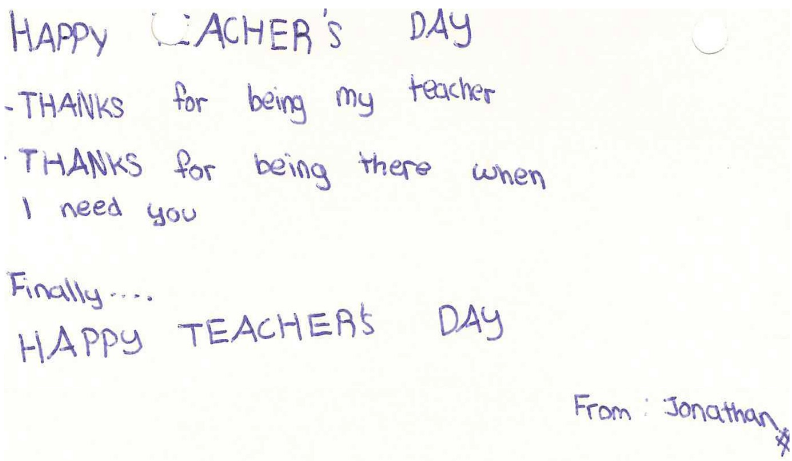
Mdm Aminah—Parent of Primary 6 student

THANK YOU MESSAGES FROM STUDENTS

"I have learnt that my pronunciation of some words is unclear because I cant hear some sounds accurately. In therapy, I learnt to identify and join the different sounds that form words. I also learnt that one way to improve my listening comprehension is to have an image or picture in my head as I listen to what people are saying since I tend to forget the words easily.

I find it easier to communicate with my friends now as I am better able to understand what they are saying. It was really difficult for me to have friends in school as I don't know how to talk to them. I don't have the confidence to approach them too. Since last year, I made two close friends whom I can share my thoughts with. My classmates told me that they can better understand what I am saying now. I no longer fear so much when I have to talk to others."

Secondary 3 Student


HAPPY [illegible]ACHER'S DAY

-THANKS for being my teacher

·THANKS for being there when I need you

Finally....

HAPPY TEACHERS DAY

From : Jonathan

CONCLUSION

The SLT team will continue to develop, execute and evaluate speech and language therapy approaches as well as teaching resources to optimally support children with different learning needs. The team will adopt the best practices that have shown apparent improvement in children's speech, language and communication skills post intervention. The team will continuously improve their knowledge and skills by attending workshops, focus group discussions and talks within the given training budget.

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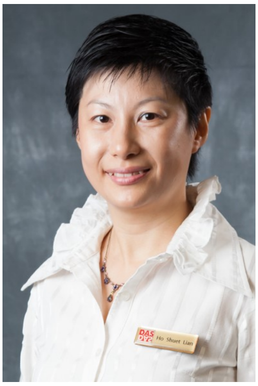
ABOUT THE AUTHOR



SHUET LIAN HO
Senior Specialist Speech and Language Therapist

Ho Shuet Lian works at the Dyslexia Association of Singapore (DAS) as a Senior Specialist Speech and Language Therapist. She received her training, an MSc (Speech and Language Pathology) from the National University of Singapore, and has a Master Degree of Business Administration (with Distinction) awarded from the University of Leeds. She is a member of Speech-Language Hearing Association Singapore (SHAS) and is Allied Health Professions Council Registered (AHPC).

She provides speech/language/communication assessment and intervention services to children with specific learning differences. Her clinical experience includes working with children between the ages of 5 and 16 years. In addition, she provides advice and clinical support to Educational Therapists and junior Speech and Language Therapists at the DAS. She also gives advice to parents on speech/language/communication issues. She conducts Social Skills workshops as well as give public talks on speech/language/communication difficulties faced by children with specific learning differences.

APPENDIX A

DYSLEXIA ASSOCIATION OF SINGAPORE – Speech-Language Therapy

STUDENT QUESTIONNAIRE

Student's name: ______________________________

Educational Level: ______________________________

Learning Centre: ______________________________

Speech-Language Therapist: ______________________________

Date: ____________

	Never	Sometime s	Often	Always
I can remember the things that people say.				
I can say what I am thinking of.				
People understand what I say all the time.				
I know when to ask a question.				
I enjoy my class with Teacher xxxxxx.				

APPENDIX B

DYSLEXIA ASSOCIATION OF SINGAPORE – Speech-Language Therapy

PARENT QUESTIONNAIRE

Parent's name: ____________________

Student's name:____________________

Educational Level:____________________

Learning Centre: ____________________

Speech-Language Therapist:____________________

Date: ____________________

	Never	Some-times	Often	Always
My child uses words that are unclear in their descriptions (e.g. this thing, that one, go there)				
My child struggles to find (think of) the right words to say.				
My child struggles to tell me what has happened in an event.				
My child can remember the things that I say.				
My child is able to talk about the same topic in a conversation.				
My child's answers are related to what I asked.				
When my child does not know something, he/she asks what it is.				
My child looks forward to attend Teacher xxxxxx's class.				

Other comments before/after speech-language intervention:

____

APPENDIX C

DYSLEXIA ASSOCIATION OF SINGAPORE – Speech-Language Therapy

EDUCATIONAL THERAPIST QUESTIONNAIRE

Educational Therapist: ______________________________

Student's Name: ______________________________

Educational Level: ______________________________

Learning Centre: ______________________________

Speech-Language Therapist: ______________________________

Date: ____________________

	Never	Some-times	Often	Always
1. This child uses words that are unclear in their descriptions (e.g., this thing, that one, go there)				
2. This child struggles to find (think of) the right words to say.				
3. This child struggles to say what has happened in an event.				
4. This child can remember the things that I say.				
5. This child is able to talk about the same topic in a conversation.				
6. This child's answers are related to what I asked.				
7. When this child does not know something, he/she asks what it is.				
8. This child asks for help when he/she can't do something.				

Other comments before/after speech-language intervention:

____

ON-SITE TEACHING

ON-SITE TEACHING is aimed at supporting students with specific learning differences at your site.

SUPPORTING SPECIFIC LEARNING DIFFERENCES

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DYSLEXIA ASSOCIATION DAS OF SINGAPORE

DYSLEXIA ASSOCIATION OF SINGAPORE
HELPING DYSLEXIC PEOPLE ACHIEVE

The Dyslexia Association of Singapore (DAS) is a non-profit organisation in Singapore which aims to build a world class organisation dedicated to helping dyslexic people achieve. It provides services ranging from screening and assessments to diagnose for dyslexia and other specific learning differences, to educational therapy and tutoring services for students with dyslexia and other specific learning differences.

Speech and Language Impairment: A Case Study

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ABSTRACT

Boy C was 8 years and 4 months when he was diagnosed with significant language impairment with mild articulation disorder. He commenced speech and language therapy (SLT) in individual as well as a small group setting of two students three months later. Boy C was discharged from SLT after twenty weeks of 2 hours per week of intervention. He made good progress. At the end of the twenty weeks of intervention, it was observed that boy C was more confident in expressing himself and he sounded more fluent in English. Boy C also showed good improvement in his mid-year examinations at school.

The purpose of this case study is to provide educators and parents an understanding on:

- What is language impairment and the degree of severity
- What is articulation disorder and the degree of severity
- How do language impairment and articulation disorder affect a child's learning at school
- The intervention goals set for a child with significant language impairment
- Some of the intervention activities carried out by the Speech and Language Therapist to improve the child's speech and language abilities
- Some teaching strategies and fun language-based activities that the educators, parents and caregivers can do with the child in the classroom or at home to improve the child's language abilities

WHAT IS LANGUAGE IMPAIRMENT?

Language impairment (LI) can be an impaired ability to understand spoken language and/or the impaired ability to use spoken and/or written language. This impairment may involve the content, form and/or function of language in communication. (American Speech-Language-Hearing Association ASHA, 2003)

Bishop (2006), stated that specific language impairment (SLI) is diagnosed when a child's language development is deficient for no obvious reason. Children with language impairment are usually as healthy and competent as their peers in all ways but they have difficulties in the understanding and use of language. According to Law J, Garrett Z and Nye C., it is thought that approximately 6% of children have speech and language difficulties of which the majority will not have any other significant developmental difficulties.

Language impairment has a broad category. Some children have mild difficulties that are easily treated with short-term intervention. Others have significant and persistent difficulties with both understanding and talking that need long-term intervention to become more competent in communication. These children do not 'outgrow' language impairment but they are likely to improve their speech, language and communication when they receive appropriate help from the Speech and Language Therapist.

Children with language impairment are all very individual. Hence, there is no "one size fits all" intervention programme for children with language impairment.

WHAT IS ARTICULATION DISORDER?

Articulation disorder is an impairment of the production of sounds to form words for communication. Dr Caroline Bowen, an Australian Speech-Language Pathologist said that most children who are said to have 'articulation disorders' have nothing wrong with their articulators (tongue, lips, palate, etc.). Instead, they have a functional difficulty at the phonetic level that makes it difficult for them to say the sounds they need in speech. Dr Bowen's examples of speech errors children (and adults) with articulation disorders make:

- The word 'super' pronounced as 'thooper'.
- The word 'zebra' pronounced as 'thebra'.
- The word 'rivers' pronounced as 'wivvers'.
- The word 'leave' pronounced as 'weave'.
- The word 'thing' pronounced as 'fing'.
- The word 'those' pronounced as 'vose'.

NOTE: Some of these sound changes are acceptable in a number of English dialects

A child with mild articulation disorder produces speech that is generally intelligible and you are able to understand what the child is saying without much difficulty. On the contrary, a child with severe articulation disorder produces unintelligible speech that is hard to understand. You will need time to get use to the child's speech and most of the time, you may not decipher what the child is saying. You are likely to rely on context clues to guess what the child has said.

CASE PRESENTATION

Case profile of Boy C

Boy C is the second of four children in a bilingual speaking family. He was 8 years and 4 months when he was diagnosed with significant language impairment with mild articulation disorder. He spent his weekdays at the children's home. Boy C spoke English at the children's home and in school. When he spent time with his parents, he spoke a mixture of Malay and English. It was reported that boy C was more fluent in Malay. His birth and early development history were unremarkable. Due to a difficult family situation, boy C missed school on several occasions when he was in primary 1 and he changed schools on a few occasions.

Boy C was diagnosed with dyslexia in August 2012. Boy C demonstrated below average single-word reading and spelling accuracy with low phonological decoding as well as very low phonological processing abilities for his age. The Psychologist from the Dyslexia Association of Singapore (DAS) referred him for a speech and language assessment as his language IQ score was below average. Boy C's caseworker was concerned about his very poor academic performance at school, his poor communication skills as well as some articulation difficulties.

The Clinical Evaluation of Language Fundamentals 4th Edition UK (CELF-4UK) was used to get an overview of boy C's ability to understand and use spoken language. The standardised language assessment revealed that he had significant language impairment. His core language score placed him below the 1st percentile with more than 99 out of 100 children his age doing better than him. The development of language skills can be affected by ESL (English as Second Language) as well as situational factors such as 'missing school and/or changing school. Taking this into account with regard to boy C's case history, there is sufficient evidence to suggest that boy C presents with significant language impairment.

This means that any skills such as listening, speaking, reading and writing which depend on language can be severely impaired and such impairment is likely to prevent boy C from showing his true level of intelligence. His speech was occasionally unclear during the assessment as a result of numerous sound substitution errors (e.g. window ->/bindo/ 'bindow'). However, his speech was generally intelligible. Nonetheless, the level and inconsistency of speech sound substitution errors were indicative of an articulation disorder.

How could language impairment and articulation disorder affect boy C's learning at school?

Due to his poor understanding of language-based concepts, boy C could have problems understanding what he had been told to do even if he appeared to have understood and was seen working in the classroom. He might also struggle in working through Math problem sums and Science because they require boy C to grasp and apply many different language-based concepts to problem solve.

When boy C failed to pay good attention (he might look like he was daydreaming) in the classroom, it might be due to him losing track of information that was delivered in a highly auditory-verbal environment.

His extremely poor knowledge of grammar rules would hinder his academic performance as his oral and written work were likely to be heavily penalised for grammatical errors.

In addition to the decoding difficulties identified as part of his dyslexia, boy C might not understand age-appropriate story books as they often use syntactically complex sentences.

Boy C's mispronunciation of words might affect his ability to spell words correctly. For example, he might spell 'trunk' as "twng", according to the way he said it.

INTERVENTIONS FOR BOY C

An individual intervention plan was drawn up based on the profile of the child obtained from the speech and language assessment.

The long term intervention goal set for boy C was to be able to effectively use his speech and language skills in a functional manner.

The short term intervention goals were set to address the five aspects of communication namely,

- Speech – the ability to produce the sounds in words
- Phonological awareness - the ability to hear and 'play' with the sounds that make up the words in spoken language
- Receptive language - the ability to understand spoken language
- Expressive language - the ability to use spoken language
- Vocabulary - a set of words that a person knows and uses daily

Speech

Whenever boy C was observed substituting sound/s in a word, attention was drawn to the Speech and Language Therapist's mouth and he was reminded to do good listening and good looking while the right way of saying the word was modeled. Boy C practised until he could pronounce the word clearly. If boy C had difficulties imitating the sound production, the spoken word would be presented to him in the written form so he could relate the speech sound/s he needed to produce to the written letters.

When teaching boy C to say long (multisyllabic) words, he was shown how to break the word into syllables (e.g. con / den / sa / tion) and point to each syllable as he listened to the slow articulation of the word with exaggerated pauses between syllables. This would facilitate him in remembering all the sounds in the word. Boy C would repeat the word a few times aiming to help retain it in his memory.

Phonological Awareness

Phonological awareness forms the basis for developing good articulation, reading and spelling skills. A child needs to recognise sounds in words and learn the skills of 'playing' with the sounds in words to read and spell well. Children with SLI have often been noted to have phonological processing deficits (Catts, 1993; Snowling, Bishop, & Stothard, 2000).

Hence, phonological awareness was included in boy C's intervention plan.

The short term goals set to improve boy C's phonological awareness were:

- To identify first and last sound in monosyllabic words with 80% accuracy in a structured activity in therapy setting
- To identify the number of syllables (up to five syllables) in a spoken word with 80% accuracy in a structured activity in therapy setting
- To blend and segment *C*VC words followed by CCVC words and CVCC words with 80% accuracy in a structured activity in therapy setting

** C represents consonant and V represents vowel*

Phonological awareness skills were taught using a variety of fun physical activities such as board game, clapping hands and dartboard game.

Receptive Language

The short term goals set to improve boy C's ability to understand spoken language in the classroom were

- To develop understanding of position concepts (prepositions) of 'in', 'on', 'under', 'in front', 'behind', 'over', 'above', 'below', 'beside', 'between', 'through', 'along' and 'across'. Examples of activities carried out were 'place an object in the position requested' and 'use a pencil and paper to draw out spoken directions containing prepositions'.

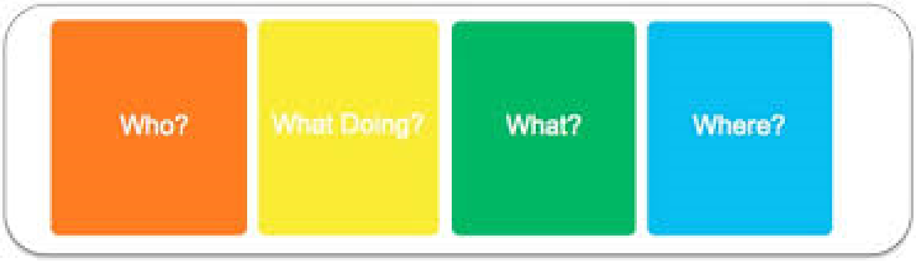
- To develop understanding of sequential concepts of 'first', 'second', 'third'...'last'. Manipulatives including toy vehicles (car racing game) and activity sheets were used to get boy C to follow 1-step simple spoken directions containing sequential concepts.

- To develop understanding and the ability to answer wh-questions. Activities carried out were 'get the child to draw the semantic (meaning) association to each wh-question word (e.g. 'when' refers to 'time')' and play wh-questions cards/board games/ipad apps.

Expressive Language

The short term goals set to improve boy C's expressive language skills were

- To formulate grammatically and semantically acceptable sentences with the use of Colourful Semantics Programme as visual prompts. The following is an example of the visual prompt used:



More information about the Colourful Semantics Programme can be found at:

www.londonspeechtherapy.co.uk/wp-content/plugins/downloads-manager/upload/Colourful%20Semantics%20Programme.pdf

In the sentence formulation task, boy C would pick a picture card and formulate a sentence to describe the picture using the target sentence structure. Board games such as 'snakes and ladders', ipad apps as well as a scoring system were used to convert the sentence formulation task into a game.

- To develop the ability in producing a simple narrative using sentence starters 'first', 'next', 'then' and 'last'. Boy C was told to sequence three picture cards and guess what would happen in the last picture card (predict the outcome).

- As boy C loved to draw, he was allowed to present his ideas (outcome) through drawing and described what he had drawn using the appropriate sentence starter.

- The Colourful Semantics Programme chart was used as a visual prompt whenever he demonstrated difficulties in stringing words to form a grammatical and informative sentence.

Vocabulary

One of the ways to teach vocabulary was to sort, group and name manipulatives or picture cards.

- Pretend play. For example, set up the theme of "At the supermarket" to teach vocabulary related to fruits and vegetables. First, boy C acted as the store assistant who was asked to sort the manipulatives into the respective group 'fruits' and 'vegetables'. He was taught the name of the objects which he did not know. Next, boy C switched roles with his classmate and pretended to be the customer. He had to tell the store assistant what he wanted to buy. When he had everything in his shopping bag, he moved to the check-out counter to make payment.

- Boy C was told to sort a stack of picture cards into the respective word categories. For example, sort animal cards into 'farm animals' and 'jungle animals'. When boy C did not know the name of the animals, phonemic cuing was sometimes used to prompt the child. For example, to retrieve the word 'crocodile', boy C would be prompted with "croco" and then he would say "crocodile".

Teaching strategies for the educators, parents and caregivers to make understanding easier for boy C

- Use simple words which are accompanied by pictures to explain concepts. For example,

Raindrops

+

Sunlight

=

Rainbow

- Teach boy C new concepts through experiential learning. For example, to explain the concept of condensation, let boy C feel the outside of a glass which is dry. Put some cold water and ice cubes into the glass. Leave the glass at room temperature. After a while, get boy C to look at and feel the outside of the glass which should be wet. The use of this experiment, together with the use of simple 1-

syllable equivalent term 'rain' for 'condensation' helps boy C to grasp and retain concepts meaningfully.

Teaching strategies for the educators, parents and caregivers to develop boy C's expressive language skills

- Recast (quick correction)
  When an adult spots an error-utterance produced by boy C during conversation, repeat the error-utterance back to him with the error corrected. For example:

  Boy C: Children *is* playing game.
  Adult: The children **are** playing a game.
  (use your voice to give a little extra emphasis on the word—'are')

- Sentence expansion
  Repeat Boy C's sentences and add on them. Then, get him to repeat them. For example:

  Boy C: Brother is playing.
  Adult: **My** brother is playing **Minecraft at home.** *(stress the words in bold).*
  Boy C: My brother is playing Minecraft at home.

Fun activities for the educators, parents and caregivers to do with Boy C to build his vocabulary

- "I spy with my little eye" is a guessing game. One player will identify an object that all other players can see. The player will provide clues about the object until someone is able to guess the object correctly. For example, one player will say "I spy something that is thin and long; the tip is sharp; it is made of wood; it is for writing" to describe a pencil.

- This game allows boy C to make meaningful associations to a word, organise the information he heard into logical chunks and retrieve the word that matches well with the given attributes. At the same time, it also trains boy C to differentiate critical from unimportant attributes of a word as well as using language to describe an object.

- Engage boy C in practical everyday activities such as shopping, cooking and PE lessons as a way of teaching him vocabulary. For example, give boy C a shopping list and assign him to pick the items at the supermarket; give boy C a recipe and get him to prepare the ingredients or teach him action verbs in a dynamic way during PE lesson.

CONCLUSION

After forty hours of SLT and indirect intervention via the advice given to the educators and the caregiver, boy C achieved 85% of his therapy targets. Boy C seemed to learn better in small group, ability based teaching with maximal use of visual, demonstration and self-practice. Engaging boy C in multi-sensory learning activities that he enjoyed doing such as drawing, playing games and pretend play helped him to focus and retain language-based information.

At end of the twenty weeks of intervention, it was observed that boy C was more confident in expressing himself. He spoke English with fewer hesitations and pauses. Boy C also showed an increase in the length and complexity of his utterances as he was able to join two ideas in a sentence using a connector more readily in conversations. For example, boy C said "When I go to school, my friend play with me. I am happy".

Boy C's caregiver noticed that he was more confident in using English to communicate at the children's home and he would share with her what he did during SLT. His caregiver also mentioned that he had shown good improvement in his mid-year examinations at school. Boy C felt that his English was much better after he had attended SLT and he had enjoyed attending the classes at the DAS.

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She provides speech/language/communication assessment and intervention services to children with specific learning differences. Her clinical experience includes working with children between the ages of 5 and 16 years. In addition, she provides advice and clinical support to Educational Therapists and junior Speech and Language Therapists at DAS. She also gives advice to parents on speech and language and communication issues. She conducts Social Skills workshops as well as give public talks on speech/language/communication difficulties faced by children with specific learning differences.

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The Computerised-based Lucid Rapid Dyslexia Screening for the Identification of Children at Risk of Dyslexia: A Singapore study

Gaynor Brookes, Veronica Ng, Boon Hong Lim, Wah Pheow Tan and Natalia Lukito

Dyslexia Association of Singapore

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The computerised-based Lucid Rapid Dyslexia Screening (Lucid Rapid) used for the speedy identification of children at risk of literacy difficulties or dyslexia has been employed as part of the dyslexia awareness drive organised by the Dyslexia Association of Singapore (DAS) to identify Singapore children who may be at risk of literacy difficulties or dyslexia. In view of a lack of research on the Lucid Rapid, this study explored the effectiveness of the Lucid Rapid in the screening of children at risk of literacy difficulties or dyslexia in the Singaporean context. In this exploratory study, a sample of 127 children aged between 6 years to 12 years 2 months was each administered the Lucid Rapid. This was followed by formal assessments conducted at the DAS or external agencies, comprising of cognitive and literacy assessments as well as phonological tests. As part of the formal assessment, a full background history was taken of each child including educational history and teachers' reports. Data from this sample showed that children found to be at risk of dyslexia on the Lucid Rapid were likely to be diagnosed to be dyslexic. However, concerns were raised on the large number of children who were misclassified falling within the false positive (misclassifying children to be at risk of dyslexia when they are not dyslexic) and false negative (misclassifying children to be at low risk of dyslexia when they are dyslexic) groups. In this sample, phonological processing, auditory sequential memory and phonic decoding, but not visual-verbal integration memory, on the Lucid Rapid positively correlated with comparable measures in formal assessments. As compared to the true negative group (children classified to be at low risk of dyslexia and not diagnosed to be dyslexic), the false negative group showed lower phonic decoding and auditory sequential memory scores. Risk levels on the Lucid Rapid have been found to be negatively correlated with a number of cognitive, literacy and phonological measures. The children's home language usage might also affect the Lucid Rapid results to some extent.

Keywords: dyslexia screening; multilingual; computer-based assessment; Singapore; DAS.

Accurate identification is an important first step to helping children with specific learning difficulties such as dyslexia. While screening tools are not typically used to diagnose dyslexia, an effective dyslexia screening tool can help identify at risk children in the population who need further attention, in terms of intervention or formal psychological assessments (Protopapas, Skaloumbakas & Bali, 2008). Dyslexia screening tests are generally brief and simple to administer relative to full psychological assessments and do not require the services of psychologists, thus making them applicable for widespread use. Learning support officers or teachers can be trained to screen children for dyslexia.

Currently, a number of conventional and computerised screening tools are available to assist the identification of children at risk of dyslexia. Among the ones most widely used in the UK are the Dyslexia Early Screening Test, 2nd edition (DEST-II) for preschool aged children (Fawcett & Nicolson, 1996) and the Dyslexia Screening Test – Junior (DST-J) for primary and secondary-school aged children (Fawcett & Nicolson, 2004). In recent years, however, there has been a growing trend towards the use of computer-based assessments (CBA) for the identification of children with specific learning difficulties (Protopapas et al., 2008; Singleton, Horne & Simmons, 2009).

Computer-based assessment for dyslexia Singleton (2001) outlined various advantages of CBA over conventional assessments. Relative to subjective judgments inherent in individual administrators, test delivery in CBA is standardised. Because most of the test delivery and scoring is performed by the computer, it is reported to be more efficient and cost-effective to administer. In addition, the technology allows the tests to be presented in more appealing formats for children, whom have displayed greater preference and motivation toward CBA over conventional assessments (Singleton, 2001).

Nevertheless, CBA programmes would not be able to take into account various additional factors that could impact test performance, such as the child's concentration, environmental factors that could occur during test administration, or background factors, which would usually be taken into consideration in conventional assessments. Thus, it is important for administrators to take note of the child's behaviour during testing as well as gather relevant background information if possible, and consider the information together with test scores when interpreting the screening results. In addition, Singleton (2001) highlighted that the ease and greater accessibility of CBA creates risk of abuse by those who do not properly understand the nature and administration of the assessment, and they might use the CBA erroneously or misinterpret findings.

LUCID RAPID DYSLEXIA SCREENING

Lucid Research Limited (Lucid Research) has produced among the most widely used dyslexia assessment software in the UK and in the world. The Cognitive Profiling System

(CoPS) is a diagnostic assessment system designed for the early identification of children with special needs (including dyslexia) between ages 4 to 8 years. CoPS has been used in over 8000 primary schools in the UK and elsewhere in the world (Lucid Research Fact Sheet 4, 2007). Apart from the CoPS, two other systems were developed for the identification of special education needs and dyslexia in other age groups, namely the Lucid Assessment Systems for Schools (LASS) Junior (ages 8 to 11 years) and LASS Secondary (ages 11 to 15 years).

Based on selected tests from their more comprehensive assessment systems, Lucid Research has produced a brief screening tool to identify children at risk of dyslexia. Taking only 15 minutes to administer, Lucid Rapid Dyslexia Screening (Lucid Rapid) is a computerised-based test designed to screen children at risk of dyslexia between ages 4 to 15 years. Due to its ease of administration and interpretation, the Lucid Rapid can be utilised by teachers or other individuals with some training.

To date, there has not been any known validation study dedicated to the Lucid Rapid. The tests within Lucid Rapid which were selected from the CoPS, LASS Junior and LASS Secondary had been individually validated and normed on 2000 children in the UK. The CoPS, LASS Junior and LASS Secondary are in widespread use in over 8000 schools (Lucid Research Fact Sheet 4, 2007). Validation studies on the CoPS, LASS Junior and LASS Secondary were used to support the validity of Lucid Rapid. The authors reported that CoPS showed a 96 per cent accuracy rate in predicting poor reading skills, with 17 per cent false negative and 2.3 per cent false positive rates. LASS Secondary reportedly showed strong correlations between its measures and widely used equivalent conventional tests for the assessment of dyslexia (Lucid Research Fact Sheet 4, 2007). More recently, Singleton et al. (2009) conducted a study examining the validity of an adult screening tool. The measures were reported to satisfactorily discriminate between dyslexic and non-dyslexic adults, with sensitivity and specificity rates of 90.6 per cent and 90.0 per cent, respectively.

Use of Lucid Rapid in Singapore Outside the UK, the Lucid Rapid has been used in various countries. In Singapore, it has been utilised by the Dyslexia Association of Singapore (DAS) since May 2009 to screen children potentially at risk of dyslexia at awareness talks organised by the DAS and at various DAS open houses. The screenings were conducted by DAS psychologists and educational therapists who had been trained in the administration and interpretation of the Lucid Rapid. Results of the screening, as well as information gathered during parent and teacher feedback sessions, were used to aid the decision on whether to refer each child for a formal psychological assessment. To date, DAS has screened over 400 children between the ages of 5 to 15 years in Singapore using the Lucid Rapid.

APPLICABILITY OF LUCID RAPID IN SINGAPORE'S MULTILINGUAL CONTEXT

As the current dyslexia screening and assessment tools have mostly been developed in the UK or the US, they were typically developed based on predominantly monolingual, English-speaking children (Everatt et al., 2000). There appears to be a consensus in the literature that traditional assessment and screening approaches for dyslexia tend to disadvantage children who speak English as a Second Language (ESL) as well as bilingual or multilingual children (Cline & Frederickson, 1999; Woolley, 2010).

Singapore possesses a multi-ethnic population of close to five million consisting of 74.1 per cent Chinese, 13.4 per cent Malays, 9.2 per cent Indians, while 3.3 per cent are classified as Others (Singapore Department of Statistics, 2010). While English is the official language and the main language of instruction in schools, Mandarin, Malay, Tamil and various dialects are widely spoken and are the predominant language for many families. Thus, it is common for Singaporean children to be able to speak one or more languages other than English.

While English is the formal language of instruction in schools and is widely used in social settings, it is not the predominant language spoken at home for the majority of the population (77 per cent). However, it is the predominant language for a substantial portion of the population (23 per cent), particularly the more educated (Singapore Department of Statistics, 2000). It is thus a concern whether the wide variation in English proficiency among children in Singapore would impact on their test performance on the Lucid Rapid.

English proficiency is likely to play a role in the understanding of task instructions, which is verbally mediated by the computer in British English which may significantly differ from Singapore colloquial English both in terms of accent and distinct rules in grammar, syntax and pragmatics (Gupta, 1992). In view of the possible linguistic differences within the Lucid Rapid, there is a need to examine the appropriate-ness of using the Lucid Rapid in Singapore's multilingual context.

PURPOSE OF THE CURRENT STUDY

To date, there is no known dedicated study on the validity of the Lucid Rapid as a screening tool for dyslexia. There is also a need to investigate the applicability of Lucid Rapid for children in Singapore in this current exploratory study. It examined a sample of children who had been screened on the Lucid Rapid and had also undergone formal psychological assessments at the DAS or other agencies; it aimed to explore the effectiveness of the Lucid Rapid in the screening of children at risk of literacy difficulties or dyslexia in the Singaporean context.

The study compared measures on the Lucid Rapid with comparable measures obtained in formal assessments and examined the relationship between cognitive and literacy skills with results on the Lucid Rapid. The study also explored if the children's home language usage could affect their scores on the Lucid Rapid.

METHOD

Participants

The assessment results of 127 children were collated for the purpose of this study. The children were tested on the Lucid Rapid between March 2009 and June 2010 to provide an indication of their risk of dyslexia. These children had also undergone full psychological assessments within six months from the date of the screening test to ascertain dyslexia.

One-hundred-and-twenty-two children were assessed by DAS psychologists and five children were assessed by educational psychologists at hospitals and external agencies. These children were from the ages of 6 years to 12 years 2 months. The mean age of the children was 8.39 years (SD=1.68) during the computerised screening test and 8.48 years (SD=1.69) during formal psychological assessments. There were 87 boys and 40 girls in this sample.

MATERIALS

Computer-based assessment

The Lucid Rapid provides an indication of a child's risk of dyslexia and an estimate of a child's performance in three dyslexia sensitive measures (Singleton et al., 2003). These measures were based on the phonological deficit model of dyslexia (Snowling, 1998) and comprised phonological processing, auditory sequential memory, and visual-verbal integration memory/phonic decoding. The three measures yield three scores and the tests administered varied with the age of the children as shown in Table 1. In this current study, the visual-verbal integration memory test was administered to 49 children, while the phonic decoding test was administered to 78 children.

The scores on the three measures were combined to derive an overall probability of dyslexia and the children were classified into one of four categories: very high probability of dyslexia (>95 per cent chance of dyslexia), high probability of dyslexia (>90 per cent chance of dyslexia), moderate probability of dyslexia (>75 per cent chance of dyslexia) and low probability of dyslexia (<10 per cent chance of dyslexia). For further information on the Lucid Rapid Dyslexia Screening, see Singleton et al. (2004).

Table 1: Description of tests on the Lucid Rapid.

Phonological Processing	Children who were younger than 8-years-old were assessed on their speed and accuracy in performing rhyming and alliteration tasks. Older children above 8-years-old were assessed on their accuracy in segmenting words into syllables and phonemes.
Auditory Sequential Memory (Working Memory)	Children who were younger than 8-years-old were tested on their ability to remember sequences of animal names. Older children above 8-years-old were tested on their ability to recall sequences of digits.
Phonic Decoding and Visual-verbal Integration Memory	Children younger than 8-years-old were tested on their ability to integrate visual and auditory information in a short-term memory task involving sequences of colours. Children above 8-years-old were tested on their phonic skills in decoding nonsense words.

Conventional formal assessment

The children were assessed on their cognitive, literacy and phonological abilities. The cognitive tests administered were obtained from the Differential Abilities Scale – 2nd edition, (DAS-II) (Elliott, 2007); the British Abilities Scale – 2nd edition, (BAS-II)(Elliott, Smith & McCulloch, 1997); and the Wechsler Intelligence Scale for

Children –4th edition (United States), (WISC-IV)(Wechsler, 2003). The specific cognitive measures which were used in the formal assessments are listed as shown in Table 2.

Table 2: Cognitive abilities measured in formal assessments.

General Conceptual Ability and the Full Scale Intelligence Quotient	These measure general cognitive ability.
Non-Verbal Reasoning Cluster	This measures the child's non-verbal inductive reasoning abilities.
Special Non-Verbal Composite	This measures the child's non-verbal reasoning and spatial abilities.
Verbal Cluster/ Verbal Comprehension Index	These measure the child's vocabulary knowledge, verbal reasoning and expressive language abilities as well as knowledge of general information.
Spatial Cluster	This measures the child's visual-spatial processing ability.
Vocabulary /Word Definition Subtests	These measure the child's vocabulary knowledge and expressive language abilities.
Verbal Similarities Subtest	This measures the child's ability to reason with verbal concepts.
Speed of Information Processing Subtest/Processing Speed Index	This measures the child's mental processing speed.
Recall of Digits Forward Subtest	This measures the child's short-term auditory memory.
Recall of Digits Backward Subtest	This measures the child's auditory working memory.
Recall of Sequential Order Subtest	This measures the child's auditory working memory requiring some degree of visualisation.
Working Memory Cluster/Index	This measures the child's auditory working memory.
Recall of Objects Subtest/ Recall of Objects Verbal-Immediate	This measures the child's visual-verbal memory.
Recall of Objects Spatial-Immediate Subtest	This measures the child's visual-spatial memory.

The literacy tests administered were obtained from the Wechsler Individual Achievement Test – 2nd Edition (WIAT-II)(Wechsler, 2001); the Wechsler Objective Reading and Language Dimensions, Singapore (WORLD^{singapore}) (Rust, 2000); and the BAS-II Achievement Scales (Elliott, Smith & McCulloch, 1997). The specific literacy tests used in the formal assessments are listed as shown in Table 3. The phonological tests were obtained from the Phonological Assessment Battery (PhAB), (Frederickson, Frith & Reason, 1997); and the DAS-II (Elliott, 2007). The phonological tests used in the formal assessments are listed as shown in Table 4.

PROCEDURE

he study was conducted in two phases. In Phase 1, each child was administered the Lucid Rapid by trained Psychologists and Educational Therapists at the DAS. In Phase 2, each child underwent full psychological assessments conducted by Psychologists at the DAS or Educational Psychologists at external agencies. Although the time interval between each phase varied with different children, Phase 2 mostly occurred within six months of Phase 1.

Not all tests were used by the various professionals in the diagnosis of children with dyslexia, accounting for the varying sample numbers for the different tests.

Table 3: Literacy skills tested in formal assessments.

Spelling Test	This measures the child's ability to spell single words.
Word Reading Test	This measures the child's ability to read single words.
Non-Word Subtest/ Pseudoword Subtest	These measure the child's phonological decoding skills.
Listening Comprehension Subtest	This measures the child's receptive vocabulary and language.
Reading Comprehension Subtest	This measures the child reading comprehension skills which include the child's ability to understand as well as to draw conclusion and make inferences of text read.

Table 4: Phonological tests used in formal assessments.

Phonological Processing Subtest	This measures the child's ability to perform rhyming tasks as well as blend phonemes into words, delete phonemes in words and segment words into their phonemes.
Alliteration Subtest	This measures the child's ability to identify words that start with the same sound.
Alliteration Fluency Subtest	This measures the child's ability to generate words that start with the same sound.
Rhyme Subtest	This measures the child's ability to identify words that end with the same sound.
Rhyme Fluency Subtest	This measures the child's ability to generate words that end with the same sound.
Naming Speed (Digit) Subtest	This measures the child's word retrieval fluency for digit sequences.
Naming Speed (Pictures) Subtest/ Rapid Naming Subtest	These measure the child's word retrieval fluency.

The sample numbers on which analyses were carried out will be specified in the reporting of the results.

Conventional formal assessments (the set 'gold standard' used in this study for the diagnosis of dyslexia) included tests of cognitive ability and literacy skills as well as tests of phonological processing and decoding abilities. The criteria used by the DAS Psychologists for the diagnosis of dyslexia were based on the DAS definition of dyslexia, *'Dyslexia is a neurologically-based specific learning difficulty which is characterised by difficulties in one or more of reading, spelling and writing. Accompanying weaknesses may be identified in the areas of language acquisition, phonological processing, working memory and sequencing. Some factors which are associated with, but do not cause dyslexia are poor motivation, impaired attention and academic frustration'* (Smith et al., 2003, no page number).

The diagnosis of dyslexia at the DAS was based on an integrative approach incorporating the principles of the discrepancy-achievement model and the symptomatic approach. The tests used in the formal assessments provided an indication of the children's cognitive, literacy and phonological processing skills. With the discrepancy-achievement model, the children's literacy skills were compared in relation to their ages as well as their cognitive and verbal abilities. However, given the limitations of the discrepancy-achievement model (for which discussion is beyond the scope of this paper), the symptomatic approach was used to provide further diagnostic information regarding the children's difficulties. Diagnostic tests were used to identify if the children showed weaknesses associated with dyslexia, such as difficulties with working memory, speed of information processing, sequencing and phonological processing. A formal diagnosis was made based on the test results, together with information gathered on the children's medical, familial and educational background.

The British Psychological Society (1999, p.18) suggests that *'Dyslexia is evident when accurate and fluent word reading and/or spelling develops very incompletely or with great difficulty. This focuses on literacy learning at the ˜word level and implies that the problem is severe and persistent despite appropriate learning opportunities. It provides the basis for a staged process of assessment through teaching.'*

In recent years there has been much debate on the need to move away from the traditional classification-based approach in the identification of children with possible learning difficulties to one which focuses on a dynamic assessment approach which is based on the children's response to intervention (Restori, Katz & Lee, 2009). Notwithstanding the merits of this approach, conventional testing continues to be a requirement in Singapore to allow children with learning difficulties to access remediation and intervention. However, Singapore is developing its own initiatives with regards to a staged approach to assessment.

RESULTS

Diagnostic accuracy of the Lucid Rapid Dyslexia Screening

The Lucid Rapid provides probabilistic categories of the probabilities of dyslexia and not a binary categorisation. Hence, for the purpose of this study, children catergorised as having 'low probability' of dyslexia were classified as having low risk of dyslexia and children categorised as having 'very high probability', 'high probability' and 'moderate probability' of dyslexia were classified as children who were at risk of dyslexia.

Based on the screening results of the Lucid Rapid and results obtained based on conventional formal assessments, the children were classified accordingly to the different groups (i.e. true positives, true negatives, false positives, false negatives) in the contingency table (see Table 5).

Table 5: Contingency table for results obtained on the Lucid Rapid and conventional formal assessments.

	Diagnosis in formal assessments	
Lucid Rapid Results	Dyslexic	Not Dyslexic
At risk of Dyslexia	77	18
Low risk of Dyslexia	17	15

A chi square test performed to examine the relationship between the results obtained on the Lucid Rapid and formal psychological assessments showed that the number of observations in each cell of the contingency table is not independent, $\chi 2$ (1, N=127)=9.71, p<.002, and the phi coefficient computed from the 2 x 2 contingency table is 0.28. This suggests that there is a 0.28 correlation between the results of screening on the Lucid Rapid and the results obtained from conventional formal assessments. An odds ratio analysis showed that children who were found to be at risk of dyslexia on the Lucid Rapid were 3.77 times more likely to be diagnosed as dyslexic in formal assessments.

In order to assess the effectiveness of the Lucid Rapid, the following measures were computed: (a) sensitivity rate, which measures the proportion of correctly identified dyslexics; (b) specificity rate, which measures the proportion of correctly identified non-dyslexics; (c) positive predictive value, which measures the proportion of children identified to be at risk for dyslexia and were diagnosed as dyslexic; and (d) negative predictive value, which measures the proportion of children identified to be at low risk for dyslexia and not diagnosed to be dyslexic.

The Lucid Rapid demonstrated a sensitivity of 81.9 per cent (95 per cent C.I.: 76.7 per cent, 86.9 per cent), specificity of 45.5 per cent (95 per cent C.I.: 30.7 per cent, 59.6 per cent), a positive predictive value of 81.1 per cent (95 per cent C.I.: 75.9 per cent, 86.0 per cent) and a negative predictive value of 46.9 per cent (95 per cent C.I.: 31.7 per cent,61.5 per cent).

Overall, the results suggest that when compared to the 'gold standard' in the diagnosis of dyslexia in a conventional full psychological assessment, the Lucid Rapid is somewhat sensitive in identifying dyslexia (i.e. picking out true positives from true positives and false negatives), but it is not very specific (i.e. picking out true negatives out of true negatives and false positives).

Comparison of the false negative and true negative groups

While the Lucid Rapid demonstrates a relatively high positive predictive value at 81.1 per cent, it is of concern that it misses approximately 20 per cent of children with dyslexia or for every five children with dyslexia, one will show low risk of dyslexia on the Lucid Rapid (false negative). Thus, it is important to identify the false negatives amongst the children in the low risk group.

To examine possible differences between the true negative and false negative groups, the test scores on the Lucid Rapid were compared with those on conventional assessments in the true negative and false negative groups using independent sample t tests. There were no differences between the true negative and false negative groups on the phonological processing test, $t(30)=0.68$, $p=.50$, and visual-verbal integration memory test, $t(4)=1.58$, $p=.19$ on the Lucid Rapid. However, the false negative group scored lower on the phonic decoding test (mean (M)=39.36, standard deviation (SD)=13.09) than the true negative group (M=52.08, SD=16.61), $t(24)=2.18$, $p=.039$. The difference on the auditory sequential memory test scores between the false negative group (M=70.35, SD=20.41) and the true negative group (M=81.73, SD=11.29) also approached significance, $t(30)=1.91$, $p=.065$. In conventional assessments, there were no significant differences between the false negative and true negative groups for all tests with the exception of the spelling and word reading tests. On the spelling test, the false negative group tended to score lower (M=99.12, SD=11.11) than the true negative group (M=110.67, SD=12.95), $t(30)=2.72$, $p=.011$. On the word reading test, the false negative group also tended to score lower (M=99.88, SD=9.43) than the true negative group (M=111.60, SD=13.71), $t(30)=2.84$, $p=.0079$. However, these scores were nevertheless within the average range.

The above analysis showed that the false negative group in this sample tended to have lower auditory sequential memory and phonic decoding test scores on the Lucid Rapid compared with the true negative group. The false negative group in this sample also tended to score lower on the spelling and word reading tests in formal assessments, although it should be noted that their scores on these tests were within the average range for the age group.

Correlational analysis

The Kendall Rank Correlations were computed on the centile test scores of the Lucid Rapid and the scores obtained in standardised conventional tests administered during the study. Table 6 shows the correlations between the test scores. The correlation values were rather varied and low, where most of the correlations were below 0.30. The phonological processing, auditory sequential memory and phonic decoding scores correlated with a number of conventional test scores. However, for the purpose of this exploratory study in ascertaining how measures on the Lucid Rapid compared with equivalent measures in formal assessments, only tests which measure similar broad cognitive domains on the Lucid Rapid and formal assessments were reported.

It is important to understand if the measures on the Lucid Rapid reliably measure what they purport to measure. Although various significant correlations were found for the various measures on the Lucid Rapid and other measures within the cognitive and literacy domains in formal assessments, the depth of the analysis is beyond the scope of this exploratory study. Instead, they are reported in the Appendix for further analysis at a later point in time.

The phonological processing test scores on the Lucid Rapid correlated significantly with the Phonological Processing subtest on the DAS-II ($r=0.22$, $p=.037$), and the Rhyme subtest on the PhAB ($r=0.21$, $p=.0094$), but not with the Alliteration subtest on the PhAB ($r=0.11$, $p=.17$). The auditory sequential memory test scores on the Lucid Rapid correlated significantly with the Recall of Digits Forward subtest on the DAS-II/BAS-II ($r=0.28$, $p=.0001$). The Phonic Decoding test scores on the Lucid Rapid also correlated significantly with the Non-word/Pseudoword subtests on the PhAB/WIAT-II ($r=0.24$, $p=.003$).

The visual-verbal integration memory scores did not correlate with comparable test scores on the Recall of Objects/Recall of Objects-Immediate Verbal subtests on the DAS-II/BAS-II. As the visual-verbal integration memory was only administered to children below 8-years-old, and given that there were far fewer 8-year-olds in this sample, the lower number of children in this group has contributed to a lack of statistical power to the analysis.
Overall, the phonological processing, auditory sequential memory and phonic decoding tests on the Lucid Rapid correlated with comparable tests in formal assessments. However, the visual-verbal integration memory scores did not correlate with comparable tests in formal assessments.

The Kendall Rank Correlations were also computed on the probability categories of the Lucid Rapid and scores obtained in standardised conventional tests administered during the study. For the purpose of the analysis, the probability categories were recorded as 0 for 'low probability', 1 for 'moderate probability', 2 for 'high probability' and 3 for 'very high probability'. Table 7 shows the correlations between the test scores and the probability categories. As can be seen from Table 7, the Lucid Rapid Probability Categories correlated negatively with the test scores of a number of tests in conventional assessments. Negative correlations were found for cognitive measures, such as General Conceptual Ability/Full Scale Intelligence Quotient (DAS-II/BAS-II/WISC-IV) ($r=-0.25$, $p=.0003$),

Table 6: Correlations between Lucid Rapid Scores and Conventional Tests Scores (*N* shown for each pair in parenthesis).

		Phonological Processing	Auditory Sequential Memory	Phonic Decoding	Visual–Verbal Integration Memory
COGNITIVE ABILITIES TESTS	General Conceptual Ability/ Full Scale Intelligence Quotient	0.21*** (127)	0.16** (127)	0.13 (79)	0.15 (48)
	Non-verbal Reasoning Cluster	0.18** (121)	0.15* (121)	0.08 (73)	0.08 (48)
	Special Non-verbal Composite	0.08 (97)	0.03 (97)	0.08 (60)	0.12 (37)
	Verbal Cluster/ Verbal Comprehension Subtest	0.17** (126)	0.14* (126)	0.13 (78)	0.03 (48)
	Spatial Cluster	0.14* (119)	0.10 (119)	0.05 (72)	0.30** (47)
	Vocabulary Subtest/ Word Definitions Subtest	0.16** (124)	0.16* (124)	0.10 (76)	0.09 (48)
	Verbal Similarities Subtest	0.17** (120)	0.14* (120)	0.03 (73)	0.01 (47)
	Speed of Information Processing Subtest/ Processing Speed Index	0.08 (122)	0.01 (122)	0.00 (75)	0.02 (47)
	Recall of Digits Forward Subtest	0.28*** (119)	0.27*** (119)	0.21* (72)	0.17 (47)
	Recall of Digits Backward Subtest	0.05 (119)	0.00 (119)	0.02 (72)	0.13 (47)
	Recall of Sequential Order Subtest	0.03 (48)	0.05 (48)	0.05 (31)	−0.05 (17)
	Working Memory Cluster/ Index	0.18 (41)	0.16 (41)	0.20 (29)	−0.06 (12)
	Recall of Objects Subtest/ Recall of Objects Verbal – Immediate	−0.08 (112)	−0.04 (112)	−0.04 (67)	0.07 (45)
	Recall of Objects Spatial – Immediate Subtest	0.07 (61)	0.03 (61)	0.18 (36)	−0.19 (25)

$^*p<0.05$ $^{**}p<0.01$ $^{***}p<0.001$

Table 6 (Continued): Correlations between Lucid Rapid Scores and Conventional Tests Scores (*N* shown for each pair in parenthesis).

		Phonological Processing	Auditory Sequential Memory	Phonic Decoding	Visual-Verbal Integration Memory
LITERACY ABILITIES TESTS	Spelling Test	0.19** (125)	0.17** (125)	0.23** (77)	0.12 (48)
	Word Reading Test	0.21*** (125)	0.15* (125)	0.33*** (77)	0.04 (48)
	Non-word Subtest/ Pseudoword S ubtest	0.22*** (121)	0.13* (121)	0.21** (74)	0.18 (47)
	Listening Comprehension Subtest	0.12 (81)	0.20* (81)	0.09 (40)	0.06 (41)
	Reading Comprehension Subtest	0.24*** (121)	0.16* (121)	0.23** (74)	−0.08 (47)
PHONOLOGICAL ABILITIES TESTS	Phonological Processing Subtest	0.26* (49)	0.14 (49)	0.16 (32)	−0.21 (17)
	Alliteration Subtest	0.11 (75)	0.16 (75)	0.28* (45)	0.30* (30)
	Alliteration Fluency Subtest	0.14 (73)	0.01 (73)	0.17 (45)	−0.20 (28)
	Rhyme Fluency Subtest	0.14 (71)	0.03 (71)	0.30** (44)	−0.06 (27)
	Naming Speed (Digit) Subtest	0.15 (70)	0.25** (70)	0.27* (42)	0.07 (28)
	Naming Speed (Pictures) Subtest/ Rapid Naming Subtest	0.05 (118)	0.09 (118)	−0.06 (73)	−0.09 (45)
	Rhyme Subtest	0.21** (76)	0.10 (76)	0.43*** (46)	0.14 (30)

*p<0.05 **p<0.01 ***p<0.001

Table 7: Correlations between Lucid Rapid Probability Categories and Conventional Tests Scores (sample size shown for each pair in parenthesis).

		Lucid Rapid Probability Category
Cognitive Abilities Tests	General Conceptual Ability Full Scale Intelligence Quotient	−0.25*** (127)
	Non-verbal Reasoning Cluster	−0.21** (121)
	Special Non-verbal Composite	−0.10 (97)
	Verbal Cluster Verbal Comprehension Subtest	−0.21** (127)
	Spatial Cluster	−0.13 (119)
	Vocabulary Subtest/Word Definitions Subtest	−0.20** (124)
	Verbal Similarities Subtest	−0.13 (120)
	Speed of Information Processing Subtest Processing Speed Index	−0.05 (122)
Literacy Abilities Tests	Spelling Test	−0.25*** (125)
	Word Reading Test	−0.28*** (125)
	Non-word Subtest / Pseudoword Subtest	−0.24*** (121)
	Listening Comprehension Subtest	−0.20* (81)
	Reading Comprehension Subtest	−0.31*** (121)
Phonological Abilities Tests	Phonological Processing Subtest	−0.24* (48)
	Alliteration Subtest	−0.22* (75)
	Alliteration Fluency Subtest	−0.09 (73)
	Rhyme Fluency Subtest	−0.24* (71)
	Naming Speed (Digit) Subtest	−0.28** (70)
	Naming Speed (Pictures) Subtest Rapid Naming Subtest	−0.06 (103)
Cognitive Abilities Tests	Recall of Digits Forward Subtest	−0.34*** (119)
	Recall of Digits Backward Subtest	0.01 (119)
	Recall of Sequential Order Subtest	0.01 (48)
	Working Memory Cluster / Index	−0.27* (41)
	Recall of Objects Subtest Recall of Objects Verbal- Immediate	0.08 (112)
	Recall of Objects Spatial-Immediate Subtest	0.03 (61)

**p<0.05 **p<0.01 ***p< 0.001*

Non-verbal Reasoning Cluster (DAS-II/BAS-II) ($r=-0.21$, $p=.0024$), Verbal Cluster/ Verbal Comprehension subtest (DAS-II/BAS-II/WISC-IV)($r=-0.21$, $p=.002$), Vocabulary/Word Definition subtest (DAS-II/BAS-II/WISC-IV)($r=-0.21$, $p=.026$), Recall of Digits Forward subtest (DAS-II/BAS-II) ($r=-0.34$, $p=.0001$) and Working Memory Cluster/Index (DAS-II/WISC-IV) ($r=-0.27$, $p=.026$). Negative correlations were also found for literacy measures, such as spelling ($r=-0.25$, $p=.0003$), word reading ($r=-0.28$, $p=.0001$), reading comprehension ($r=-0.31$, $p=.00$) and listening comprehension ($r=-0.20$, $p=.021$).

Negative correlations were found for phonological measures as well. The probability categories were negatively correlated to the Phonological Processing subtest (DAS-II)($r=-0.30$, $p=.007$), Alliteration subtest (PhAB)($r=-0.22$, $p=.014$), Rhyme Fluency subtest (PhAB) ($r=-0.24$, $p=.011$), Naming Speed – Digits subtest (PhAB) ($r=-0.28$, $p=.002$) and Rhyme subtest (PhAB) ($r=-0.24$, $p=.0069$).

HOME LANGUAGE USED

To investigate the relationship between home language usage and the results obtained on the Lucid Rapid, the risk levels of the screening results were categorised according to the home language usage of the children (see Table 8). The data for three children were removed because of missing data (i.e. their home language usage was not available). A chi square test was performed to examine the relationship between the results obtained on the Lucid Rapid and home language usage. Results showed that home language usage did not affect the Lucid Rapid screening results, $\chi2$ (3, N=124)=5.03, p=.16.

Although the above analysis indicated that home language usage did not affect the Lucid Rapid screening results, children who spoke Mandarin at home tended to be classified as 'Moderate Risk'. Another chi square test was performed on home language usage and a binary categorisation of the Lucid Rapid screening results (see Table 9), similar to the analysis of diagnostic accuracy on the Lucid Rapid. The further analysis was performed to examine whether home language usage affected the Lucid Rapid if the screening results were subjected to a binary categorisation. Results showed that children who spoke Mandarin at home tended to be classified as at risk of dyslexia, $\chi2$ (1, N=124)=3.89, p=0.048

An examination of the children's home language usage was made on the true positive and negative, as well as false positive and negative groups (see Table 10). A chi square test was performed to ascertain whether home language usage affected the distribution of the different diagnostic classifications.

Results showed that home language usage affected the distribution, Ï‡2 (3, N=124)=11.53, p=0.009. An examination of Table 10 showed that this was likely to be due to the higher proportion of Mandarin speakers in both the true positive and the false positive categories. The above analysis suggests that home language usage might affect the Lucid Rapid screening results to some extent.

However, the above analysis was based on a forced binary categorisation of the Lucid Rapid screening results and not the original categorisation as intended by the developers of the screening tool. Hence, we have to treat these findings as preliminary and further research is required to examine the effects of using the Lucid Rapid screening tool within a multilingual environment.

Table 8: Lucid Rapid Screening Results categorised by home language usage.

LUCID Rapid Risk Level	Home Language	
	English	Mandarin
Low	29	3
Moderate	36	15
High	18	4
Very High	14	5

Table 9: Lucid Rapid Screening Results (Binary) categorised by home language usage.

LUCID Rapid Risk Level	Home Language	
	English	Mandarin
Low Risk	29	3
At Risk	68	24

Table 10: Diagnostic classification categorised by home language usage.

Classification	Home Language	
	English	Mandarin
True Positives	59	15
True Negatives	14	1
False Positives	9	9
False Negatives	15	2

DISCUSSION

The screening of children at risk of dyslexia using CBA is a relatively new initiative implemented by the DAS. Having screened more than 400 children using the Lucid Rapid, it is important to evaluate the Lucid Rapid as a tool for the screening of children at risk of dyslexia in the Singaporean context. The gender ratio in this sample was 2.2 boys to 1 girl and seemed to suggest that more boys suspected of a learning difficulty were referred for the screening on the Lucid Rapid than girls. This could be attributed to a referral bias where boys with a learning difficulty tend to act out their difficulties more than girls (Shaywitz et al., 1990).

Overall, the findings based on this exploratory study seem to suggest that the Lucid Rapid can generally be a useful tool in the identification of children at risk of dyslexia, and who may require further psychological assessments and intervention. Generally, children who were found to be at risk of dyslexia on the Lucid Rapid were likely to be diagnosed as dyslexic during formal psychological assessments. However, some misclassifications by the Lucid Rapid were noted and analysed to understand some of the reasons which could account for the misclassifications.

The Lucid Rapid in this study showed a sensitivity rate (proportion of students who were dyslexic and were correctly identified by the Lucid Rapid to be at risk of dyslexia) of 81.9 per cent suggesting that the Lucid Rapid can identify children who are dyslexic rather accurately. The results also showed a specificity rate (proportion of students who were not dyslexic but were identified by the Lucid Rapid to be at risk of dyslexia) of 45.5 per cent suggesting that the Lucid Rapid is less specific in identifying children who are not dyslexic. While the Lucid Rapid showed an acceptable sensitivity rate of at least 80 per cent, its specificity rate of 45.5 per cent seemed rather low. It has been argued that sensitivity rate should be at least 80 per cent and specificity rate at least 90 per cent in order for a screening test to be considered as satisfactory (Glascoe & Byrne, 1993).

When examining the profile of the 18 children in the false positive group (children found to be at risk on the Lucid Rapid and not found to be dyslexic in formal assessments), nine showed language difficulties which could be due to a specific language impairment or a lack of exposure to the English language; three were globally delayed and their difficulties were each compounded by a non-English speaking background; two were suspected to have Attention Deficit Hyperactivity Disorder; one was suspected to have Pervasive Developmental Disorder and another was suspected to have Dyscalculia. The remaining two did not show sufficient evidence to warrant a diagnosis of dyslexia; a 6-year-old who begun home schooling only for a year and another did not seem to show apparent difficulties. The profile of the false positive group suggests that although the Lucid Rapid may not be very specific in identifying children with no dyslexia, it has identified children who may have other learning difficulties and who may require additional learning support and further assessments.

As noted in the profile of children in the false positive group, about 50 per cent of children in this group showed difficulties with language which could be due to specific language impairment or a lack of exposure to the English language. Given the varying degree of English proficiency of children in Singapore, it would be important to under-stand if the children's home language could impact their results on the Lucid Rapid. Although the children's home language in this study did not seem to affect their at risk levels on the Lucid Rapid, children who spoke Mandarin at home tended to be classified as at risk of dyslexia when the results were subjected to a binary categorisation.

The results in this sample also showed that the children's home language usage affected their categorisation in the true positive and negative groups as well as false positive and negative groups, with a higher proportion of children with Mandarin-speaking background in both the true positive and false positive groups. Thus home language might affect the Lucid Rapid results to some extent. There is a chance that a child's lack of proficiency in English might contribute to the child's categorisation in the at risk group on the Lucid Rapid.

However, as the binary classification was used, these results are only preliminary and subject to further research. We acknowledge the limitations of self reports. As the information on home language usage was self-reported, there were concerns relating to socially desirable responses provided by parents. The quality of English in Singapore varies, and it is not uncommon for Singaporean families to adopt more than one language in the home environment. Some parents may tend to report English as the dominant language used, despite the lack of quality and frequency of usage of the language. The effect of quality and frequency of usage of spoken English at home on the child's proficiency in the language was not determined. It is acknowledged that this could have impacted on the results reported above on the relationship between home language usage and the results obtained on the Lucid Rapid.

The study showed that the Lucid Rapid has a positive predictive value (also known as precision rate) of 81.1 per cent (proportion of children found to be at risk of dyslexia on the Lucid Rapid and eventually correctly diagnosed to be dyslexic) and a negative predictive value of 46.9 per cent (proportion of children with low risk of dyslexia and correctly diagnosed not to be dyslexic). Although the Lucid Rapid demonstrated a relatively high positive predictive value at 81.1 per cent, it was of concern that for every five children with dyslexia, one was misclassified to be at low risk of dyslexia on the Lucid Rapid. It was important to identify the profile of children who fell within this group.

Children in the false negative group (children with low risk of dyslexia on the Lucid Rapid and eventually found to be dyslexic) have been found to show lower phonic decoding scores as compared to their non-dyslexic counterparts in the true negative group (children with low risk of dyslexia on the Lucid Rapid and correctly found to be not dyslexic). The mean score of phonic decoding in the false negative group was found to be within the lower end of the average range. An examination of the profile of the 17 children in the false negative group showed that most displayed weaknesses in phonological measures on the Lucid Rapid.

Thus, it might be reasonable to infer that children who obtained a low risk probability and scores in the lower end of the average range on phonic decoding on the Lucid Rapid might warrant further investigation by way of formal psychological assessments. These highlight the importance of interpreting the child's individual Lucid Rapid scores together with consideration of the child's overall risk factor before recommendations to teachers and parents can be made. This is consistent with the proposed guidelines set out in the administration manual of the Lucid Rapid in the interpretation of scores (Singleton et al., 2004).

Apart from phonic decoding, it was found that children in the false negative group showed lower auditory sequential memory scores as compared to their non-dyslexic counterparts in the true negative group. Nonetheless, despite the lower sequential auditory memory scores in the false negative group, the mean scores were within the above average range. The higher scores were likely to contribute to the low risk classification of children in this group. The false negative group in this sample also tended to score lower on the spelling and word reading tests in formal assessments when compared to the true negative group although these scores were within the average range.

Generally, the phonological processing, auditory sequential memory and phonic decoding scores on the Lucid Rapid correlated with the most comparable scores in formal assessments. However, the correlations were not high. Although the measures on the Lucid Rapid and conventional formal assessment were deemed comparable, there were salient differences in the test delivery on the Lucid Rapid compared with tests in formal assessments. This is consistent with a study conducted by Singleton (2001). Singleton found significance but not exceptionally high correlations between two CBAs measuring verbal and non-verbal abilities with established cognitive tests on the BAS-II. He postulated that it was likely that the tests were not measuring exactly the same cognitive skills, and the absence of verbal responses on the CBAs might preclude important components in cognitive assessments. The measure of visual-verbal integration memory on the Lucid Rapid did not correlate with comparable tests in formal assessments. In view of the lower number of children below 8-years-old in this sample, the number of data available for this analysis was limited. A bigger sample size of children below 8-years-old would increase the statistical power of the analysis. Thus, the lack of statistical correlation on the visual-verbal integration memory on the Lucid Rapid with comparable conventional tests should be interpreted with caution.

Risk levels on the Lucid Rapid have been found to be negatively correlated with cognitive measures in formal assessments such as general cognitive ability, non-verbal inductive reasoning ability, verbal ability, vocabulary knowledge, short-term auditory memory and working memory. These suggest that children who were found to be at risk of dyslexia on the Lucid Rapid in this sample tended to show weaker scores on a number of cognitive measures, and children who obtained low risks of dyslexia on the Lucid Rapid in this sample tended to show better scores on a number of cognitive measures. Further research would be required to ascertain if these cognitive measures mediate the children's at risk levels on the Lucid Rapid.

Risk levels on the Lucid Rapid have been found to correlate negatively to a number of phonological measures in formal assessments as well. Children who were found to be at risk of dyslexia on the Lucid Rapid in this sample tended to obtain lower scores on phonological measures while children found to be at low risk of dyslexia on the Lucid Rapid in this sample tended to obtain better scores on measures of phonological processing. Risk levels on the Lucid Rapid have also been found to negatively correlate with literacy measures, such as reading, spelling, reading comprehension and listening comprehension abilities.

These correlations are encouraging and imply the inherent usefulness of the Lucid Rapid in identifying children with dyslexia and literacy difficulties. Notwithstanding the limitations of the study, the Lucid Rapid has been found to have practical application in the screening of children with dyslexia/literacy difficulties. It is speedy to administer and can be administered to relatively larger groups of children in a relatively short time, as compared to formal assessments. It has also proven to be an effective tool in raising awareness of dyslexia in Singapore, as well as providing opportunities for informed discussions with parents about their children's learning difficulties.

However, as gleaned from the findings of this study, it is important that administrators of the Lucid Rapid are well-versed in the interpretation of the results. As the Lucid Rapid and other CBA cannot easily accommodate information, such as the child's educational or familial background, as well as the child's use of compensatory strategies during testing (Singleton et al., 2009), it is imperative that the screening results are interpreted in conjunction with background information gathered from teachers and parents so that informed recommendations may be made, preventing children who need learning support to slip through the net and denied attention. It is also important to ensure that children who do not have a learning difficulty are correctly identified as such.

This is only an exploratory study in the evaluation of the effectiveness of Lucid Rapid in Singapore and its limitations are acknowledged. The sample of children used in this study was based on an unselected sample of children, referred for the screening by parents and teachers who suspected that their children might have learning difficulties. In this sample, 74 per cent were found to be dyslexic as compared to the estimated prevalence of dyslexia of five per cent to 10 per cent in a general population (Rodgers, 1983; Shaywitz et al., 1992; Siegel, 2006). It might be inappropriate to generalise some of these findings to the general school population.

Despite working with the set basic criteria for the diagnosis of dyslexia in conventional assessments, a varied battery of normalised tests can be used in the formal assessments of children with dyslexia. As formal assessments were administered by a total of 19 psychologists in this study, both from the DAS and external agencies, there were likely to be differences in the criteria and personal preferences amongst the professionals in the conventional tests used. The varied normalised tests administered have resulted in the varied sample numbers used for data analysis. This is likely to limit the robustness of the study. Thus, designated specific tests in conventional assessments would provide some standardisation to the sample numbers.

The DAS experience in using the Lucid Rapid for the mass screening of children at risk of dyslexia in Singapore can no doubt be useful information for practitioners who are using CBA for the identification of children who might be at risk of dyslexia. Although the Lucid Rapid has been shown to be rather accurate in identifying children with dyslexia, it is important to be vigilant in identifying the false positives and false negatives. It is also important to understand that the children's proficiency in the English language may affect results on the Lucid Rapid. This research should be relevant to practitioners who have a keen interest in using the Lucid Rapid or other CBA for the identification of children at risk of dyslexia.

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APPENDIX

The phonological processing measure on the Lucid Rapid was found to correlate significantly with cognitive measures such as, General Conceptual Ability/Full Scale Intelligence Quotient (r=0.21, p=.001), Non- verbal Reasoning Cluster (r=0.18, p=.006), Verbal Cluster/Verbal Comprehension subtest (r=0.19, p=.003), Spatial Cluster (r=0.14, p=.03), Vocabulary/ Word Definitions subtests (r=0.15, p=.02), Verbal Similarities subtest (r=0.17, p=.009) and Recall of Digits Forward subtest (r=0.28, p=.009). Significant correlations were also observed for literacy measures such as, Spelling (r=0.19, p=.002), Word Reading (r=0.21 p=.0007), Non-word/Pseudoword (r=0.20, p=.0016) and Reading Comprehension (r=0.24, p=.0002).

The auditory sequential memory measure on the Lucid Rapid was found to correlate significantly with General Conceptual Ability/Full Scale Intelligence Quotient (r=0.16, p=.009), Non-verbal Reasoning Cluster (r=0.15, p=.02), Verbal Cluster/Verbal Comprehension subtest (r=0.15, p=.02), Vocabulary/Word Definitions subtest (r=0.19, p=.002), Verbal Similarities subtest (r=0.14, p=.03) and Recall of Digits Forward subtest (r=0.27, p=.0001). Significant correlations were also observed for literacy measures such as Spelling (r=0.17, p=.007), Word Reading (r=0.15, p=.02), Listening Comprehension (r=0.20, p=.01) and Reading Comprehension (r=0.16, p=.004).

Phonic decoding on the Lucid Rapid was found to correlate significantly with the Recall of Digits Forward subtest (r=0.21, p=.009) as well as literacy measures such as, Spelling (r=0.24, p=.003), Word Reading (r=0.33, p=.0001), and Reading Comprehension (r=0.23, p=.004). Phonic decoding on the Lucid Rapid also correlates with the Alliteration test (r=0.28, p=.01), Rhyme test (r=0.43, p=.0001), Rhyme Fluency test (r=0.30, p=.009) and Naming Speed (Digit) test (r=0.27, p=.01).

Visual-verbal integration memory on the Lucid Rapid was also found to correlate significantly with the Spatial Cluster (r=0.30, p=.005) and the Alliteration test (r=0.30, p=.03).

The Identification of Dyslexia in Preschool Children in a Multilingual Society

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Given the importance of reading proficiency to literacy performance and beyond, dyslexia has received much attention in recent decades, fuelling vast research elucidating the factors underlying reading difficulties. Research has consistently demonstrated the importance and benefits of early intervention, hence underscoring the need for early identification of dyslexia. However, the existing research and the various early screening instruments developed were largely based on children in monolingual societies. This study examined the early identification of dyslexia in preschool children in a multilingual society such as Singapore. The Dyslexia Early Screening Test – Second Edition (DEST-II), and the Cognitive Profiling System (CoPS) were administered to Kindergarten One and Two preschoolers. In addition, a rating scale on the children's literacy development was also administered to the teachers of these preschoolers. Preliminary results suggest that the DEST-II and the teachers' rating scale are effective and reliable first-line screening instruments in the identification of preschool children "at risk" of dyslexia, albeit with some adaptations for use in the local context.

Keywords: Preschool screening, teacher rating scales

Reading proficiency is essential for educational success in school and into the later stages of life. Given the importance of literacy performance, an extensive amount of research has been conducted over the past few decades to understand and elucidate the factors underlying reading difficulties. In particular, the emergence of greater awareness and attention to dyslexia has fuelled vast research on this specific learning difficulty.

DYSLEXIA AS A SPECIFIC LEARNING DIFFICULTY

Dyslexia is a neurologically-based specific learning difficulty that interferes with the acquisition and processing of language that is not caused by a lack of intelligence or opportunities for learning (The International Dyslexia Association [IDA], 2002). It is characterised by difficulties in reading, spelling and/or writing that typically result from a deficit in the phonological component of language (IDA, 2002). Apart from these cardinal problems, there may be accompanying weaknesses in the areas of language acquisition, phonological processing, speed of processing, working memory, auditory and/or visual perception, sequencing and organisation (The British Dyslexia Association [BDA], 2006). In addition, dyslexia is also associated with poor motivation, impaired attention and academic frustration.

The extent to which dyslexia is apparent in a particular language is a function of the quantity and quality of exposure to that language and other languages. Individuals with dyslexia are likely to have greater difficulty with languages of more complicated orthographic, phonological and/or grammatical systems. The incidence of dyslexia in Singapore is within the international range of 3% to 10% (Snowling, 2000). This translates to about 20,000 children in local primary and secondary schools, and another 3,500 children in preschool education. In other words, an average of one to two students in every classroom of 40 students is estimated to be dyslexic and will need ongoing specialist teaching and support.

IDENTIFICATION AND ASSESSMENT OF DYSLEXIA

There have been a number of different approaches to diagnose dyslexia. Among these approaches, the Discrepancy and the Symptomatic approach emerge as the main ones used in identifying dyslexia. The advantages and disadvantages of each approach are discussed as follows.

THE DISCREPANCY APPROACH

As the mainstream methodology used to diagnose dyslexia, the Discrepancy approach identifies specific underachievement in a child's literacy attainments, in the areas of reading, spelling, writing and/or comprehension, relative to his or her intellectual capacity. Although this method is highly debated (e.g., Stanovich, 1994; 2005), it is nevertheless the diagnostic criteria that is reflective of mainstream definitions of the dyslexia construct (e.g., World Federation of Neurology, 1968) and is the diagnostic criteria set forth by the Diagnostic and Statistical Manual – Fourth Edition (American Psychiatric Association, 2000). In addition to an ability-achievement discrepancy, cognitive deficits including weaknesses in processing speed and working memory are also present.

According to this model, a diagnosis of dyslexia is made if the child's performance on various literacy tasks is significantly below what is expected given his or her cognitive functioning – a diagnostic criteria also known as the "wait to fail" model. Consequently, a child with an average level of intellectual ability yet demonstrates below average literacy performance suggests dyslexia. Likewise, despite age-appropriate literacy attainments, a child with high cognitive abilities may be found to be dyslexic as he or she is not performing up to his or her potential academic ability. Accordingly, this approach provides a clear, direct and straightforward methodology for the identification of dyslexia.

On the other hand, to obtain a clear discrepancy between one's cognitive ability and literacy achievement, the child would have to experience failure and lag significantly behind in school. Relative to other children with no learning difficulties, these children typically receive less practice in reading (Allington, 1984), missed the opportunity to develop reading comprehension skills (Brown, Palincsar & Purcell, 1986), might have acquired negative attitudes about reading (Oka & Paris, 1986) or develop a low self esteem (Humphrey, 2002). Of greater importance is that once these children have delayed the development of critical word reading skills, it may require intensive interventions to improve and restore adequate levels of reading accuracy (Allington & McGill-Franzen, 1989; Vaughn & Schumm, 1996). This is further exacerbated by the large amount of reading practice that is lost with time as these children remain poor readers (Torgesen, 1998). Children who lag behind in the development of early reading skills have fewer opportunities to practise reading.

Recent evidence suggests that due to this loss of practice, it is extremely difficult for children who remain as poor readers during the first three years of elementary school to acquire age-appropriate levels of reading fluency (Torgesen, Rashotte, & Alexander, 2001). Consequently, recent studies have increasingly focused on the identification of dyslexia in early years to facilitate early intervention.

THE SYMPTOMATIC APPROACH

Through the identification of various characteristics and symptoms of dyslexia, the Symptomatic approach provides an alternative methodology to the assessment of dyslexia. According to this model, dyslexia-type symptoms such as literacy errors, phonological processing difficulties, sequencing difficulties, as well as poor working memory and motor skills provide a basis for a positive diagnosis. Using this approach, some early dyslexia screening tools aim to identify children who are "at risk" of dyslexia by examining some of these underlying deficits.

Several studies have documented various factors that strongly correlate with reading ability and reliably distinguish between successful and poor readers. Among these include phonological processing skills (Badian, 1998; Felton & Brown, 1990; Foorman, Francis, Shaywitz, Shaywitz, & Fletcher, 1997), short-term memory for words, digits and other verbally coded material (Fowler, 1991; Sawyer, 1992), and rapid serial naming skills (Wolf & Bowers, 2000). Other issues such as family history, speech development, birth history and socioeconomic status are also significant differentiating factors (Badian, 1988). In addition, research has also shown that a child's language experiences such as rhyming and sound game activities, as well as reading interactions, too influence the development of skills necessary for reading competence (Lonigan, Anthony, Bloomfield, Dyer, & Samwel, 1999; MacLean, Bryant & Bradley, 1987).

Apart from preventing the child from experiencing failure before help is given, the Symptomatic approach is particularly useful for the early identification of (and subsequently, the provision of early intervention for) dyslexia in young children such as preschoolers. This is especially so given that preschool children would have rather limited literacy skills and are thus less likely to demonstrate a discrepancy between their abilities and attainments.

SINGAPORE: A MULTILINGUAL PERSPECTIVE

The identification and diagnosis of dyslexia in Singapore is compounded by multilingualism. With the rise and prevalence of globalisation in the world, multilingualism and linguistic diversity have assumed a global identity. Consequently, the identification of dyslexia in a multilingual society such as Singapore has implications for all multilingual communities in many countries. Multilingual students live in an environment in which they are regularly exposed to, or need to use, two or more languages at home and at school. However, this does not imply that they are fluent in these languages or that they are competent and literate in any of these languages. In contrast, a monolingual student uses only one language at home and at school, but may learn a foreign language (or more) at school.

Within the local scene, the nature of the different languages used among various ethnic groups presents different problems. English and Malay are alphabetic languages; Chinese is a logographic script; and Tamil and Hindi are syllabic scripts. Due to cultural differences and the inherent confusion between different languages, children in Singapore are presented with great challenges as they negotiate between the local working language – English – and their respective Mother Tongues. Furthermore, given that English is adopted as the academic language and the main medium of instruction in school, many children coming from non-English speaking backgrounds, termed English-as-second-language

(ESL), may encounter difficulties learning to read and spell as a consequence of limited exposure to the English language, rather than due to a specific learning difficulty such as dyslexia per se.

On the other hand, the identification of dyslexia in a multilingual society such as Singapore is almost always based on assessment and screening tools which were developed in monolingual societies. There are fundamental differences in linguistic, cultural, social and educational experiences between children in monolingual and multilingual societies. Consequently, it is important to determine if these tools can exercise adequate levels of diagnostic sensitivity and specificity by reliably distinguishing children with dyslexia from children presenting with other confounding issues that also contribute to literacy difficulties (e.g., ESL). The last decade has seen a rising interest in multilingualism and international cooperation and networking in research. This research suggests that dyslexia is a language-based disorder that may manifest itself differently in different language systems (Miles, 2000).

THE BENEFITS AND IMPORTANCE OF EARLY IDENTIFICATION OF DYSLEXIA

There is an extensive amount of research demonstrating the benefits and importance of early identification and intervention of reading difficulties. Early reading failure has been shown to have a broad impact on general cognitive development (Cunningham & Stanovich, 1998) and the demand for literacy in our technologically advanced society is increasing (Snow, Burns, & Griffins, 1998). Generally, the earlier the intervention, the easier it is for a child with dyslexia to learn to read, and the lower the incidence of psychological issues associated with reading difficulties. Research has demonstrated that children who were unsuccessful readers in first grade almost invariably remained as poor readers (Francis, Shaywitz, Stuebing, Shaywitz, & Fletcher, 1996; Juel, 1988; Torgesen & Burgess, 1998). Due to the fact that it is increasingly difficult to remediate reading difficulties as the child progresses into the later school years (Fletcher & Foorman, 1994), the gap between successful and poor readers widens over the elementary school years (Stanovich, 1986). The situation is further exacerbated by the persistence of reading difficulties throughout school and into adulthood (LaBuda & DeFries, 1988).

In contrast, children who are successful readers at the start of school are likely to experience academic success, graduate from high school and college and subsequently, seek employment after school (Slavin, Karweit, & Madden, 1989). Studies have consistently documented the benefits that early intervention yield in the acquisition of reading skills and on measures of reading and spelling (e.g., Ball & Blachman, 1991; Felton, 1993; Foorman, Francis, Fletcher, Schatschneider,

& Mehta, 1998). Given the pivotal role of reading in a child's success in school and thereafter, and the benefits of early literacy intervention, the early identification of dyslexia in preschool children is essential.

There are also some advantages of early screening tests. A screening assessment is a relatively short evaluation aimed at identifying children at risk of dyslexia, as compared to a detailed psychological assessment which usually occurs over two sessions. Accordingly, the former assessment is usually relatively inexpensive and may be administered by school professionals (e.g., teachers, special needs officers). This is in contrast to the latter assessment which requires a trained professional to administer. In addition, a screening assessment can also serve as a filter to identify children who demonstrate greater risk of dyslexia so that these children who require a detailed diagnostic assessment can go on to receive it.

AIM OF CURRENT RESEARCH PROJECT

Taking into the consideration the complexities involved in the identification of dyslexia, it is both important and beneficial to ascertain the suitability and applicability of contemporary assessment tools to the local multilingual population. This is particularly so for those children who are not native English speakers. In addition, early identification of dyslexia in preschool children leads to the possibility of early intervention aimed at preventing prospective failure in school during later years. Consequently, the aim of the present research study is to investigate and review the best way to identify preschool children in Singapore who are "at risk" for dyslexia. Two contemporary screening tools developed for preschool children of this age range would be examined and compared: the Dyslexia Early Screening Test – Second Edition (DEST-II; Nicolson & Fawcett, 2004) and the Cognitive Profiling System (CoPS; Singleton, Thomas, & Leedale, 1996). These assessment and screening instruments were chosen due to their comprehensive coverage of the various symptoms of dyslexia, as well as their extensive use in the United Kingdom.

In addition, a rating scale of behavioural characteristics developed for use by teachers will be used to obtain information about the child's learning behaviour and performance in class. Teachers' ratings of behaviour and learning progress of a child in the classroom setting may play an important role in the early identification of children "at risk" for dyslexia. Such reports have been frequently used as part of comprehensive diagnostic procedures such as that for children with general learning difficulties (e.g., Myklebust Pupil Rating Scale; Margolia, Sheridan, & Lemanowicz, 1981) and Attention-Deficit Hyperactivity Disorder (e.g., Conners' Teacher Rating Scales – Revised; Conners, Sitarenios, Parker, &

Epstein, 1998). Through the administration of these instruments and rating scale, the present study aimed to examine and elucidate the effectiveness of these tools in identifying preschool children who are "at risk" for dyslexia, including the consistency in identification outcomes among these different instruments.

METHOD

Participants

Kindergarten One and Two preschoolers, aged between 4 years 6 months and 6 years 5 months, from one kindergarten and four childcare centres in Singapore were included in the study: (1) St. James' Church Kindergarten; (2) Learning Vision @ Punggol Field Walk; (3) NTUC Childcare Bukit Merah; (4) NTUC Childcare Bedok; and (5) NTUC Childcare Jurong West. These centres were selected to obtain a representative sample and include children from diverse backgrounds. With the assistance of these selected centres, letters of consent including information about the study and some questions about the child's background information were sent to parents. A total of 136 children participated in the study upon parental consent. However, the final sample of children who completed the study was reduced to 119 following the language screening test.

MATERIALS

Rating Scale. A rating scale was constructed based on the major characteristics of dyslexia commonly displayed by preschool children. At the pilot phase, feedback was collected from a few kindergarten teachers and principals to ensure that all items are comprehensible. A few changes were made to the wording of the items and the revised version of the rating scale comprised 21 items covering the following area of difficulties: (i) phonics; (ii) reading/spelling/writing; (iii) speech; (iv) motor skills; and (v) general. Teachers were instructed to rate the child on the respective dimensions based on his or her performance relative to same-aged peers, using a 5-point frequency scale anchored at the ends with 1 = Never and 5 = Always.

British Picture Vocabulary Scale – Second Edition (BPVS-II). The language screening procedure was conducted through the administration of the BPVS-II (Dunn, Dunn, Whetton, & Burley, 1997). The BPVS-II is designed for use with children from age three to 15 years and is used to measure a child's level of English receptive vocabulary. Each item has four simple black and white illustrations on a page arranged in a two-by-two array. The child is simply required to select the picture that is considered to best illustrate the meaning of a target word presented orally by the examiner.

In order to exclude the confounding influence of language comprehension on task performance, an exclusion criterion was adopted to screen out children who may have problems understanding and following the instructions on subsequent test instruments. In particular, children with BPVS scores of less than 70 (more than two standard deviations away from the mean of 100) were excluded from the study.

Dyslexia Early Screening Test – Second Edition (DEST-II). The DEST-II (Nicolson & Fawcett, 2004) is a dyslexia screening instrument intended for use with children aged between 4 years 6 months to 6 years 5 months. It was designed to identify children "at risk" for reading failure early enough so that they can be given extra support in school.

The DEST-II comprises 12 subtests which assess the child's ability in the areas of phonological awareness and discrimination, pre-reading skills, motor skills, rapid naming ability, working memory, spatial sequential memory, balance ability, receptive vocabulary and verbal reasoning. These tests were based on a review of the literature on dyslexia and chosen to include a sufficiently comprehensive range of skills found to be impaired in individuals with dyslexia (e.g., Bishop, 1985; Denckla & Rudel, 1976; Fawcett, Maclagan, & Nicolson, 2001; Wolf & Bowers, 1999). Performance on each subtest is reflected by an "At Risk Index", which is used to compute an overall "At Risk Quotient" (ARQ) ranging from 0 to 2. An ARQ of 0.9 or greater is strong evidence of being "at risk" of dyslexia, and an ARQ of 0.6 to 0.8 is mild evidence of being "at risk".

For the purpose of this study, only 10 out of the 12 subtests were administered. The Postural Stability subtest was excluded due to concerns about the administering procedure – blind-folding and touching the child's body – which may be intimidating to the child. In addition, the Vocabulary subtest as a measure of receptive vocabulary and verbal reasoning was excluded as the BPVS-II was already administered. Furthermore, given that some children come from a non-English speaking background, including the Vocabulary subtest may not provide as adequate an indication of dyslexia in Singapore as in other monolingual societies.

Cognitive Profiling System (CoPS). The CoPS (Singleton, Thomas, & Leedale, 1996) is a computer-based standardised assessment instrument intended for use with children aged between 4 years 0 months to 8 years 11 months. It is designed for use by individuals trained in the field of education or psychology to identify children's cognitive strengths and weaknesses. The gathered information can assist in the identification of dyslexia, various developmental difficulties and other special educational needs so as to recognise the child's learning style and provide them with individualised and differentiated teaching.

The CoPS consists of nine tests delivered in the form of games to assess the following areas of cognitive ability: visual/verbal sequential memory; visual/spatial sequential memory; auditory/visual associative memory; auditory/verbal sequential memory; visual/verbal associative learning; phonological awareness; auditory (phoneme) discrimination; colour discrimination; information processing speed; and motor processing. Each test is preceded by verbal instructions delivered by the computer, followed by a practice phase in which the child is told by the computer how to play the 'game'. A mouse practice activity is incorporated into the program to provide an opportunity for the child to practise moving and clicking the mouse. This is especially important for children with no experience using a computer mouse.

PROCEDURE

Stage 1: Pre-testing & Pilot

All the researchers went through a period of training to familiarise themselves with the administration and scoring procedure for the BPVS-II, DEST-II and CoPS. Each researcher then conducted a trial run and administered these instruments to a volunteer.

Stage 2: Checklist & Screening

Teachers' Rating Scale. Rating scales were distributed to the teachers through the principals of the selected centres. With the exception of those children whose parents had opted to be excluded from the study, teachers were requested to rate each child individually using the rating scales provided.

Screening Procedure. All children with parental consent to participate in the study were administered the BPVS-II during the first session of testing. Those who scored exceptionally poor (BPVS < 70) were excluded from the next stage of the study.

Stage 3: Experimental Testing (Sessions 2 to 5)

The final sample of children was then administered the DEST-II and CoPS. Due to the rather long administration time needed for the COPs (approximately 45 minutes to an hour; as compared to the DEST-II which takes about 20 to 30 minutes), and the relatively shorter attention span of young children, the CoPS was subdivided into CoPS1, CoPS2, and CoPS3 to be completed in three separate sessions in that order, as shown in Table 1. Each sub-session comprised a combination of visual and auditory/verbal tests. In addition, all children were required to complete the mouse practice activity before commencing any of the actual tests.

Table 1. Breakdown of CoPS into three different sessions

CoPS1	CoPS2	CoPS3
(Mouse Practice)	Toybox*	Rabbits*
Clown‡	Rhymes†	Zoid's Letter Names†
Zoid's Friend*	Zoid's Letters*	Races†
Wock†		

**Visual Tests; †Auditory/Verbal Tests; ‡Colour Discrimination*

RESULTS & DISCUSSION

Prior to any analysis, the collected data from the various instruments were screened. For the purpose of preliminary analysis, children with missing data from any of the instruments administered (i.e. teachers' checklist, DEST-II, CoPS) were excluded from data analysis. These included one child who was consistently absent from school and another who withdrew from school and thus, did not participate further in the study. Consequently, the final sample size used for data analysis was reduced from 119 (following language screening using BPVS-II) to 97.

PARTICIPANT CHARACTERISTICS

Table 2 provides a summary of the demographic characteristics and level of receptive vocabulary of the children from the five preschool centres. There were no significant differences in age (at first testing), $F(4, 92) = 1.70$, ns, nor gender distribution, all $c2(1) < 0.90$, ns, between the children from the five preschool centres.

However, at the centre level, these children were significantly different in terms of their level of receptive vocabulary reflected by the BPVS-II scores, $F(4, 92) = 7.49$, $p < .001$ (see Figure 1). A further analysis of these scores revealed that children from preschool centres 1 and 2 scored significantly higher than children from the other three centres[1]. In retrospect, while the five preschool centres

Table 2. Age, Gender Distribution, BPVS scores and Race Composite by Preschool Centre

Characteristics	Centre 1 (*n* = 13)	Centre 2 (*n* = 12)	Centre 3 (*n* = 14)	Centre 4 (*n* = 40)	Centre 5 (*n* = 18)	Total Sample (*N* = 97)
Age at 1st test (years)						
M	5.43	5.09	5.60	5.32	5.34	5.35
SD	0.47	0.48	0.53	0.52	0.50	0.52
Gender						
Male	6	5	8	23	8	50
Female	7	7	6	17	10	47
BPVS-II Score						
M	99.77	102.25	85.86	88.23	91.17	91.71
SD	11.28	13.78	8.09	9.57	9.78	11.55
Race Composite						
Chinese	13	11	10	33	13	80 (82.5%)
Malay	0	1	1	6	5	13 (13.4%)
Indian	0	0	3	1	0	4 (4.1%)

were recruited from five different regions in Singapore, there may arguably be differences in the socioeconomic status of its residents.

Specifically, preschool centres 1 and 2 are situated in Holland Village and the new estate of Punggol respectively. In comparison, centres 3, 4 and 5 are situated in more mature and established housing estates. Almost all tested children from the former group of centres came from an English-speaking background (92% to 100%) as compared to a lower percentage of such children from the latter group centres (50% to 66%). On the other hand, preschool centres 3, 4 and 5 saw a relatively greater proportion of children from a non-English speaking or ESL background (more than 70% in these centres versus 46% in preschool centres 1 and 2).

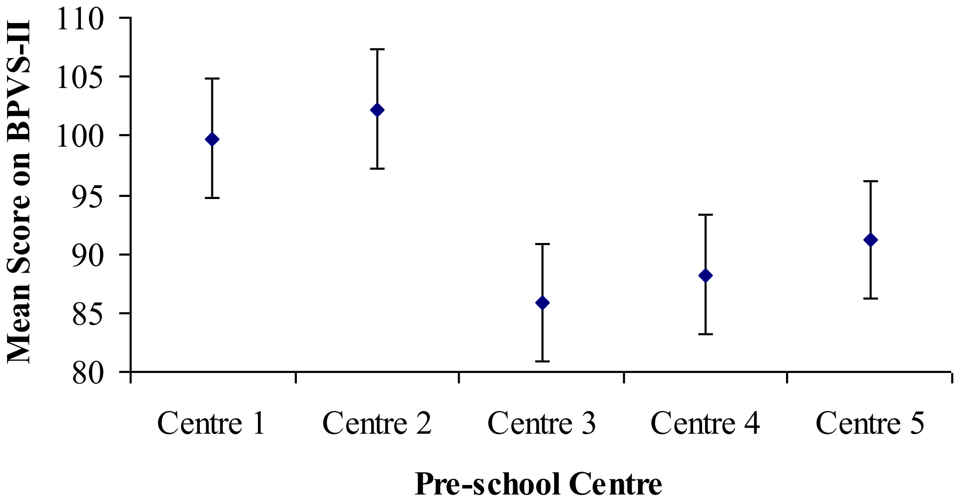

Figure 1. Mean scores on BPVS-II by preschool centre. 5% error bars are shown.

CoPS

Taking into consideration the short attention span of preschool children, each of the five sessions of testing was limited to twenty minutes. In addition, the original CoPS was divided into CoPS 1, 2 and 3 to be administered over three shorter sessions. Nevertheless, it was observed that many children required close supervision when completing the CoPS and they had to be constantly reminded to remain focused on the task at hand. Their inattention and distractibility appeared to have affected their performance on the various tasks. Although almost all children were fascinated by the attractive pictures and sounds presented using the laptop during the initial presentation of each sub-test, they lost interest quickly as the items presented were getting more difficult, or as the target stimuli that they should remember increased.

In addition, the nature of the CoPS is such that on the main test items, the child is required to produce a response on the computer mouse and subsequently, he/she can then proceed to the next item regardless of whether the answer is correct. On the other hand, the practice items required the child to produce a correct response, upon which the failure to do so would see the practice items being repeated over and over again until a correct answer is recorded. Many children were observed to engage in random responding when unsure or when their attention drifted.

Table 3. Total Rating Scale Score by Preschool Centre

	Centre 1 (n = 13)	Centre 2 (n = 12)	Centre 3 (n = 14)	Centre 4 (n = 40)	Centre 5 (n = 18)	Total Sample (N = 97)
M	25.92	33.25	69.57	40.05	33.11	40.29
SD	8.21	9.63	16.77	11.01	18.36	18.3
Percentile						
10th	20	21.9	44	25.2	21.9	22
25th	20.5	24.5	57	30	22	24.5
50th	23	29.5	69.5	38.5	23.5	37
75th	28.5	44	84.25	49	40	50.5
90th	42.8	44.7	92.5	54	66.8	65

Table 4. "At Risk Quotient" on DEST-II by Preschool Centre

	Centre 1 (n = 13)	Centre 2 (n = 12)	Centre 3 (n = 14)	Centre 4 (n = 40)	Centre 5 (n = 18)	Total Sample (N = 97)
M	0.1	0.18	0.62	0.23	0.36	0.23
SD	0.1	0.16	0.38	0.17	0.23	0.26
Frequency(%) of:						
Strong risk (ARQ>0.9)	0	0	5 (35.7)	0	0	5 (5.2)
Mild Risk (0.6<ARQ <0.8)	0	0	1 (7.1)	1 (0.025)	4 (22.2)	6 (6.2)
No Risk (ARQ<0.6)	13 (100)	12 (100)	8 (57.1)	39 (99.075)	14 (78.8)	86 (88.7)

Consequently, the results on the CoPS are not reported as they did not appear to be reliable and preliminary analyses of the collected data revealed several inconsistencies that question the validity of the results. In general, at least at the preliminary level of analysis, the CoPS does not appear to be as an effective tool for the purpose of identifying preschool children “at risk” for dyslexia, in view of the aforementioned issues.

TEACHERS’ RATING SCALE

The rating scale was completed by each participating child’s school teacher to obtain an understanding of the child’s day-to-day performance in school. It was noticed that some checklists contained missing data as the teachers did not complete every item. This could be due to the possibility that some items were not applicable to the school curriculum or that the teachers had no chance of observing the child carrying out certain activities. Alternatively, the teachers might have accidentally missed out some items.

A preliminary analysis of the distribution of scores on each item suggests that a number of items had a very positively skewed distribution. In general, about 10% of the scores lie within the extreme high end of the distribution. However, considering that dyslexia occurs in about 3% to 10% of the population, the results from the rating scale appear to be in accordance to prevalence statistics. Given a 5-point rating scale with 21 items, possible total scores on the rating scale range from 21 to 105, with higher scores indicating a higher frequency of the stated difficulty. Table 3 presents the descriptive statistics for total rating scale score by preschool centre. Reliability analysis revealed high internal consistency (Cronbach’s $\alpha = 0.956$) of the items on the rating scale.

One-way ANOVA revealed significant differences between preschool centres on total rating scale scores, $F(4, 92) = 23.39$, $p<.001$. Post-hoc analysis demonstrated that children from preschool centre 3 scored significantly higher on the rating scale relative to children from all the other preschool centres. Notably, children from preschool centre 4 scored significantly higher than children from preschool centre 1.

DEST-II

On the DEST-II, the distribution of scores on some of the subtests was rather skewed. In addition, it appeared that Singaporean preschool children generally performed better on tests assessing motor coordination skills, digit span, letter naming and digit naming. In contrast, they did significantly poorer on tests that assessed their phonological awareness, especially rhyme. Consequently, the ARQ, which was calculated based on the child’s overall performance on the

DEST, may not be a valid representation of the child's abilities in these areas in which many dyslexic individuals have difficulties. Table 4 presents the descriptive statistics of the DEST-II ARQ by preschool centre.

One-way ANOVA revealed significant differences between preschool centres on ARQ scores on the DEST-II, $F(4, 92) = 12.78$, $p<.001$. Post-hoc analyses demonstrated that children from preschool centre 3 scored significantly higher ARQs relative to children from all the other preschool centres. Children from preschool centre 5 scored significantly higher ARQs than children from preschool centre 1.

RELATIONSHIP BETWEEN INSTRUMENTS

To examine the consistency in identification outcomes across the different instruments, and the influence of children's language backgrounds on their level of performance, scores on the rating scale, DEST-II and BPVS-II were compared and examined. Pearson correlations revealed a significant relationship between scores on the rating scale and DEST-II, $r(97) = 0.63$, $p < .001$, and this correlation remained significant when differences in BPVS-II scores (i.e. the influence of receptive vocabulary) were partialled out of the relationship, $r(94) = 0.58$, $p < .001$. This suggests that a child who is found to be "at risk" on the DEST-II was also rated as demonstrating more difficulties by the teacher. This is a genuine and direct association that is not mediated by the child's receptive language.

It could be argued, that the teachers' teaching experience of preschool children might have affected their responses on the rating scale and hence mediated the association between total rating scale scores and ARQ on the DEST-II. However, correlational analysis suggest that this relationship remained strong when the teachers' teaching experience was partialled out of the association, $r(89) = 0.56$, $p < .001$. Taken together, it appears that there is consistency between a child's ability as reflected by the teachers' rating scale, and the child's performance on the DEST-II. At least at the preliminary level of analysis, there appears to be between-instrument reliability in identifying children "at risk" of dyslexia.

A scatterplot was obtained using the total rating scale scores and DEST-II ARQ. Regression functions were then calculated to determine whether a linear or quadratic function could significantly account for the data. Figure 2 illustrates both the resulting scatterplot, and regression lines.

There is a clear effect of teachers' rating scale on the child's ARQ on the DEST-II, which was significantly accounted for by a moderately strong linear function, R2 = 0.39, $F(1, 95) = 60.93$, $p < .001$. This revealed that the teachers' rating of the child's performance and behaviour in class is a significant and moderately

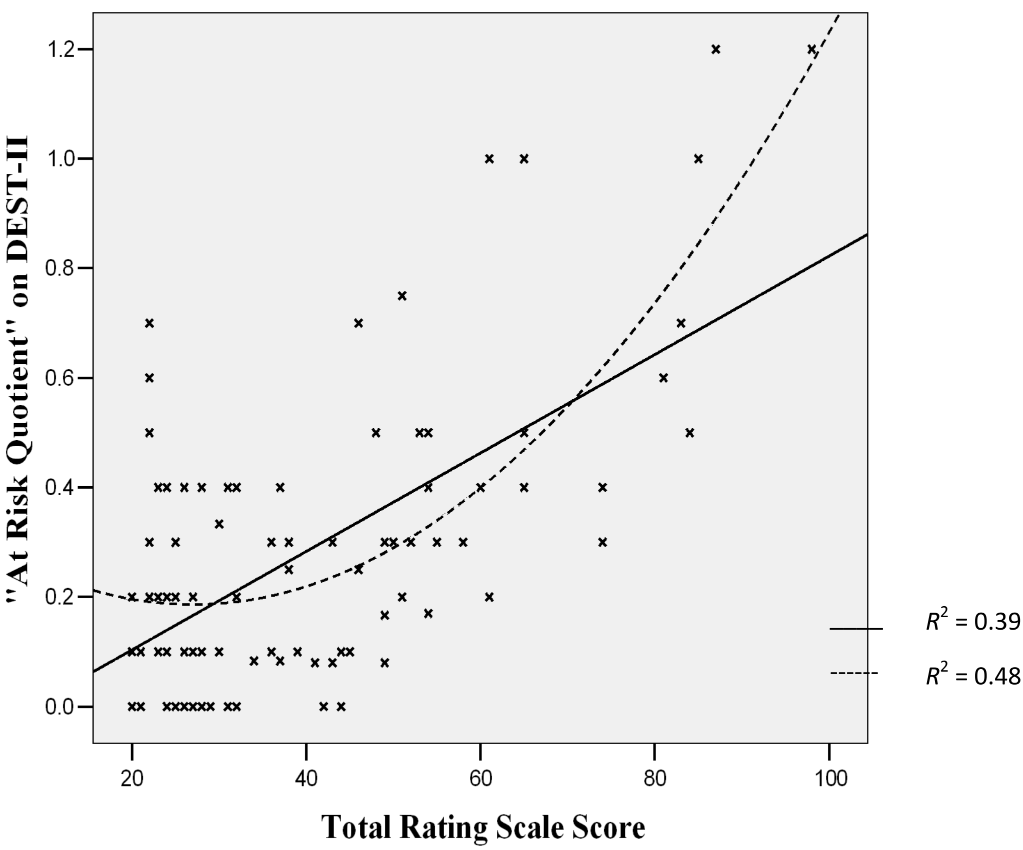

Figure 2. "At Risk Quotient" on DEST-II plotted against total rating scale score. Linear and quadratic regression functions are fitted to the data.

strong predictor of the child's "at risk" index on the DEST-II. Interestingly, a quadratic regression function significantly accounted for more variance of the ARQ on the DEST-II, R2 = 0.48, $F(2, 94) = 43.00$, $p < .001$. However, more research and data is needed before any inference can be drawn from this finding.

In general, the DEST-II appears to possess great potential for use as a screening instrument to identify preschool children "at risk" of dyslexia. The DEST-II requires a relatively short administration time and has a straightforward scoring and interpretive procedure. Also, given that it is intended for use by school professionals such as teachers and special needs coordinators, it provides a cost -effective method of conducting large-scale screening projects. Finally, preliminary results suggest the effectiveness of DEST-II in identifying Singaporean preschool children "at risk" of dyslexia, albeit with some adaptations for more applicable use in the local context.

FUTURE DIRECTIONS & AVENUES FOR RESEARCH

More research is needed to look into further modifications of the DEST-II for effective use within a multilingual society. With the increased prevalence of multilingual communities in many countries as a result of globalisation, the potential and implications of this research are far-reaching and significant. Given that preschool children in Singapore appear to perform better on some subtests and worse on others, future research can examine the best combination of subtests that produces the greatest ability to identify "at risk" children. Subsequently, it is important to establish the ease and reliability of the administration of the DEST-II as an initial screening instrument by teachers in preschool settings. The same applies to the teachers' rating scale which requires modifications based on the preliminary analyses and observations from the current study. Eventually, it is envisaged that the revised DEST-II and teachers' rating scale will serve as first-line screening instruments that are effective and reliable in the identification of dyslexia in preschool children in a multilingual society such as Singapore.

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Sustained Benefits of a Multi-skill Intervention for Preschool Children at Risk of Literacy Difficulties

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Children at mild risk for literacy difficulties (n=32, mean age 4.1 years) were identified using a multi-skill screening battery. The majority – the intervention group - had small group support (15 minute sessions twice weekly for 10 weeks), while the control group experienced the standard nursery group. The intervention comprised four 'streams' – language and phonics, memory (auditory and visual), gross motor skills (balance, imitation and catching) and fine motor skills (pegboard, tool use and fine pencil work). Both groups performed equivalently at pre-test. An immediate post-test showed mean standard score improvement for the intervention group (93.1 to 106.2), by contrast with controls (96.9 to 98.5). Mean effect sizes for the two groups were 0.88 and 0.23 respectively. Significantly greater improvements occurred for gross motor skill, memory, and phonology including rhyming, but not for fine motor skill, pre-literacy and speed which improved significantly in both groups. After 18 months, sustained improvements were found in memory, a key predictor of success in early learning, as well as in gross motor skill. The results suggest that a balanced, multi-skill intervention may be particularly effective for preschool children.

Keywords: Preschool screening, early intervention, learning difficulties, screening tests, longitudinal

INTRODUCTION

This paper addresses the key issue of whether or not screening and intervention is feasible and worthwhile for children at age 4, before they start formal education. There is now considerable evidence throughout the school years that the earlier literacy-related problems are identified, the more effective, and the more cost-effective, interventions are likely to be (National Reading Panel, 2000; Snow Burns and Griffin, 1998; Torgesen, 2001). Summarising a range of studies of support of children with severe literacy difficulties (Alexander, Anderson, Heilman, Voeller and Torgesen, 1991; Lovett, Lacarenza, Borden, Frijters, Steinbach and DePalma, 2000; Rashotte, McPhee & Torgesen (2001); Torgesen, Alexander, Wagner, Rashotte, Voeller, Conway and Rose, (2001, 2004); Truch, 1994; Wise, Ring & Olsen, 1999), Torgesen (2001) estimates that an hour's intervention at age 8 is likely to lead to a gain of 0.20 points in standard score on word identification and 0.30 points in phonemic decoding. He concludes that an intensive 70 hour intervention may be seen as 'normalising' the problems – accelerating the child back into the normal range of achievement. By contrast, interventions with older children tended to be 'stabilizing' rather than normalising the difficulties [Kavale, 1988], and led to very modest mean gains. We have provided a range of short term small group intervention studies for children aged 6 and above which proved highly successful (Nicolson and Fawcett, 1999). In the light of the 'stitch in time saves nine' nature of this relationship, we decided to investigate whether still earlier intervention – in the preschool period - is likely to lead to prove effective.

The skills with which a child enters school are highly predictive of future progress, (e.g. Vellutino & Scanlon, 2002; Whitehurst & Lonigan 2001; Denton & West 2002). Consequently, preschool has been identified as a key period (McCardle & Chhabra, 2004) to ensure that children enter school ready to learn to read. There is limited evidence available on the impact of intervention with preschool children, although explicit attempts to train up aspects of phonological awareness preschool lead to improved outcomes in literacy (Byrne, Fielding-Barnsley & Ashley, 2000). Evidence suggests that children 'at risk' of failure on phonological and orthographic skills can be 'inoculated' by intervention in kindergarten (Coyne, Kame'enui, Simmons and Harn, 2004; Outdeans, 2003; Schneider Roth and Ennemoser, 2000; Smit-Glaude, van Strein, Licht and Bakker, 2005). Studying economically at risk children in pre-kindergarten established that preschool children benefit from a program that emphasises social-emotional, motor and cognitive skills (Molfese, Modiglin, Beswick, Neaman, Berg, Berg and Molnar, 2006).

Preschool intervention suffers from the obvious difficulty that it is not clear at the preschool stage which children are most likely to have literacy difficulties, and consequently it may be necessary to provide an intervention for a greater proportion of the cohort than considered necessary with older children. For some years we have argued that a two stage approach to this problem is the most cost-effective, based on the development of an appropriate screening test with relatively wide scope, followed up by an intervention for those children screened as at risk. In earlier research, (Fawcett, Nicolson, Moss, Nicolson and Reason, 2001; Nicolson, Fawcett, Moss, Nicolson and Reason, 1999) we established that screening children in school at age 6 (using the Dyslexia Early Screening Test, Nicolson and Fawcett, 1996) followed by targeted short-term intervention can significantly assist most children at risk of reading failure. A 10 week intervention at age 6 led to an improvement of 3.8 standard score points in WORD (Rust, Golombok and Trickey 1993) reading standard score. This equates to 0.38 standard score units per hour instruction (around twice the improvement reported by Torgesen, 2001). Cost effectiveness was additionally quadrupled by using groups of 4 children. The fact that the support personnel were teachers rather than highly trained phonological support specialists lends further cost savings, leading to a cost-effectiveness perhaps 10 times those reported in the literature. It is important, however, to note that one is not 'comparing like with like' in this comparison. Although all low performing children in the screening were supported, their problems were by no means as entrenched as those considered by Torgesen.

The research reported here adapted the above approach to the preschool period. The methodology involved included formal, controlled, small group comparisons, together with the evaluation of a screening-support system. In brief, a skill-based screening test was administered (PREST, Fawcett, Nicolson and Lee, 2001), and an intervention package delivered to children who showed problems in pre-reading skills. Children were also given a test of receptive vocabulary (British Picture Vocabulary, BPVS – Dunn, Dunn, Whotton and Pintillie, 1982), as a rough measure of verbal IQ. The children's progress was followed from age 4yrs to 5yrs 8 months in all, and progress compared with a control group drawn from the same nursery who had received no intervention beyond normal nursery experience. This approach has similarities to Bailet, Rapper, Piasta and Murphy, 2009 who demonstrated significant improvements in emergent literacy in a major study of phonological intervention with 220 prekindergarten children identified as 'at risk' for reading failure based on their performance on screening tests between the ages of 4 and 5. Our study worked with even younger children aged just 4.1. There are both theoretical and applied justifications for using a multi-skill screening and intervention with children of this age range, to measure a broad range of aspects of 'readiness to learn' which can impact on progress in the early years, Five main issues were addressed:

i. whether the screening and intervention process was feasible with children as young as 4 years;
ii. whether it proved effective and cost-effective;
iii. whether any improvements were sustained in the years post-intervention;
iv. to establish benchmarks for future research; and
v. to identify pointers for subsequent developments.

METHOD

Participants

Two cohorts of children were screened in two Sheffield nursery schools sharing the same academic program and environmental input. The schools were Broomhall Nursery (Nursery 1) and its annexe, Mushroom Lane nursery (Nursery 2). Both nurseries work to the same timetable, share planning meetings and follow the same rationale for the methods they adopted. The schools were selected for their existing links with the university and for their willingness to allow access to a nursery research worker taking children out to work in pairs in a small room.

These inner city nurseries cater for 120 children aged 3-5, they are funded by the local education authority so that parents do not pay fees, and draw from a mixed catchment area, including high rise flats and rented accommodation as well as private housing. Children are drawn from diverse ethnic backgrounds, with around 20% in total of Asian or African background, and 11% were entitled to free school meals. 22.5% had EAL (English as an alternative language), and 11% Special (educational) needs. None of the SEN or EAL participants were included in this study; they formed a separate group whose outcomes are not reported here. Both schools are well rated for their outcomes in terms of language and literacy, mathematics, and personal and social development, with children at school entry above the level expected for the average 5 year old.

Based on the screening, intervention was undertaken with 20 children screened as most 'at risk' based on the PREST test (Fawcett, Nicolson and Lee, 2001). A control group of 12 children was also identified, matched for initial scores with the intervention group (3 of the control group were not available at post-test because they had moved away from the area, and so only 9 controls are included in the analyses). Mean data for the intervention and control groups respectively were as follows: Age: mean 4.06, range 3.9 to 4.3, sd 0.01; control mean 4.22, range 4.1 to 4.3, sd 0.05. British Picture Vocabulary scores: mean 102.1, range 80-127, sd 13.67; control mean 103.6, range 82-127, sd 14/62. Gender balance: intervention 12M 8F; control 4M, 5F.

Nursery 1 was asked to identify all children of the appropriate age, parental permission was sought for participation in the study, and children were screened using the Preschool Screening Test (Fawcett, Nicolson and Lee, 2001). This test (PREST) was based on a simplified version of the DEST that is suitable for 4.5 plus (Fawcett, Nicolson and Lee, 2001) and was developed for children aged 3.5 upwards in school.

The test takes around 30 minutes to administer and produces a profile of strengths and weaknesses in comparison with age referenced norms. Ten children from cohort 1 were selected for intervention on the basis of risk scores of 0.4 or greater, given the prototype intervention over a 10-week period, and their performance was checked again. Having established the feasibility of the approach, in the second phase, Nursery 1 contributed the control group, and a second cohort was screened for intervention in Nursery 2. The control group included the children in Nursery I in the age group 3:9-4:3 to match the intervention group.

DESIGN

Performance of the intervention and control groups on the screening test was measured both before and after the 10-week training period. The critical variable was the amount of improvement for the experimental group and the control group from pre-test to post-test. The control group received standard nursery school experience, which involved no structured support. The differential improvement of the experimental group would give an indication of the effectiveness of the intervention. In addition, a further 'delayed screening test' was undertaken when the children reached the age of 5:8 using the DEST (Nicolson and Fawcett, 1996) in order to assess the extent to which any improvements were maintained in the absence of further interventions.

The training regime was designed for children working in groups of two in two/three weekly sessions of around 15 minutes, over 10 weeks, with the interventions taking place within the normal nursery session. Nursery attendance was two hours daily (10 hours per week). The intervention group and the control group therefore shared 90-95% of the nursery environment, with the remaining time allocated to the intervention activities for the intervention group and general, professionally administered, nursery activities for the controls. In terms of criteria (McCardle and Chabra, 2004) the design is more rigorous than a 'quasi experimental' design, in which the control group have no intervention, but less rigorous than a 'clinical' design, in which alternative interventions are pitted against each other. In our view, it represents a reasonable compromise in that it provides an appropriate estimate of what gains might be made within an established educational system by targeted short-term interventions.

a) Screening

Screening and intervention were delivered by a nursery nurse, with no specialist training but with an interest in special needs. Screening was carried out using the Preschool Screening Test (Fawcett, Nicolson and Lee, 2001). The PREST was developed by combining simplified components of the Dyslexia Early Screening Test (Nicolson &Fawcett, 1996), a screening test for children from 4.5 to 6.5 years, with some components from the Middleton-in-Teasdale Screening Test (MIST, Lee, 2004), a comprehensive but time-consuming battery.

Ten two- or three-minute tests were used from PREST, eight of which were based on DEST: two tests of pre-literacy [digit naming, in which the digits 4, 3, 5, 7, 6 are shown and the number read correctly is recorded], and letter naming (c a t s r and first letter of child's name); two tests of phonological awareness [rhyming in which children are asked to identify the rhyme in a nursery rhyme, and pick out the odd one from sets of three pictures, and phonemic discrimination, in which pairs of phonemically confusable (or identical) words are spoken by the tester, and the child has to say whether they are the same or different]; speed of processing (the Rapid Automatised Naming test in which the child has to say the names of a set of 20 pictures of common objects as fast as possible]; Memory (verbal memory including a standard digit span test, and spatial memory via the 'Corsi frog' test in which the child has to remember which 'lily pads' a frog jumps to]; fine motor skills [bead threading speed and scissor use, and shape copying accuracy] and gross motor tasks (heel-to-toe balance and catching and hopping) from the DEST/MIST were adapted to include simple balancing tasks, and a Romberg test (standing on both feet with one foot in front of the other) appropriate for children of this age group. The tests therefore cover literacy, cognitive and motor domains together with visual, auditory and kinaesthetic modalities.

b) Assessment

Participants were assessed using the PREST at age 4:0 (pre-intervention) and again at 4:4 (post-intervention). For the follow-up at 5:0 and 5:8 they were assessed using the Dyslexia Early Screening Test. The PREST is a simpler version of the DEST for a younger age group, the DEST has commonalities with the PREST and so the data are comparable. The DEST comprises 11 sub-tests in five areas (literacy skills, phonological awareness, verbal memory, motor skill and balance, and auditory processing).

The sub-tests are as follows. Digit names tests knowledge of digits 1-9, Letter names tests knowledge of t, s, d, e, w, o, b, q, n, y. Rhyme tests both for understanding of rhyme and of first letter sounds; Rapid naming involves the time taken to speak the names of pictures on a page full of common objects; Discrimination is the score on saying whether word pairs such as 'fuse' and 'views' are identical. Digit span tests verbal memory for sequences of digits. Beads is the number of beads threaded in 30 s; Postural stability reflects the degree of movement when pushed gently in the back; Shape copying tests the accuracy of copying simple geometrical shapes. Sound order tests the ability to determine which of two sounds played shortly after each other was first. The overall DEST score is essentially the average of the scores on the individual sub-tests.

c) The intervention

The intervention was developed by the first two authors based on a whole school intervention (Middleton Rescue Package, MIRP, Lee, 2004), modified and extended for small group work. It is important to highlight the fact that four year old children are still in a phase of rapid development of a range of cognitive and motor skills. Consequently, although in assembling the intervention battery we were placing strong emphasis on language based skills, we aimed to cover the full range of the nursery school curriculum, including skills that may also underpin motor and cognitive development. Furthermore, in order to be successful, it was important to engage the attention and co-operation of young children with no experience of formal schooling, and very short attention span.

Intervention took place in groups of two, for around 15 minutes. All children had at least 2 sessions weekly. The 13 children with moderate risk scores on PREST had two sessions of language support, and one of motor skill per week with the remainder having only two sessions per week. In each session three skills were presented to maintain variety and interest, and maximise learning. The intervention researcher adapted the program to the needs of the children, spending longer on games which the children clearly enjoyed.

At each stage care was taken to provide the right mixture of familiarity and challenge, so that children were exposed to new skills. Skills trained by both language and motor intervention explicitly included a range of concentration and listening skills. The aim of the intervention was therefore to introduce a more explicit teaching element, and to encourage all children to take part, while maintaining the element of fun which is crucial for success at any age. Above all, instant reinforcement and feedback was provided.

Rationale for the training methods adopted

The link between language difficulties and learning disabilities is well established (see the report of the National Reading Panel). The rationale for motor skills intervention was based on a whole school intervention package developed by the second author and his colleagues (the Middleton-in-Teesdale Intervention and Rescue Programme, 2001), that had proved particularly effective in previous school-based outcome evaluations.

We focused here on a combination of language and motor skills appropriate for learners in the early stages of development. Although both gross and fine motor skills were included, the training was set up in such a way that all children had more language than motor skill input, with a ratio of around 70:30 language to motor, and all motor skills intervention included aspects of language. In other words, an integrated program of skills was devised and delivered as a generic program to the children in the intervention group.

Activities included**:**

i) Language and Phonological Activities. Tasks included segmentation, phoneme identity and blending using their own name, finding initial sounds, rhyming, ear training, sequencing, tongue twisters linked to letter sounds

ii) Cognitive and Memory Activities: tasks included auditory and visual memory, prepositions with small plastic coloured bears, memory games, opposites, miming, copying patterns, associating geometric shapes on different properties including shape, size, colour and thickness.

Iii) Gross Motor Activities. Balancing on the wobble board (a wooden board balancing on runners, which can be adjusted to make it more or less difficult to balance), playing 'Simon says' (a game where the child follows the spoken directions only if they are preceded by the phrase 'Simon says') and trying to catch bean bags or throw them at skittles.

iv) Fine Motor Activities included colouring in, peg board, sewing, hammering, sequencing, and Graphisme (filling in a picture with dots).

Table 1. Mean performance of the intervention group and controls on subtests of the PREST pre and post intervention, together with performance of the intervention group at a follow-up at age 18 months later. (Standard deviations are in parentheses)

	Pre-literacy	Speed	Phonology		Memory		Fine Motor Skill		Gross Motor Skill	
	Digits & letters	Rapid Naming	Phon Disc	Rhyme	Digit Span	Corsi frog	Beads & Cutting	Shape Copying	Balance	Catch & jump
Intervention Pre	101.35 (15.44)	101.00 (15.05)	97.83 (19.57)	97.24 (14.89)	94.57 (11.48)	92.64 (12.69)	104.33 (14.57)	87.62 (11.87)	87.50 (14.31)	67.11 (21.77)
Intervention Post	109.69 (13.28)	107.63 (9.47)	108.98 (18.76)	119.50 (16.86)	108.75 (13.26)	104.23 (9.73)	110.86 (10.12)	97.76 (9.51)	103.91 (14.41)	91.07 (18.35)
Effect Size	0.60	0.47	0.61	1.57	1.34	0.87	0.47	0.82	1.02	1.01
Control Pre	98.75 (16.83)	100.09 (16.69)	99.21 (10.69)	97.00 (13.69)	98.13 (10.64)	93.79 (18.18)	113.80 (10.60)	91.93 (10.11)	101.30 (18.19)	74.69 (33.60)
Control Post	105.65 (10.23)	105.82 (11.68)	103.16 (15.29)	96.17 (13.23)	97.29 (8.70)	92.27 (16.51)	111.60 (11.22)	93.93 (12.88)	97.68 (18.48)	81.25 (23.49)
Effect Size	0.49	0.47	0.29	-0.06	-0.08	-0.11	-0.16	0.16	-0.23	0.29
Intervention Follow-up	100.46 (10.72)	98.87 (9.39)	104.04 (17.75)	107.06 (7.44)	114.23 (14.30)		105.36 (26.12)	112.84 (7.66)	100.88 (11.22)	
Control Follow-up	105.89 (3.41)	91.65 (26.16)	106.04 (9.62)	108.24 (7.07)	107.94 (14.13)		101.90 (20.90)	110.21 (4.85)	85.03 (19.07)	

In later weeks, children were encouraged to pit themselves against a stop-watch or an egg timer, not only to emphasise the need to work quickly, but also to assist concentration.

It is important to note that, following the intervention, it was considered that five children continued to have difficulties. These were then given support for a further four weeks. This intervention was delivered to children individually, targeted at their areas of particular difficulty. It is also important to note that the interventions delivered are not commercially available, and represent a generic approach that can be modified as required to suit the teacher/participants.

DATA ANALYSIS

The 'raw' scores on the PREST sub-tests at pre-training and post-training were converted into age-adjusted standard scores using the conversion data available in the normative sample. In order to highlight the different skill domains, the separate sub-tests were also combined to give scores on six skill domains: pre-literacy, phonology, memory, speed, fine motor skill and gross motor skill. Following a multivariate analysis of variance of the pre- and post-training scores for the two groups, individual two factor analyses of variance were undertaken on the separate sub-tests, with the aim of identifying for which skills the intervention group improved significantly more than the control group (revealed by a significant interaction between group and time-of-test). In order to provide quantitative estimates of the amount of improvement, changes in standard score were calculated. In addition, effect sizes of the improvements were calculated for each group by dividing the group change in standard score by the standard deviation of the cohort on the initial test (Cohen, 1977). Corresponding standard score analyses were undertaken at the 5:8 follow-up using the DEST data.

RESULTS

The means and standard deviations of the standard scores for both groups at pre- and post-training test, together with the corresponding effect sizes, are reported in table 1 below, and illustrated in figure 1.

If we consider first the control group, it may be seen that they have made some progress overall. Their mean standard score improved from 96.9 to 98.5 (mean effect size 0.23). There was a clear 7 point improvement in digit and letter knowledge, but other scores showed variable changes. By contrast, the intervention group showed improvements across the board, with a mean

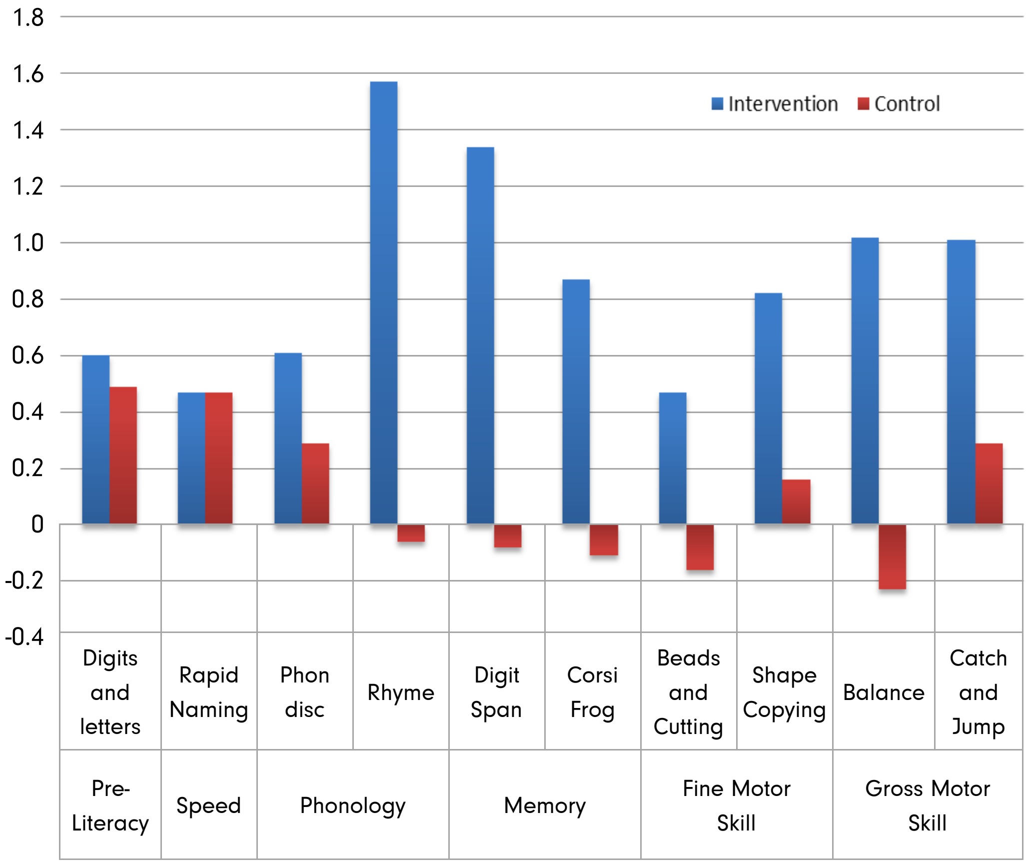

Figure 1. Effect sizes for improvement pre/post for intervention and controls. An effect size of 0.2 is small, 0.5 is medium, and 0.8 or more is large (Cohen). It may be seen that some skills improve in both groups, but others seem to deteriorate in the control group without explicit support.

improvement from 93.1 to 106.2 - with a minimum increase of 6.6 points and notable increases (10 points or more) in all but Rapid Naming, Beads & cutting and digits & letters. The mean effect size was 0.88.

In terms of inferential statistics, the multivariate analysis on the six skill domains indicated that significant interaction effects (using Wilks' lambda) occurred for: phonology, memory and gross motor skills. [$F=5.83$, $p<.05$, $F=18.63$, $p<.001$; $F=4.57$, $p<.05$] but not for pre-literacy, speed or fine motor skill [highest $F=1.95$, NS]. Significant effects of time-of-test were found for pre-literacy, phonology, speed, fine motor skill and gross motor skill [$F=6.32$, $p<.05$; $F=7.56$, $p<.05$; $F=5.44$, $p<.05$; $F=7.78$. $p<.05$; $F=4.37$, $p<.05$ respectively] but not for memory [$F=1.52$].

The above analyses reflect group differences rather than individual differences. It was therefore of particular interest to assess the pattern of changes at the individual level. We categorised each individual score on a sub-test as 'at risk' if it fell one standard deviation or more below the mean (a standard score of 85 or less). Any individual with 30% or more of their PREST scores ≤85 was categorised 'at risk' overall. Overall risk incidence fell from 65% to 5% for the intervention group, and from 42% to 33% for the control group.

FOLLOW-UP TESTS AT 5:8 YEARS

As noted above, the groups were followed up roughly 18 months after the end of the intervention in order to establish whether the improvement in performance was sustained after the intervention finished, or, as is most common in such cases, whether they slipped back toward their original performance levels. The standard score data are shown in the bottom lines of Table 1 (with 18 of the intervention group and 9 of the controls). It may be seen that in general the mean standard scores were indeed sustained. There were drops of over 5 points in pre-literacy and in rhyme (but that is not surprising in that there are ceiling effects on these tests at 5:8, in that it is impossible to score over 110). There was also a drop in rapid naming. Otherwise scores remained the roughly same or improved. The minimum standard score was 98.87, easily within the normal band. None of the 18 individuals was at risk, with only one individual having more than one at risk score out of the 9 measures.

In general the control group also made satisfactory progress over the period. The most notable differences from the intervention group derive from the low mean scores for rapid naming and for balance, which arise from poor scores from 7 individuals within the group (2 for rapid naming and 5 for balance). Two of the 9 had at risk scores on 2 of the 9 tasks, with 6 of the remainder having one at risk score.

Interestingly, the intervention group continued to show an advantage in memory in comparison with controls, based on standard scores 7 points higher overall. Despite being significantly poorer than controls at pre-test on digit span, the effect size for the intervention group was 1.37 compared with the control effect size of -0.08. Memory is notoriously difficult to improve, and the research was careful not to teach the test, encouraging instead a series of listening skills, and memory games such as "I went to market and I bought' which builds up an alphabetical sequence which each child must correctly repeat, while adding the next letter in the alphabet. These games are suitable for use by parents as well as preschool teachers to enhance auditory memory development.

OVERALL DISCUSSION

Five key issues were noted in the introduction. We consider them in turn.

(i) Feasibility of the screening and intervention process

Clearly this minimal requirement was satisfactorily met. It should be stressed that this was by no means a foregone conclusion, in that a very abbreviated intervention program had to be developed suitable for working in 15-minute periods two to three times per week. The participants enjoyed both the screening and the intervention, as did the intervention researcher!

(ii) Effectiveness

The maximum time in the intervention was 45 minutes for 10 weeks – 7.5 hours. From a child's perspective therefore 7.5 hours' intervention led to a mean increase of 12.1 standard score points, or 1.6 standard score points per hour intervention. Given that the children were seen in pairs, one can double this figure to obtain the cost-effectiveness, namely 3.2 standard score points per hour. These are extraordinarily strong findings, suggesting that it would be entirely feasible to screen and support many times as many children at age 4 than if one waits for the problems to become entrenched by age 8. A stitch in time truly saves 9 in this case.

(iii) Maintenance of improved performance

The 18 month follow-up suggested that none of the intervention group had any problems at 5.8 years. There appears to be some evidence of a diminution in processing speed, but otherwise all the skills appear to have been maintained.

(iv) Benchmarking of interventions at age 4

One of the major contributions of the National Reading Panel (2000) was to 'benchmark' interventions, so that it should be possible to predict the expected improvement for different types of interventions. The Panel expressed their findings in terms of effect sizes of gains for phonological awareness, single word reading accuracy and fluency and comprehension. Torgesen (2001) produced the further important refinement in terms of cost effectiveness (that is, effect per hour of instruction) as introduced by Nicolson et al., (1999). To our knowledge, there are no corresponding benchmarks – in terms of effect sizes or standard score improvements, for 4 year old children, and indeed we are not aware of any benchmarks at any age for skills such as memory, speed, fine and gross motor skills. Consequently, even though these data are based on a very small sample of children we hope that they will provide a start in this important endeavour.

(v) Directions for further research.

One of the most intriguing issues raised by this research is that, based on one of the author's (Lee) decade of first hand experience of the value of including gross and motor skill practice within a balanced intervention program, we made our intervention very much broader (and shallower) than those normally advocated. This study in itself can yield little direct evidence relating to the differential value of including interventions for skills at best indirectly related to literacy.

Nonetheless, there is consistent evidence within the literature that broadening an intervention to include say fluency as well as reading leads to consequent advantage (Berninger, Abbott, Vermeulen and Fulton, 2006; Fawcett, Moss, Nicolson, Reason and Nicolson, 2001; Hatcher, Goetz, Gibbs and Smith, 2006; Nicolson, Fawcett, Moss, Nicolson and Reason, 1999; Nicolson 2001; Wolf, Miller & Donnelly, 2000). It would clearly be an important research priority to replicate the present study with larger numbers of participants and with differing types of intervention so as to explore these issues systematically.

One further issue is the degree to which it is valuable to make skills explicit. One of the goals of the intervention was to be explicit at all times, not only articulating what the target performance was, but also whether the child was achieving it. It seems that the standard nursery curriculum (at least in the UK) simply exposes a child to a range of experiences. We conclude, with Molfese and colleagues (2006) that it is important that material is delivered explicitly for children at risk of failure, because they are less well equipped to extract implicit information.

A final intriguing issue is why it was that the intervention group showed gains 'across the board'. It is probable that this reflects the breadth of the multi-skill intervention, but it is also possible that there were gains in meta-skills that underlie improved school performance. In particular, based on anecdotal records maintained for each child, we noted that the intervention group learned to listen, to do what the researcher/nursery nurse asked, and to seek appropriate feedback on their performance. In other words, they were learning how to learn! (Fawcett, Nicolson, & Lee, 2004)

This is a key requirement for success in the early years at school. Some evidence for this view derives from further measurements that we have not reported here owing to the lack of suitable norms, because these subtests were not included in the published PREST. There were striking improvements for the intervention group in repetition memory (the ability to repeat a sequence of words). 100% of the intervention group improved, 75% achieving near perfect scores by contrast with scores of zero at pre-test, whereas performance of the controls remained unchanged.

The study reported here fits in particularly well with current moves in policy in the UK, towards a broader curriculum in the early years. It has been particularly relevant in Wales in terms of the new Foundation phase that emphasises the need for outdoor play before formal literacy teaching is introduced. It is an approach that seems to be simple, effective and cost-effective, and further studies are now in progress using this approach. 35 schools in South Wales have now adopted this model with 5 year olds, with considerable success (Jones and Fawcett, 2013), and a new intervention package based on this is now available (Hands on Literacy, 2012).

IMPLICATIONS FOR THE ASIAN PACIFIC REGION

Children here start school later, and there is an expectation that their literacy skills will be well developed by the time they start formal schooling, with a variable range of support available for children in preschool. A similar approach could be particularly useful in the preschool period in countries where children start school later, thus ensuring that all children can fully benefit from instruction by the time school starts. Most children at risk of dyslexia need specific and explicit support individually or in small groups in order to make the progress expected of them and keep pace with their peers on school entry. The skills outlined here must be in place before any more formal literacy learning can take place. These are the principles behind moves towards preschool support for children at risk for dyslexia on early screening tests as advocated by the Dyslexia association of Singapore.

LIMITATIONS OF THE STUDY

It should be acknowledged that this was only a small-scale study, that it reflects real world limitations in subject attrition, notably in the control group, that we have no information on any support provided from home, and intervention was delivered by only one person, who had no specialised training in intervention of any type. If these findings could be replicated in larger studies, it seems that screening and intervention might prove a key factor in prevention of learning difficulties, at least for a substantial proportion of young children in the lead up to school entry.

CONCLUSIONS

The results of this study suggest that a multi-skill 10 week intervention delivered to four year old children in nursery in two to three sessions of 15 minutes weekly can be successful in improving the pre-reading skills of children in comparison with a control group receiving only normal nursery schooling. Even those children resistant to remediation improved their skills following a further more targeted intervention over a four week period. We consider that this research has significant implications for educational policy and practice, in the UK and beyond.

Guidelines for cost-effective nursery screening and intervention emerging from this study include the administration of short age-normed screening tests designed for this age group, followed by explicit small group teaching of language and motor skills over a short time frame, with further individual targeted intervention for children who do not accelerate. This leads to the possibility of 'inoculating' children against failure, combining the advantages of early teaching with the sheltered environment of the nursery. This should have significant 'knock on' effects, allowing a more rapid pace of teaching in the early school years and reduced incidence of reading failure, leading to beneficial effects throughout the educational system, and, in due course, society.

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Research Consultant
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Emeritus Professor Angela Fawcett is a leading international researcher into dyslexia and other developmental disabilities, encompassing a range of theoretical and applied contributions to this field. Angela is also an Honorary Professor at the University of Sheffield. Her approach is broad and interdisciplinary ranging from child and cognitive development to educational screening and intervention, as well as developmental cognitive neuroscience. She is the Vice President of the British Dyslexia Association and also the Former Chair and Director of the Centre for Child Research at the Swansea University, UK.

PRESCHOOL PROGRAMME

Specialised Educational Services
UNLOCKING POTENTIAL

The aim of the SES Preschool Programme is to help preschoolers who are potentially at risk of dyslexia, or have developmental delay in early literacy, develop skills and strategies to become confident achievers when they enter primary school.

RECOMMENDED FOR
Preschoolers in Kindergarten One and Two who are at risk of dyslexia or having difficulties with reading, spelling and/or writing.

OUR APPROACH

Our programme helps preschoolers acquire a good foundation in alphabet knowledge and phonograms, leading up to learning sight words essential for reading. These abilities gear them towards reading and spelling readiness.

In class, your child will be taught rules, facts and generalisations about the English language, enabling them to read and spell more effectively. They will also be taught strategies to cope with letter reversals. The programme follows a prescribed scope and sequence for systematic, sequential and cumulative teaching.

Components covered in a typical lesson:

- Alphabet Knowledge
- Phonograms
- Learned Word Knowledge (e.g. said)
- Reading
- Spelling

Preschoolers will be advised to go for a Full Aged Psychological Assessment when they turn six. Children diagnosed with dyslexia have the option to continue with the MOE-aided DAS Literacy Programme.

Learning that makes sense: See, Say, Do!

Wong Kah Lai [1], Thilakam Renganathan,[2] Suthasha Kelly Bijay [2]

1. Programme Manager of Preschool Early Intervention Programme

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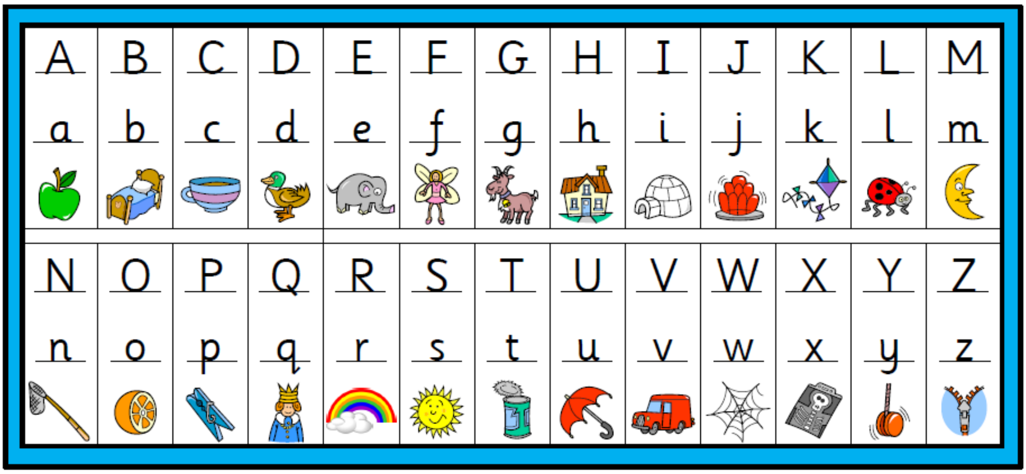
Dyslexia Association of Singapore

UNDERSTANDING THE CONTEXT OF INTERVENTION

Listening, speaking, reading and writing, in this order; are cornerstones fundamental to early language learning. In order to effectively intervene, one must first know the strength and weakness within each stone based on knowledge of developmental milestones and pedagogy. Children with a weak grasp of spoken English, a weakness in the cornerstone of speaking, for instance, are ill-equiped to meet the demands of higher order activity such as reading meaningfully. Checking out the soundness of the first corner stone; Listening—to see if the child is able to understand age appropriate instructions spoken in English, is the first step. Is the child able to respond appropriately, either through actions, gestures or speech, indicative of comprehension, is the second step.

Language is a tool for communication, be it spoken or written. Addressing weaknesses inherent in each of these fundamental cornerstones to language learning is a task DAS Preschool Early Intervention Programme (PS EIP) undertakes with zeal, passion and results.

It is impossible to fully share the entire scope, sequence and breadth of intervention strategies and practices used during our intervention sessions in the context of this write-up. The sections to follow are some strategies, activities and potential resources that we hope parents, teachers and stakeholders would find useful in engaging and supporting children with learning difficulties. It works really well when children are allowed to use the method— 'see-say-do-all-at-the-same-time'.



'See' means having something actual to look at or refer to, without having to recall from memory. It is challenging for preschoolers to remember all twenty-six letters of the alphabet. Letters are just shapes with names in the eyes of the very young. There is no real meaning attached to it. Imagine, after being taught a few times, you are expected to visually identify the letter, verbally name it, physically write it down on paper accurately and to provide the letter sound. It gets confusing when both letters share the same name in the instance of upper and lower case. E.g. "E" and "e".

'Say' means speaking aloud in a normal tone of voice, at a volume that you can hear yourself without shouting. This is challenging because children are often told to "keep quiet" or "whisper only" and to "sit still, concentrate and learn".

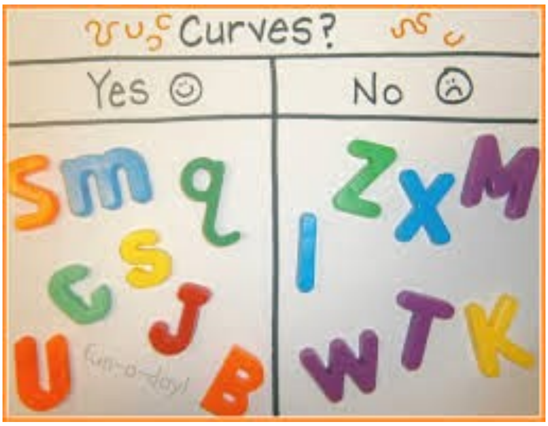
'Do' means allowing some level of physical movement, not limited to only hands-on (fine motor skills) activities; but also activities that allow the entire body (gross motor skills) to move about. This is one of the biggest challenges young children face in their journey to learning because they are often told, "Sit still, stop moving. Concentrate and learn". Body movement is often viewed as signs of being fidgety and not concentrating on the task at hand.

SEQUENCING THE ALPHABET

Which letter comes first? What comes next, followed by...? Imagine twenty-six letters of the alphabet as 26 different faces of friends, family or strangers arranged in a particular order.

How successfully can you get all these people to physically line up in a row, as you would, like letters of the alphabet? Sounds a bit mind boggling and daunting, isn't it? Well, may be. But may be not. Children get to play. Play is a child's job. Puzzles, wall charts, magnetic letters, wooden letters, sand letters, letter tiles, ... the list of exciting opportunities to practice getting letter sequencing right, is endless.

Colourful attractive magnets are a great start. Make sure you have a readily visible alphabet wall chart that you can encourage your child/ student to go looking-for-answers or to do self-evaluation when they are done. It's an important by product if you seek to cultivate active knowledge seekers who are both independent, resourceful and resilient.



Invent creative and "risk-free" ways for children to make sense of letters that may or may not look the same. Other suggested categories: upper vs lower case letters; identical looking letters (e.g. C, c), letters that you can rotate (e.g. b, d, p, q), confusing letters...

Involve your child/students to come up with new categories. They will come up with ways to make sense of letters that they are having trouble with. Thereby, overcoming their own learning difficulties.

Some magnetic letters come in plain uniform colours, e.g. vowels (a, e, i, o ,u) in red and consonants in blue. These are good if you want your child to remember 'letters' by their 'shape' when sequencing them, instead of using colour cues. i.e. what-colour-comes-next.

ALPHABET GAMES

ALPHABET BINGO

What you need:

1. A cloth bag
2. Wooden/plastic/magnetic letters
3. Bingo board (draw a board on paper)
   Use varying degrees of difficulty for the board; 2 x 2 simple, 3 x 2 average, 3 x 3 more complex and challenging

How to play:

1. Taking turns, both child and parent choose a few desired letters and put them into the bag
2. On the bingo board randomly write down some of the letters found in the cloth bag (Caution – do not write any letters that are not in the bag)
3. Roll a dice or simply to decide who goes first
4. Player 1 draws a letter out from the bag without looking, says the letter name out aloud, and match to see if the letter is in their bingo board, if so, then the letter is left on their board
5. The player with the most pieces covering the board, wins

BINGO!	
A	V
Z	X

BINGO!		
b	c	f
e	x	t

BINGO!		
b	c	f
e	x	t
w	y	k

LETTER HUNTING

What you need:

1. Any old magazine, colourful sales catalogue, classified ads from the newspaper, etc. with good font size for your child to colour or circle
2. Colour pencils, highlighters or felt pens
3. Kitchen timer or sand glass (optional)
4. Magnifying glass (optional) to be a 'letter-detective'

How to play:

1. Pick any letter that your child is struggling with. E.g. 't'. Encourage your child pick a random letter for you, too. E.g. 'w' (Fair play, you picked his, he chose one for you). Each shall attempt to circle as many 't' and 'w' as possible, on that sheet of paper before the timer pings when time runs out.
2. Count. Letter 't' versus 'w', who wins?
3. Alternatively, if your child is older, you can let keep this open-ended without using the timer. Encourage your child to hunt for all the e.g. 't' and then 'w'. Count and see which letter "wins". The same idea can also be extended to hunting for repeated sight words e.g. 'the' in a short paragraph.
4. Have Fun!

SEE, SAY DO! LETTER FORMATION AND LETTER SOUND

Play dough and plasticine are wonderful resources to learning letter formation whilst giving intangible skills, such as fine motor skills control and on-task concentration, a good workout!

WAYS TO LEARN SIGHT WORDS AND EVEN SPELLING WORDS AT SCHOOL

Words formed with play dough

Rainbow writing

Writing in coloured sand trays made out of storage containers.

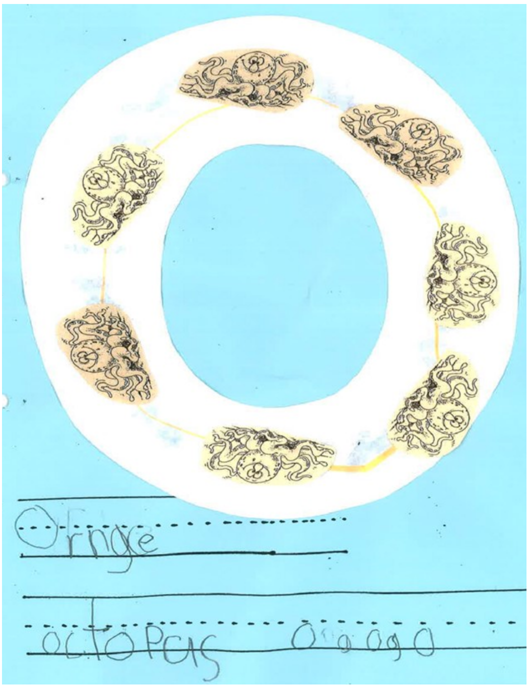
Rice grains and shaving cream make excellent substitutes, too.

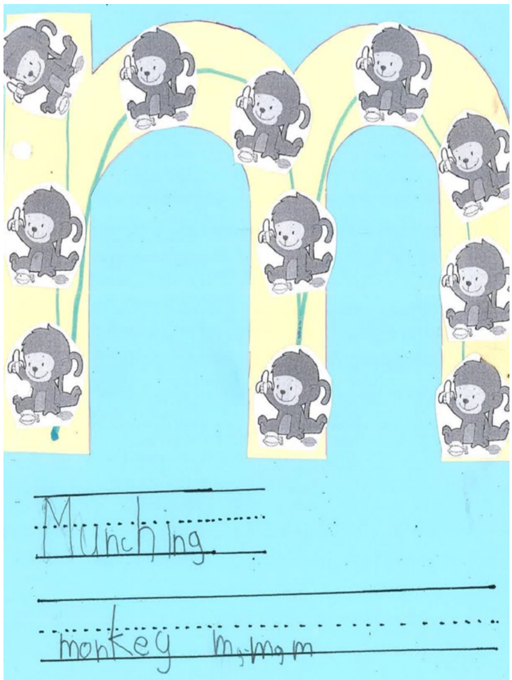
Pipe cleaners! A wonderful way to learn and remember a word whilst problem -solving...how am I going to get that letter to stay in shape, looking right?

VISUAL AND AUDIO MNEMONICS— LEARNING LETTERS AND LETTER SOUND ASSOCIATION

"See, say, hear-yourself-saying-it, do!" Alliteration makes letter learning more engaging and can be meaningful. Below: Red ribbons, r, r, r Pink pig, p, p, p Zig, zag, zebra, z, z, z Up umbrella, u, u, u

Orange octopus, o, o, o   Munching monkey m, m, m   Fluffy feather f, f, f
Green grass, g, g, g



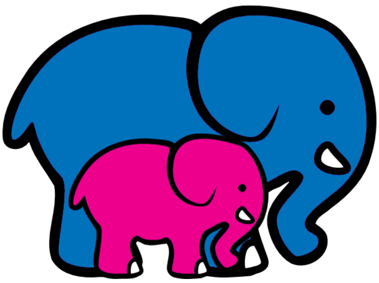


MNEMONICS—VISUAL AND AUDITORY—LEARNING SIGHT WORDS AND SPELLING WORDS

Socks are in demand

FAMILY

Father and mother I love you



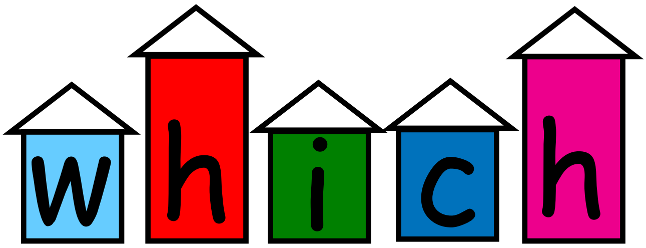
BECAUSE

Big elephants can always understand small elephants

RHYTHM

Rhythm helps your two hips move.

‘which’ and ‘witch’?



WHICH

Which house is Charlie’s house?

WITCH

Watch it, the caldron's hot!

VISUAL AND AUDIO MNEMONICS—LETTER REVERSALS, TELLING LETTERS APART

READING—AUDIO BOOKS

There are many good, structured and levelled readers available in the market that parents and educators can choose from. As such, we shall not go into details of selecting appropriate graded readers and ways of engaging in pre-reading activities.

Instead, we would like to bring your attention to another resource, audio books. Audio books are interactive and engaging for children - children can listen to audio books - this models expressive reading and intonation. Some audio book with apps allow children to record and playback their own recording. Children get a thrill out of listening to their own voices reading back to them. It's a self-fulfilling and self-satisfying experience, entirely sustainable on its own!

Books can be extended by asking open-ended or inferential questions to motivate children to engage in speaking and critical thinking. Repeated exposure to the same book develops reading fluency, build vocabulary and sight word knowledge. Audio books also introduce new genres that children might not otherwise consider. Imagine, what if you are a 4 to 5 year old, and reading is entirely dependent on your ability to decode and make sense of printed text, what would your reading options be? Hmm, your book options just shrank. However, you can solve that problem if you can interest an adult to read to/with/for you, satisfying your innate curiosity and active, intelligent mind.

Making available to young children, a wide range of both fiction and nonfiction levelled books in accordance to their reading level, is akin to putting children in their own driver's seat.

Information books build general knowledge. Each destination or choice of books may differ, but they are driving their own reading. Exhilarating and self-driven. Subsequent reading of textbooks or academic text materials will just be another natural reading activity... a walk in the park.

WRITING — FONTS MATTER, SPACING BETWEEN WORDS HELPS A LOT, TOO!!

Looking through the eyes of young children, letters are simply shapes with names. Fonts matter! The following are some fonts that help young children who are just starting to learn reading and writing.

Different fonts can create potential barriers to reading. It confuses some young children when letters having the same letter name looks different with different fonts. e.g. 'a' 'a' , and difference between I (I), l (L) and 1 (number). It will be less confusing if letters like 'l' and 'q' have a flick at the bottom like this 'l' 'q' will accentuate the letter shape. Therefore, fonts are important and finding an ideal font to minimise these confusions will significantly reduce additional stress during reading. It needs to be based on the natural style of handwriting.

OpenDyslexic is a new open source font created to increase readability for readers with dyslexia. It is being updated continually and improved based on input from dyslexic users. There are no restrictions on using OpenDyslexic outside of attribution. www.opendyslexic.org. Please note that Fonts are very personal, not everyone will like the font that you like, however, the basic principle is to use a font that reflects the letters you are teaching your student. Avoid serif fonts where letters are not typical like the letter 'a' and 'g' (Times New Roman 'a' and 'g')

Spacing between letters and words are just as important, for example 'rn' vs 'm'. The combination of spacing, weight and type of font makes a world of difference for early readers and writers. Below are three sample text justification. Wherever possible **LEFT JUSTIFIED TEXT** should be used for learners with reading differences, the predictable spacing between words and letters helps with fluent reading, you should AVOID FULLY JUSTIFIED TEXT

AVOID FULLY JUSTIFIED TEXT

This is an example of FULLY justified text where each line is blocked and starts and finishes at the same place. When text is fully justified it creates gaps, cracks and rivers between the text and inconsistent spacing can reduce reading fluency.

✗

AVOID FULLY JUSTIFIED TEXT WITH HYPHENATION

Hyphenation should always be turned off as it makes text very difficult to read. When text is hyphenated on fully justified text the gaps, between the text reduces however, inconsistent spacing still occurs and can affect reading fluency.

✗

USE LEFT JUSTIFIED TEXT

This is an example of left justified text. Left justifying text leaves a 'ragged' edge on the right side of the page Hyphenation should not be used at all for children. When text is left justified it is easier for a child to read and can increase their fluency.

✓

Listed over the page are a number of fonts that our teachers use in their teaching resources. All fonts are 100% free to use. Explore fonts and keep your

Sans Serif Font	Example
Comic Sans 11 Pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
Century Gothic 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
Print Clearly 14pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
Print Clearly Dashed 14pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
OpenDyslexic 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
Fibel Nord 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
TeXGyre Adventor 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
KG Primary Penmanship 14pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
KG Primary Penmanship 14pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
KB Bubblegum 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
Short Stack 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
Quicksand 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
Quicksand Dash 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789
Vag Rounded Light 11pt	ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz 0123456789

TECHNOLOGY

Technology can level the playing field for a child with learning differences. Being able to support their learning with online dictionaries, thesaurus', spell-checkers, text to speech and speech to text can make a significant difference to a child's learning journey.

TOUCH TYPING

Teach children to touch type, it is a valuable skill that will last them a lifetime!

FREE application—www.typingclub.com

IPADS

There are many free educational applications available for children to play and learn. IPad's are simple to use, have touch screens and are easier to transport than a laptop.

LEARNING SOFTWARE

There are many, many good software applications that support all aspects of learning. At DAS we use the NESSY LEARNING Software to supplement our lessons. The kids love it and learn at the same time!

GOOGLE APPLICATIONS

Google Chrome applications and extensions are useful in helping a dyslexic learner in and out of the classroom. Parents, you can now use different ways to get children interested in reading and revising their work by using different applications or apps from Google Chrome. Go to the Google Chrome Web Store to find many more applications, or apps in short, for you to help your children at home.

Study Stack
SKILLS: Flash Cards, Vocabulary and Revision Games

Has many ways that the child can learn. Present it to the child in the form of flash cards. Has interesting revision games for the child to practice with. Has many topics e.g. morphology, sight words and many more.

MeeGenius
SKILLS: Reading and Comprehension

Highlights the word as the dictator reads it. Useful for parents because we might have to point and read at the same time.

Photofit Me
SKILLS: Writing, Description of a person

To allow children to create a face using a description. Emphasises the importance of describing a character well in writing.

Hangman
SKILLS: Vocabulary

Hangman is categorised into different subjects and also has a section on commonly misspelt words.

The Dolch Sight Words and Learn Elementary Sight Words
SKILL: Sight words & high frequency words

Delivered in flashcard style, a good avenue to learn and review.

A wide range of interesting apps are available to support your child's reading needs. We have researched, played and experimented with a variety of apps, to create the list below. This list details 11 highly interactive apps that encourage learning and a fun-filled experience for your child.

The apps listed target a wide age group. Apps such as 'Hairy Letters', 'Read with Biff, Chip & Kipper' target younger readers, while 'Spelling City' & '4 Pics. 1 Word' assists in vocabulary expansion and word retrieval. For older learners, 'Story Maker', 'Brain Pop', 'Jumbled Sentences' and 'Fizzy's Lab Lunch' promote essential comprehension skills, which include sentence structure, sequencing and problem solving.

To build up your child's confidence in creative story-telling, 'Toontastic' is a great app that allows for much amusement and experimentation with comic strips, whilst familiarising the creator with the story mountain format.

APP GAMES FOR IOS AND ANDROID

There are many educational apps, like the ones below, that will help teach reading, spelling, and much more in a fun way and the best thing is they are free. These games give a student with learning differences the opportunity to practice their word skills in an enjoyable way.

Draw Something

Draw Something is a virtual Pictionary-type game that gives you a word to draw out for other players to guess. You get multiple colors and tools to draw with, but there's a time limit, so draw fast!

Hang with Friends

Hanging With Friends is a creative Hangman-type game. Build mystery words to confuse or impress other players, and wait for the complicated words they send back to you.

Scramble with Friends

It's a scramble to find the words in a jumbled grid! Form words frontwards, backwards, sideways, and any way possible.

Words with Friends

Much like Scrabble, Words with Friends is one of the most popular apps available today. Try to spell out the most complex words for the most points!.

App Name	Developer	Description	Price (SGD)
Hairy Letters	Nessy Learning	Multi-sensory and fun approach to learning phonics	$3.98
Spelling City	Spelling City	Fun and interactive way learn spelling and build vocabulary	Free
StoryMaker	Super Duper Publications	Practice Sequencing, Vocabulary, Sentence Structure and more as you form interactive stories www.superduperinc.com/apps/apple.aspx	Free
BrainPOP/ BrainPOP Jr	BrainPOP	Learn various subjects with videos and interactive activities	Free
Read with Biff, Chip and Kipper	Gazoob Limited	Build up your child's reading ability through leveled e-books (Oxford Reading Tree Series)	Per book
4 Pics. 1 Word	LOTUM gmbH	Fun puzzle game to guess the word based on commonality between 4 pictures you see	Free
Grammaropolis	Grammaropolis Inc.	Making learning grammar fun and exciting!	Free
Toontastic	Toontastic Inc	Get to create interesting comic strips using story mountain format	Free
Jumbled Sentences 1, 2, 3	Innovative Net Learning Ltd	Sequence sentences in the correct order	Free
Fizzy's Lab Lunch: Fresh Pick	PBS Kids	Fun problem-solving activities	Free

REVIEW

- ✓ Pastel Paper instead of white for reading and writing
- ✓ Pencil Grips to help correct hand position on the pencil
- ✓ Coloured Overlays or clear rulers for reading
- ✓ Only use fonts that look like the letters that are taught to preschoolers
- ✓ Include technology in the classroom
- ✓ Teach multisensory—See, say, (hear), do!
- ✓ Play games to reinforce learning
- ✓ Repetition is ESSENTIAL

A CALL FOR ACTION

Children are smart even though they may be only 4 or 5 years old. They can sense, and know, if they are falling behind their friends when it comes to certain activities. E.g. remembering the sequence of the alphabet, difficulty with number sense, pre-writing, reading and so on.

ALL preschoolers aim to please and they want to earn praises from teachers and parents, their nearest and dearest. However, if they get criticised or scolded overly much when it comes to tasks associated with reading, writing and spelling, may be they need specialised help.

Seek advice for early intervention.

ABOUT THE AUTHORS

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Preschool Early Intervention Programme Manager

Wong Kah Lai is the Preschool Programme Manager at DAS. An enthusiastic and passionate educator with more than twenty years' experience in the field of early childhood education, Kah Lai taught young children, mentored teachers, supported parents and caregivers in a wide range of setting, from within the classroom to community outreach, while juggling her Diploma in Early Childhood Education from Wheelock College, and subsequent Bachelor of Education in ECCE from the University of South Australia. She completed her Masters in Teaching English to Young Learners from the University of York through distance learning whilst working full time as head teacher of a bilingual kindergarten in China.

THILAKAM RENGANATHAN
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Thila is an Educational Therapist with DAS. She holds a Bachelor of Education in Early Childhood Education from University of South Australia and a Post Graduate Diploma in Special Needs Teaching. Thila is a core member of the DAS Preschool Early Intervention programme. She has been working in the preschool industry over 10 years and enjoys developing curriculum and training new teachers. She believes in creating joyful learning experiences through hands on activities and conducive learning environment for her students. She hopes to reach out to many preschoolers who are in need for intervention in the early years.

SUTHASHA KELLY BIJAY
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Kelly holds an honours degree in Early Childhood Education from the University of South Australia and has completed her Post Graduate Certificate in Special Educational Needs. As a core member of the DAS Preschool Early Intervention programme, Kelly is involved in curriculum development, early intervention and preschool teacher training at DAS Preschool Intervention programme. Kelly has 15 years of working experience with both local and international preschool in Singapore.

SECTION 2

EARLY SCHOOL INTERVENTION

Embrace Dyslexia Commitment

Embrace Dyslexia intends to raise awareness of dyslexia in the Singaporean community with an aim to have as many people understand both the strengths and challenges that individuals with dyslexia face everyday.

Raise awareness for Embrace Dyslexia by:
- Sharing information about dyslexia in your workplace
- Inviting DAS to conduct Awareness Talks
- Including information about dyslexia in the staff handbook

Explore opportunities to work with DAS
- Workplace Giving or Volunteering Initiatives
- Mentoring DAS Alumni for internships or work experience

Champion dyslexic individuals
- Recognising their strengths and understand their weaknesses
- Providing appropriate support and encouragement

Donate to DAS Programmes
- Support low-income families by giving to the Bursary Fund

Advocate for Embrace Dyslexia

Embrace Dyslexia with us. Sign your commitment today.

www.das.org.sg/embrace-dyslexia

DYSLEXIA ASSOCIATION OF SINGAPORE
HELPING DYSLEXIC PEOPLE ACHIEVE

The Dyslexia Association of Singapore (DAS) is a vibrant organisation serving the specialised educational needs of over 2,900 students with learning differences. DAS has over 240 professional staff offering a wide array of services and operates 13 learning centres across Singapore.

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The Importance of Early Intervention: A Review

Emeritus Professor Angela Fawcett
Research Consultant
Dyslexia Association of Singapore

The issue of what age is best to intervene to provide support for children with dyslexia or at risk of dyslexia has been a fruitful topic for some years now. In this review we draw together material from a range of sources. We include the review (Fawcett, 2002) for the UK Department of Education, the findings of the US National Reading panel; Greg Brooks (UK) 2002, 2007 and 2013 papers 'What works for pupils with literacy problems', Chris Singleton's (UK) 2009 review of interventions for the Rose Report; and recommendations from the 'What works Clearinghouse', Robert Slavin's (US) 2009 systematic review of US interventions, as well as a systematic review of the current literature. We have also included an updated search for research by Joe Torgesen, who is a key figure in US intervention research (Torgesen et al., 2014).

Our conclusions are that early intervention is the most effective and cost effective in terms of reaching a child's potential and reducing the impact of failure on their self-esteem.

> "...early intervention is the most effective and cost effective in terms of reaching a child's potential and reducing the impact of failure on their self-esteem. ."

WHAT ARE OUR CRITERIA FOR INCLUSION?

It is important to note that we started with stringent criteria for what we would accept and planned to include only studies undertaken with children with diagnoses of dyslexia or language disability, which would meet the 'gold standard' of randomised controlled studies including pre and post tests with standardised tests. However, this would exclude studies which aim to prevent failure with 'at risk' children prior to diagnosis at age 8. This would be in line with the Rose report (2009) that moves away from early screening and intervention in years 1 and 2 to focus on children with known difficulties.

Nevertheless, many of the most successful studies are conducted at any early age, before formal diagnosis has taken place. We will also try to keep to rigorous standards for the studies presented, all of which will have been published in a peer-reviewed journal, apart from the recent report on 'No to failure' that is included for information on the difficulties which can be experienced working in an educational setting, even for those who are experts in the field.

For a review of the issues in designing intervention studies, see Haslum (2007), who notes that it may not be possible or desirable to adopt the gold standard randomised controlled double blind study in educational research.

THE REVIEWS

It should be noted that although these reviews are comprehensive and well received, none are peer reviewed and published in journal form.

Note here that the impact of interventions is usually measured by effect size analyses (ES) (Cohen, 1969) that suggest an effect size of 0.20 is small, 0.5 is medium and 0.8 is large.

i) Slavin (2009)

These reviews taken from the website 'Best Evidence Encyclopedia', examine the impact of different reading approaches with beginning and struggling readers, and include interventions of 12 weeks or longer which represents strong medium or weak evidence, with effect sizes of at least 0.20.

The method is known as Best Evidence Synthesis, and uses well-justified standards to evaluate studies and pool effects, in an approach similar to the What works clearinghouse. Slavin included 96 quasi experimental-control comparisons, 39 of which were randomised and five quasi experimental.

ii) Singleton (2009)

Singleton notes that there is a dearth of well-controlled studies with children with known difficulties, and acknowledges the need to recognize 'silver standard' studies using quasi- experimental designs including pre and post tests, some of which may not include controls. Singleton (2009) has included a large number of unpublished studies presented at conferences or published in book chapters in his review.

iii) Brooks (2007)

Brooks has similarly presented unpublished material, more specifically studies that have investigated intervention approaches that he finds promising.

iv) What works clearinghouse (2007)

This website maintained by the US Department of Education includes sections on beginning reading (ages 5-8) and adolescent reading, as well as achievements more generally. This website allows searches for specified interventions, and includes single case studies as well as randomized trials and quasi-experimental studies. (http://ies.ed.gov/ncee/wwc/reports.)

v) Fawcett (2002)

This review for the DfES website included an analysis of current publications plus the findings of the US National Reading panel.

vi) US National Reading Panel.

It is particularly interesting to cross reference across these reviews and identify strong UK intervention studies which have been highlighted in a range of US and UK reviews.

In 2002, Fawcett (2002) noted that even well evaluated traditional therapies were not proving as successful as had previously been hoped, despite the development of costly long term controlled studies in the US by the National Institute for Child Health and Human Development (NICHD) designed to help children with dyslexia and other reading difficulties costing between $10 and $20 USD million dollars a year.

The problem is that training leads to improvements in the area which has been trained, but it is much more difficult to ensure that this generalises to reading skill overall.

The most difficult task is to improve children's standard scores in literacy, because these take age into account, and are often based on irregular words that do not improve with phonological training. Therefore the results from the US National Reading panel (2001) showed improvement in phonological skills, but this did not always generalise into accurate reading, nor typically has this improvement generalised into more fluent reading, and spelling is even more difficult to remediate.

However, there are a number of critical issues that need to be resolved before progress can be evaluated properly, and many of these were addressed in the US analysis. These include:

- What age is likely to be the best to intervene?
- Is it better to allow children 'at risk' to fall behind and then intervene with children with recognised difficulties?
- Are there significant differences between training programmes and what is the best type of training?
- How long should a programme be administered for?
- Is it most effective to give it for weeks or is it necessary to provide a year of intervention?
- Does it matter how intelligent the children are, or can the same approach be used with children of all types?
- What is the significance of a poor start for children from a low socio-economic background?

The approach adopted here is to use the insights from the US research, to combine these with best practice in UK research, and present the evidence within a framework that emphasises not only effectiveness but also cost-effectiveness.

THE BACKGROUND

Although most educationalists would agree that understanding is the key, research in the area has largely focused on the ability to improve single word reading. This is mainly because it is the easiest to measure objectively. There is solid evidence that this can be improved, although typically it is easier to improve skills in a normal reader, or an 'at risk' beginning reader, than it is to help an older disabled child.

The major area of debate here has been which method is the most effective. The major focus of US research has therefore been a series of comparative evaluations of the effectiveness of each method, with a general consensus among researchers that phonological training is likely to be the most effective. This has led to a series of longitudinal studies, spanning 3 years or more, with some programmes of research adopting a 10 year perspective in order to consider long-term outcomes.

The results of these US interventions have, embarrassingly, been somewhat disappointing, with no significant differences between any of the remediation methods evaluated, although phonological approaches are more successful overall. On closer analysis, a general dissatisfaction with the impact of intervention studies led the US government to commission a National Reading panel into reading remediation (2000). For the first time for over a decade, it became clear to policy makers that interventions that target phonological skills alone or even in combination with single word reading may not be enough.

Despite an improvement in these component skills, the reading of disabled readers remained laboured, which impacts on their understanding of what they are trying to read. It was still not clear what could be done to effect change. This change in emphasis prompted the US National Reading panel's critical analysis of the effects of intervention worldwide. This will be augmented with material from ongoing and recently published UK and US research, in an attempt to establish which techniques are most useful. In line with a balanced approach, it should come as no surprise to find that a judicious mix of techniques tuned to the individual needs of the child is the approach that will be advocated by this review.

THE EFFECTS OF INTERVENTION

When considering outcomes from an intervention study, it would be hardly surprising if children improved on the skill they had been directly trained in. However, there may also be evidence of near transfer or far transfer. Near transfer means that there are improvements in skills only indirectly related to the skill trained. Intervention studies seek evidence of far transfer, so that a skill held to be unrelated to the trained skill, is improved. Naturally, this is the most difficult to achieve, and so most studies of phonological intervention look at near transfer to reading, and possibly far transfer to spelling. Note that complementary techniques that are not based on phonological or reading intervention are by definition evaluated on far transfer.

Finally, it is useful to establish that improvements are not just a general Hawthorne effect of the greater interest taken in the child. This means that evidence should be specific to the skill in question, rather than just a generalised improvement (good as this might be!).

Interestingly, phonology and fluency are almost invariably separated in the US literature, but in the UK a more pragmatic approach is normally taken, possibly based on the limited funds available for large-scale research of the type common in the US that evaluates controlled studies (Intervention A versus Intervention B).

Note also that educational interventions in the US are highly competitive, each state has their own system and can specify their own intervention packages, and those which are well-evaluated and widely used stand to generate significant amounts of money. Amongst the articles selected for the National reading panel review the following key UK intervention studies were featured; Hatcher Hulme and Ellis, 1994 and Solity (2000). These are discussed below.

WHICH PROGRAMMES WORK BEST?

In Table 1 we present a review of effective studies with the highest effect sizes at the top, split into primary and secondary age studies. It is interesting to note amongst the most successful interventions for the UK are a series of studies from Hatcher and colleagues with an effect size of from 0.69 to 1.6 for a 10/20 hour intervention which delivered a combination of reading and phonology (Hatcher et al., 1994, 2006a and b), and a series of 10 hour phonics and fluency interventions from the Sheffield group (Nicolson et al., 1999; Fawcett et al., 1999, 2000).

These studies with children aged 5-7 were highlighted in Fawcett (2002) in Brooks (2007), and remain amongst the most successful in Singleton (2009) and in the current review. The approach adopted for the Sheffield studies used a scheme known as Interactive assessment and teaching, a photocopiable scheme by Reason and Boote (1994) recommended by the UK literacy strategy. This approach was based on classic comparisons of intervention and control groups matched on reading age at pre-test, and with intervention in small groups for 20 minute sessions three times weekly.

Table 1. Summary of Intervention Studies in Decreasing Order of Effect Size, Showing Effect Size of 0.8 or greater

Study	Sample	Effect Size	Source
Solity, et al. (2000)	370	3.5	Brooks, 2007
Juel (1996)	6	3.15	Elbaum, 2000
Nicolson, Fawcett & Nicolson (1999)	16	1.34	Singleton, 2009
Hempenstall (2008)	206	1.22	Slavin, 2009
Ehri et al. (2007)	102	1.08	Slavin, 2009
Santa & Hǿ ien (1999)	49	1.04	Slavin, 2009
Brown et al. (2005)	59	1.03	Slavin, 2009
Nicolson et al. (1999)	116	0.98 (spelling)	Brooks, 2007
Foorman et al. (1998)	68	0.91	Ehri, 2001
Torgesen, et al. (1997)	65	0.90	Slavin, 2009
Ehri et al. (2007)	96	0.89	Slavin, 2009
Meier & Invernizzi (2001)	55	0.89	Slavin, 2009
Center, et al. (1995)	56	0.86	Slavin, 2009
Morris, Tyner,& Perney (2000)	186	0.86	Slavin, 2009
Blachman et al. (2004)	69	0.85	Slavin, 2009

In more recent studies, Hatcher et al., (2006), have compared the UK Early Literacy Support (ELS) and their 'Sound Linkage' program with 128 six year olds, and found that both schemes produced significant gains in reading and spelling which were maintained at follow-up. The authors note the limitations of this study, in which there was no untreated control group, and allocation to treatment was not random. In a further study (Hatcher et al., 2009b) a randomised controlled trial was undertaken which overcame these limitations, with children working in groups of 3 with a teacher, or individually with a teaching assistant in daily 20 minute sessions.

However, there are also issues of cost-effectiveness to take into account here, based on the amount of teacher input needed to achieve the effect. There can clearly be very different costs and benefits involved in projects of this type.

Even interventions with equivalent effect sizes may not always be directly comparable. The ideal scenario would be an intervention which produced the maximum benefit at reasonable costs in terms of teacher time, using teachers with no specialist training, the effects of which could be shown to persist after the intervention ends. Interestingly, Hatcher (Hatcher et al., 2006b) found no significant differences between outcomes for children who received either 10 or 20 weeks intervention.

i) Phonemic awareness training

What is phonemic awareness training? It is understanding the concept of phonemes (the smallest sounds of spoken language, either single letters or sounds like sh or ch). This is difficult for children to grasp without some explicit instruction, because in speech words are usually co-articulated. This means that the way letters are pronounced is influenced by the sounds before or after, so that it is not easy for children to identify the component sounds.

Phonemic awareness can be measured in a variety of ways. Separating out the first phoneme in a word (c in cat), blending sounds to make the word (c-a-t makes cat), or segmenting sounds within a word (say cat without the c).

When phonemic awareness is measured using letters as well as sounds, it becomes phonics training. Interestingly, the findings on phonemic awareness training from the National Reading panel suggest that it is most effective when combined with letters (**0.67** around twice as effective as without letters), which makes it essentially **phonics** training.

ii) Phonics training

When evaluating phonemic and phonics training, the National Reading Panel note that it is important to realise that the development of phonic skills is not an end in itself, but simply provides the tools which a child can use to read more effectively. It seems likely that this has been largely forgotten in the debates on the merits of rival approaches in the US!

APPROACHES USED

i) Analysis and synthesis

Analytic phonics uses the onset (First letter) and rime (rest of the word) - so the onset of cat is c, the rime is 'at'. It also breaks the word down into syllables or segments the word. Synthetic phonics starts with the sounds of the letters and avoids whole words. This is currently the major approach favoured in the UK, but interestingly despite the publicity this approach has received through the work of Rhona Johnston over the last 7 years in Scotland, we could not find published peer reviewed articles by Johnston evaluating this technique.

ii) Embedded phonics

This uses phonics as they appear in text. This is not a planned and structured approach like the others, but is based on a more natural experience of reading.

WHAT AGE SHOULD WE INTERVENE?

Strikingly, moreover, there were clear implications from the National Reading Panel for special needs from an analysis of the results of phonics intervention on literacy. This was most effective when delivered to 'at risk' preschoolers, with the impact on reading for children with known difficulties declining as the children grow older (grades 2-6, ages 7+), and with no impact on spelling after 1st grade (with an effect size of only **0.09**).

Declining effectiveness for children at junior school level is displayed graphically in the figure below. Studies in the UK have confirmed that younger children are more likely to 'accelerate' to keep pace with their peers than children at junior school level, (Nicolson & Fawcett 1999, Fawcett & Nicolson, 2000) possibly because problems at junior level are based on real difficulties rather than lack of exposure to the skills in question. These results suggest that early identification reflects good practice in the field, and that this approach should be adopted more universally in Singapore and the Asia Pacific region..

Contrast the effect size gains for 'at risk' and normal children in the 1st grade in the figures below, with children with difficulties. Problems are much more intractable, and it is unusual to produce a strong effect size, even with quite intensive support. Indeed, intensive support can prove counterproductive in improving skills, although this may simply reflect the severity of the difficulties

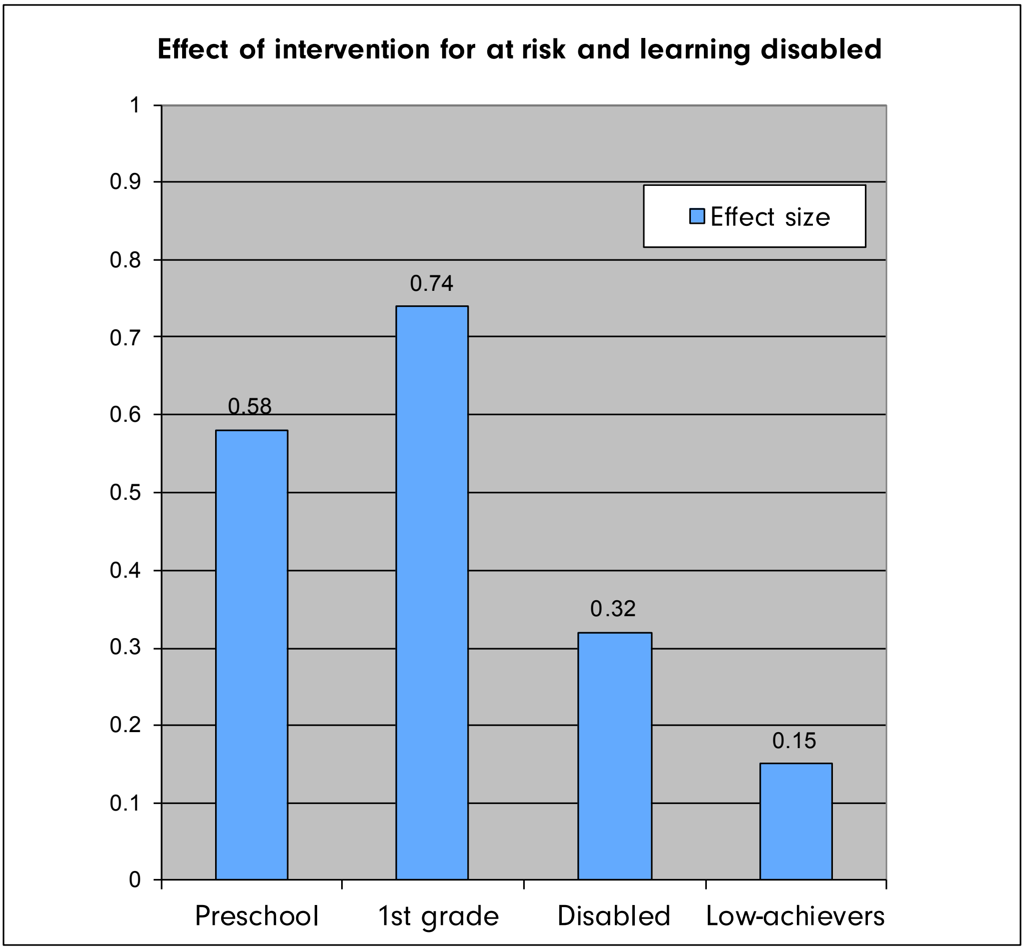

Figure 1. Phonics intervention is most effective for reading in 1st grade and less effective for older children (data from the National Reading Panel).

experienced by children who are offered this intense support.
In his 2013 review, Brooks adopts a different approach, assessing work in terms of the reading scheme used. Unfortunately, for many of the studies reported, the data to evaluate effect sizes is not available, and ratio gains are reported in preference. Here, exceptional impacts are found for Reading Recovery in year 1, with effect sizes of 1.67, with good but less striking impact in year 3, at 0.84. Catch up Literacy in year 3 shows an effect size of 1.11 and Paired Reading 0.87. Brooks concludes that the majority of effect sizes are between 0 and 1, and anything exceeding this level is very strong impact indeed.

FLUENCY

This aspect of reading has largely been overlooked for some years, with the emphasis being placed on training in phonics and phonology. The idea that you need to become automatic in skills in order to free resources has been known since the 1970's, but not necessarily recognised in the context of reading. The idea that this analysis should be applied to reading was an important conclusion of a recent influential overview and analysis of the teaching of reading: " ... Laboratory research indicates that the most critical factor beneath fluent word reading is the ability to recognise letters, spelling patterns, and whole words effortlessly, automatically and visually. The central goal of all reading instruction - comprehension - depends critically on this ability." (Adams, 1990, p. 54).

This issue has now been universally recognised as important in the US, following a report (Pinnell et al., 1995), from the National Assessment of Educational Progress, which showed that 44% of 4th graders (9/10 year olds) were not fluent even with material appropriate for grade level that they had already read in class. These students may find it difficult to understand what they read.

It is clear that fluency develops with practice, but what is the best kind of practice? If poor readers are considered, they naturally tend to have less practice than good readers, because they are not fluent enough to read for enjoyment. Moreover, different techniques have been recommended, with two main approaches; firstly variations of 'guided oral reading', where students read out loud and receive systematic and explicit feedback and guidance from a teacher; and secondly, 'independent silent reading', which simply encourages readers to read more, based on a known correlation between the amount of reading undertaken and the development of reading skill.

Interestingly, the silent reading approach does not attempt to evaluate any changes in children's word reading accuracy or speed, but monitors increases in vocabulary and comprehension skills. Poor readers needed an average of 25 hours repeated reading, compared to 18 for the average readers. Overall, this is encouraging because repeated reading requires no particular training or materials, and can be delivered by parents or peer tutors. It is therefore both effective and cost-effective, and can be carried out in the classroom, rather than withdrawing children for costly individual support. By contrast, studies that simply encouraged children to read more had no effect on outcomes in terms of fluency, accuracy or comprehension.

DIRECTIONS FOR FURTHER RESEARCH

A series of points have emerged from the analysis above that suggests that there may be a critical time for intervention. It does not seem to matter whether children are taught individually, in small groups, or as a class. As their reading skills develop, guided oral repeated reading is more successful than simply practicing reading silently. It is clear that children's skills can be improved with a range of interventions, but this becomes more difficult as the child becomes older. The most effective approach would be to identify children as 'at risk' in the early years of school and provide a short structured intervention.

It is clear that providing support at this stage is much more successful than waiting for children to fall behind. This early support would 'accelerate' the literacy skills of the majority of the children leaving a few children whose difficulties are particularly intractable. This could then be followed by a longer targeted intervention, which addressed the specific needs of the individual child. This would prove not only more effective, but also more cost-effective, providing tailored support for children with real difficulties.

EDUCATIONAL SAVINGS

Intervention can be provided in small groups, and the evidence suggests that this can be just as effective as working with children individually, particularly with younger children. Cost effectiveness can be estimated based on the added value on effect size, and the number of hours that the teacher inputs per child. This is a true measure of overall cost-effectiveness.

SUMMARY AND CONCLUSIONS

It is clear that the timing of the intervention is more critical than the type of intervention, with an eclectic mix which links sounds and letters producing the best effects overall. The evidence suggests that early intervention (Nicolson et al., 1999, Hatcher et al., 1994, 2006) can reduce the severity of impairments, allowing some children to keep pace with their peers and others to move into a category of milder deficit. This should not only impact favourably on educational costs but also improve standards within education, based

> "Preschool intervention can level the playing field for those with dyslexia and related difficulties."

on the greater malleability of skills noted in this review in the early years of primary school.

However, it should be borne in mind here that there remain a constant number of children with severe and profound difficulties who will demand higher levels of resources for their educational provision. Moreover, there will be a core of children who fail to improve despite the early years input and will continue to need specialised help in school. Nevertheless, the numbers of these children could be significantly reduced by early intervention, thus ensuring that funding is concentrated on those children with entrenched difficulties.

The implications of these findings on the importance of early intervention should be considered in countries such as Singapore where standards are high, school does not start until age 7, and there will be strong individual differences in the levels of achievement even within children starting school. Preschool intervention can level the playing field for those with dyslexia and related difficulties.

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Dyslexia: A Brief for Educators and Parents

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Purpose:

Dyslexia is a term that has been applied since the early part of the 20th Century to many students with reading difficulties. The term comes from medicine, but its broadest application is within education. Many educators, however, remain confused about the term in spite of the fact that major advances in our understanding of dyslexia have been made through scientific research over the past 40 years. The purpose of this paper is to briefly describe what is currently known about dyslexia, focusing particularly on methods of early identification, prevention, and remedial instruction.

WHAT IS DYSLEXIA?

The most widely accepted current definition of dyslexia is the following:

> *Dyslexia is a specific learning disability that is neurological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge.*

This definition is the one used by the National Institutes of Child Health and Human Development which has sponsored the majority of recent research on dyslexia, and it was also adopted by the Board of the International Dyslexia Association in 2002. The individual elements of this definition will be discussed in turn.

Dyslexia is a specific learning disability that is neurological in origin.

Dyslexia is a term used to refer to a specific type of learning disability. It is important to acknowledge that students may struggle in learning to read for many reasons, including lack of motivation and interest, weak preparation from the preschool home environment, weak English language skills, or low general intellectual ability (Snow, Burns, & Griffin, 1998).

In fact, the family and socio-cultural conditions associated with poverty actually contribute to a broader and more pervasive array of reading difficulties in school-aged children than do the neuro-biological conditions associated with dyslexia. Students with dyslexia represent a *subgroup* of all the students in school who experience difficulties learning to read.

The primary evidence that students with dyslexia have a problem that is inherent, and not the sole result of poor teaching or lack of experience, comes from twin studies showing that dyslexia is substantially heritable (Olson & Gayan, 2001), and from brain imagery studies showing differences in the way the brains of dyslexic students function (Shaywitz, 2003).

It is characterized by difficulties with accurate and / or fluent word recognition and by poor spelling and decoding abilities.

Although students with dyslexia can show a variety of subtle or not-so-subtle language problems prior to entry in school (Catts & Kahmi, 2005), their problems become very noticeable once they begin learning to read. They have extreme difficulties acquiring accurate and fluent phonemic decoding skills (phonics), and this interferes with their ability to read text accurately or to read independently.

Dyslexic students struggle to acquire both knowledge of letter-sound correspondences and skill in using this knowledge to "decode" unfamiliar words in text. In first grade, their difficulties with accurate word identification quickly begin to interfere with the development of text reading fluency. Difficulties decoding unfamiliar words in text interfere with the development of fluency because, to become a fluent reader in the primary grades, students must learn to recognize large numbers of words automatically, or at a single glance.

Students learn to recognize individual words "by sight" only after they accurately read them several times (Ehri, 2002). Thus, the initial difficulties that students with dyslexia have in becoming accurate and independent readers interfere with the development of their "sight word vocabularies," and they quickly fall behind their peers in the development of reading fluency.

These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction.

The discovery that students with dyslexia experience difficulties processing the phonological features of language (Liberman, Shankweiler, & Liberman, 1989) was important in establishing the foundations of the current scientific understanding of dyslexia. The phonological processing problems of students with dyslexia are usually not severe enough to interfere with the acquisition of speech, but they sometimes produce delays in language development, and they significantly interfere with the development of phonemic awareness and phonics skills for reading.

Spoken words are composed of strings of phonemes, with a phoneme being the smallest unit of sound in a word that makes a difference to its meaning. Thus, the word *cat* has three phonemes, /c/-/a/-/t/. If the first phoneme is changed to /b/, it makes the word *bat*, or if the second phoneme is changed to /i/, it makes the word *bit*.

When students first begin to learn to read, they must become aware of these individual bits of sound within syllables so they can learn how our writing system represents words in print. The letters in printed words correspond roughly to the phonemes in spoken words. Once a child understands this fact, and begins to learn some of the more common letter/sound correspondences, he/she becomes able to "sound out" simple unfamiliar words in print. Skill in using phonemic analysis to identify words that have not been seen before in print (and beginning readers encounter these words in their reading almost every day) is one of the foundational skills required in learning to read text independently (Share & Stanovich, 1995). Because of their phonological processing difficulties, students with dyslexia experience difficulties acquiring phonemic awareness, which is followed by the difficulties learning letter sounds and phonemic decoding skills that have already been described.

Phonological processing skills are only moderately correlated with general intelligence, so it is possible to have average, or above average general intellectual ability and still experience the kind of reading difficulties observed in students with dyslexia. A student can also have below average general intellectual skills and have the same kind of phonological processing disabilities.

Dyslexia is *not caused* by low general intellectual ability, but rather by special difficulties processing the phonological features of language, that can co-exist with above average, average, or below average general intellectual ability. This is one reason why previously used "discrepancy formulas" for the identification of students with learning disabilities were unfair to many students.

Children who had both low general intellectual ability and phonological processing difficulties were routinely denied learning disability services, even though their reading problem was not caused by low general ability, but rather by the type of phonological processing problems identified as the core cause of dyslexia (Fletcher, Denton, & Francis, 2005).

It is important to note here that science has shown it is incorrect to think of dyslexia as an "all or none" phenomena. That is, the phonological processing abilities required for acquisition of early reading skills are normally distributed in the population, just like musical talent, athletic ability, or most other human abilities. It is possible to have extremely weak phonological processing skills, or to be only mildly impaired in this area. It is also possible to have above average skills in the phonological domain. If students have extreme phonological processing weaknesses, it is very, very difficult for them to acquire early reading skills, while students with mild difficulties in this area often require only a moderate amount of extra instruction to become good readers (Wagner & Torgesen, 1987).

Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge.

One of the most serious consequences of early difficulties becoming an accurate, confident, fluent, and independent reader is that it affects the amount of reading that students do. For example, a study done a few years ago indicated that students reading at the 50th percentile (average) in 5th grade read about 600,000 words in and out of school during the school year. In contrast, students reading at the 10th percentile read about 50,000 words during the same period of time (Anderson, Wilson, & Fielding, 1988). Large differences in reading practice emerge as early as the beginning of first grade (Allington, 1984).

In addition to directly affecting the development of reading fluency, these practice differences have a significant impact on the development of other cognitive skills and knowledge, such as vocabulary, reading comprehension strategies, and conceptual knowledge (Cunningham & Stanovich, 1998). This latter type of knowledge and skill, in turn, is important for comprehension of texts in upper elementary, middle, and high school (Rand, 2002).

Of course, other "secondary consequences" to the child's self-esteem and interest in school can be just as important as the effect on intellectual skills in determining ultimate school success.

HOW CAN STUDENTS WITH DYSLEXIA BE IDENTIFIED IN SCHOOL?

Children likely to have difficulties learning to read can be identified as early as preschool or kindergarten, but it is frequently not possible to differentiate in preschool or kindergarten between students who have dyslexia, and students who are at risk for reading problems for other reasons. For example, the clearest indicators of dyslexia in kindergarten are difficulties acquiring phonemic awareness, learning letter/sound correspondences, and learning to decode print using phonemic decoding strategies (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001).

Unfortunately, many poor children, or those with limited exposure to Standard English in their homes, also manifest these same types of difficulties in kindergarten.

An accurate diagnosis of dyslexia in preschool or kindergarten is more likely when these problems occur in students who:

1. have strong abilities in other areas of language such as vocabulary;

2. come from homes that provide a language and print rich preschool environment; and,

3. have a first or second-degree relative who experienced severe early reading difficulties. However, inherent phonological processing difficulties can also occur in poor children who come to school with limited vocabularies and knowledge of print. Although the phonological weaknesses of these students are most likely the result of lack of certain kinds of language experience in the home, they may also be the result of biologically based, inherent phonological processing weaknesses.

One group of researchers (Vellutino et al., 1996) has argued that because early reading difficulties can result from both inherent weaknesses in phonological processing ability and from poor instruction or lack of prior print/language experience, response to high-quality, intensive reading instruction may be the best way to identify students with inherent cognitive limitations. Theoretically at least, students who lag behind in the development of early reading skills because of a lack of appropriate experience in the preschool environment should respond rapidly to high-quality, intensive interventions.

In contrast, students with severe and inherent phonological processing weaknesses should respond more slowly if at all. Although response to this type of intervention would not identify as dyslexic a student whose inherent phonological difficulties were mild (because these students should respond well to explicit and intensive instruction), it will certainly identify students with the *most serious* reading difficulties, whether they be caused by inherent phonological weaknesses or by other factors.

If students are still struggling to master early reading skills by the end of kindergarten, even though they have had exposure to relatively intensive interventions, then they should be provided with additional intensive intervention in first grade (or longer) until they are able to master all reading skills appropriate to their grade level. This, of course, is true for all children, regardless of the exact cause of their reading difficulties.

To summarize, we currently understand how to identify students at risk for reading failure with a relatively high degree of accuracy as early as preschool or kindergarten. Reliable tests of phonemic awareness, letter/sound knowledge, or phonemic decoding will show these students to be substantially behind their peers, unless they have already received powerful instructional interventions.

At present, however, we have neither the equipment nor the scientific knowledge to use brain imaging as a way of diagnosing dyslexia in young children, particularly if the goal is to differentiate them from other students who are struggling in learning to read for different reasons.

In first grade, reliable tests of phonemic awareness, phonemic decoding, and text reading accuracy and fluency will also identify these students accurately. In later grades, dyslexic students who have not received powerful interventions may still remain relatively impaired in phonemic awareness, and will always perform poorly on tests of phonemic decoding, text reading fluency, and spelling. In late elementary, middle, and high school, the reading comprehension performance of these students is likely to be below average (in spite of intellectual abilities that are frequently average or above average), but their reading comprehension performance is usually not quite as low as their word-level reading scores. Particularly in cases where these students have average or above average general intellectual skills, they can often compensate for their poor ability to read the words on a page by "filling in the gaps" through reasoning and use of their background knowledge.

We currently have no scientific evidence that effective prevention of reading difficulties in students with dyslexia depends on accurate differential diagnosis of the disorder in kindergarten or first grade. What is critical is that difficulties learning to read are identified as early as possible, and that intensive and well-targeted interventions be provided to students who are lagging behind, no matter what the cause. This approach to early assessment and intervention is exemplified in the "response to intervention" (RTI) approach which is currently being proposed as a replacement for discrepancy models as a method of identifying students with learning disabilities (Burns, Jimerson, & VanDerHayden, 2007; Fletcher, Lyon, Fuchs, & Barnes, 2006).

The RTI approach is both a method that can be used to diagnose learning disabilities (dyslexia included), and a way of organizing early instruction in reading. When used as a diagnostic approach, it assigns the diagnosis of disabilities like dyslexia to students who show continued inability to acquire grade appropriate reading skills in spite of high quality initial instruction and appropriately intensive intervention support.

The major weakness of the RTI approach (which is also true of discrepancy approaches) to diagnosis is that the number of students who will be diagnosed as having "dyslexia", or "learning disabilities", depends directly on the quality and intensity of instruction students receive. If schools provide only weak initial instruction and minimal interventions, then a large number of students will end up in third grade (or any grade) as poor readers who could be diagnosed as having "dyslexia" because of their failure to respond to weak instruction.

However, if schools provide consistently strong initial instruction along with sufficient amounts of high-quality, well-targeted, and intensive interventions, then relatively few students will end up being diagnosed as having dyslexia because of continued poor reading skills.

The model for instruction prescribed by the RTI approach involves three elements:

1. Classroom teachers that provide high quality initial instruction along with small group instruction that is differentiated according to student needs. Classroom teachers are encouraged to differentiate instruction in multiple ways (time, group size, focus of instruction, lesson structure) in order to more effectively meet the needs of all students in their classroom.

2. Reliable screening and progress monitoring tests to identify students falling behind in reading growth. Any system that provides reliable assessment of emerging reading skills several times a year would identify all students with dyslexia in the system as well as other students who are struggling in reading for different reasons.

3. Interventions for struggling readers that are sufficiently powerful to accelerate their reading development toward grade level standards. Sometimes these interventions are provided by classroom teachers, sometimes by reading specialists (including special educators), and sometimes by paraprofessional tutors. Data from ongoing progress monitoring of student growth is used to guide adjustments to interventions so that all students receive instruction that effectively accelerates their reading growth. In many schools, the classroom teacher, by herself, will not be able to provide sufficiently intensive interventions to meet the needs of all her students, so a school level system for allocating intervention resources will be required (Torgesen, 2006).

The most important point of this section is that we can, using tests currently available, accurately identify students who are likely to struggle with reading starting in preschool or kindergarten.

What these tests cannot do this early is to differentiate students with dyslexia from other students who will struggle in learning to read for reasons other than dyslexia. The goal of every school should be to provide interventions for all struggling readers that are sufficiently powerful to bring their reading skills up to grade level standards. If this is accomplished for all struggling readers, then it will automatically be accomplished for all students with dyslexia.

WHAT TYPE OF INSTRUCTION IS MOST EFFECTIVE FOR STUDENTS WITH DYSLEXIA?

Prevention of reading difficulties in students with dyslexia requires both effective classroom instruction during the regular "reading block" and powerful intervention support for children with the most severe phonological processing difficulties (Foorman & Torgesen, 2001). From their classroom teacher, children with dyslexia need engaging, systematic, and explicit instruction in all the critical components of literacy development (i.e. phonemic awareness and phonics, fluency, comprehension, vocabulary, spelling, and writing), and they will also need extra support during the time when small group instruction is differentiated based on student needs.

If classroom teachers are not skilled in providing this type of instruction, many schools will simply have too many students requiring extra interventions, and school resources will be overwhelmed. Another way of saying this is that regular classroom teachers should be able to meet the instructional needs of many students with dyslexia who are only *mildly impaired* in phonological processing. If their instruction is not strong enough to meet the needs of mildly impaired students, those with more severe processing difficulties may not be able to receive the much more intensive instruction they require (Foorman, Breier, & Fletcher, 2003).

At this point, it is useful to remember that children with dyslexia are only *one subgroup* of all the students in a school that that may be at risk for reading failure. Many students with dyslexia come to school with well developed vocabularies, strong reasoning and thinking skills, and excellent language comprehension abilities. The most efficient approach for these students will usually be to provide intervention support focused on their areas of primary difficulty which would typically be phonemic awareness, phonemic decoding, and text reading accuracy and fluency. Of course, like all other students, children with dyslexia need instruction in vocabulary and reading comprehension strategies, but the instruction they receive from their regular classroom teachers in these areas will typically be sufficient.

In many schools, there will be another large group of students "at risk" for reading difficulties. These children come largely from families of lower socio-economic or minority status, or they are English Language Learners, and they enter school significantly delayed in a much broader range of pre-reading skills (Whitehurst & Lonigan, 1998; Hart & Risley, 1995). These children have weaknesses in both the broad oral language knowledge that supports reading comprehension and in the phonological and print-related knowledge required in learning to read words.

Classroom instruction that explicitly teaches how letters and sounds relate with ample opportunities to practice these relations by reading text are important for such children (Foorman, Francis, Fletcher, Schatschneider, & Mehta, 1998), as well as outreach to parents to build language and literacy experiences in the home (Foorman, Anthony, Seals, & Mouzaki, 2002). Although it is theoretically possible for a child to enter school weak in vocabulary and conceptual knowledge, but strong in the phonological skills and knowledge required in learning to read words, these children are, in fact, quite rare. This pattern of abilities is not commonly observed because the same preschool environmental conditions that are associated with limited vocabulary growth also have a negative impact on the growth of print-related knowledge and skills like phonemic awareness and letter knowledge.

Children with general oral language weaknesses plus phonological weaknesses will require interventions in a broader range of knowledge and skill than those who come to school impaired only in phonological ability. However, because both groups have weaknesses in the phonological and print-related domain, *both kinds of children* will require special support in the growth of early word reading skills if they are to get off to a strong start in learning to read. As was mentioned earlier in the section on identification of students with dyslexia, the screening, progress monitoring, and diagnostic tests used with young children should be able to help target interventions on areas of greatest need in all students requiring special reading interventions. The same, is true, of course, for older students with dyslexia who continue to have reading difficulties.

The primary differences between instruction appropriate for all children in the classroom and that required by children with relatively severe dyslexia are related to the manner in which instruction is provided. Specifically, instruction for children with severe dyslexia must be more *explicit and comprehensive*, more *intensive*, and more *supportive* than the instruction provided to the majority of children. Interventions provided to students with dyslexia should also be targeted on the specific types of skill and knowledge that are interfering with their reading growth.

Explicit instruction is direct, systematic, and leaves nothing to chance. Most of the knowledge that is acquired in the process of *typical* reading development is discovered by the child during interactions with print. As children read, they notice useful generalizations about print-sound relationships, and they also learn to recognize many words "by sight" which is the first step toward fluent reading (Share & Stanovich, 1995).

However, because of their weaknesses in the area of phonological processing (specifically their delayed development of phonemic awareness), children with dyslexia require explicit and systematic instruction to help them acquire the knowledge and strategies necessary for decoding print. As Gaskins, Ehri, Cress, O'Hara, and Donnelly (1997) have pointed out, "First graders who are at risk for failure in learning to read do not discover what teachers leave unsaid about the complexities of word learning. As a result, it is important to teach them procedures for learning words" (p. 325).

Not only do children with dyslexia require more explicit instruction (meaning that more things must be directly taught), they also acquire skills and knowledge in the phonological domain more slowly than average students. Both of these teaching/learning challenges make it necessary to provide students with dyslexia much more *intensive instruction* than other students in order to maintain normal growth patterns in reading. The most practical method for increasing instructional intensity for highly at-risk students is to provide small group instruction both during, and in addition to, the instruction the students receive during the reading block. Although there are many different ways to organize this instruction (Greenwood, 1996; Fuchs, Fuchs, Mathes, & Simmons, 1997; Torgesen, Houston, Rissman, & Kosanovich, 2007), there can be no question that children with dyslexia will learn more rapidly under conditions of greater instructional intensity than they will in typical classroom settings.

Effective early interventions, as well as remedial instruction that is powerful enough to accelerate students' rate of reading growth, almost always involve extra small group or 1:1 instruction for periods of time varying from 20 minute a day to 90 minutes a day, four or five days a week (Elbaum, Vaughn, Hughes, & Moody, 1999, Scamacca, et al., 2007, Torgesen, 2005). To provide effective preventive or remedial instruction for students with severe dyslexia, schools need to develop the capacity to provide substantial amounts of skillful and targeted small group instruction to these students for as long as it takes to help them acquire grade level reading skills.

The last characteristic of effective instruction for students with dyslexia that differentiates it from instruction sufficient for most children is that it must be more supportive, both emotionally and cognitively. Because acquiring the basic skills required for accurate and fluent reading is so difficult for children with dyslexia, their need for more positive emotional support in the form of encouragement, feedback, and positive reinforcement is widely understood. However, their potential need for more cognitive support, in the form of carefully "scaffolded" instruction, is less widely appreciated. Instruction for at risk or children with reading disabilities typically involves two types of scaffolding.

One type of scaffolding involves careful sequencing so that skills build very gradually—children are always systematically taught and practiced on the skills required for any task they are asked to do (Swanson, 1999). Another type of scaffolding involves finely tuned interactions between teacher and child that support the child in accomplishing a task that he/she could not do without the teacher's help (Stone, 1989). The dialogue between teacher and student leads the child to discover what kind of processing, or thinking, needs to be done in order to complete the task successfully. The point of this type of instructional interaction is that the child is led to discover the information or strategies that are critical to accomplishing the task, rather than simply being told what to do. As Juel suggested (1996), the ability to offer scaffolded support while children are acquiring reading skills may have increasing importance as the severity of the child's disability increases.

CAN READING DIFFICULTIES IN DYSLEXIC STUDENTS BE PREVENTED?

The best answer to this question from current research is that serious reading difficulties can be prevented in most students with dyslexia if the right kind of instruction is provided with sufficient intensity early in development. For example, in one study conducted in Florida several years ago (Torgesen, et al., 1999), the 12 percent of students most at-risk for reading difficulties were identified in kindergarten based on their performance on measures of letter knowledge and phonemic awareness. Students received 1:1 intervention in reading for 20 minutes a day, four days a week, starting in the second semester of kindergarten and extending through the end of second grade. However, by today's standards, these students' regular classroom teachers did not provide systematic and explicit instruction in phonemic awareness and phonics during the regular reading block.

At the conclusion of instruction, children in the strongest instructional condition performed in the average range on measures of phonemic decoding (average score = 48th percentile) and reading accuracy (average score = 45th percentile). However, there was substantial variability in response to the instruction, and 30% of the group scored below the 30th percentile in phonemic decoding at the end of the study. The corresponding figure for reading accuracy was 39 percent.

Since the children in this study were selected to be the 12% most at risk for reading failure, the authors estimated that, if the strongest condition from this study were available to all students who needed it, approximately 4% of all children would remain weak in phonemic decoding ability and 5% would perform below the 30th percentile in sight word reading at the end of second grade.

In a follow-up study conducted by the same research team (Torgesen, Rashotte, Wagner, & Herron, 2001), students who were the 18% most at risk for reading failure at the beginning of first grade (based on performance on letter knowledge and phonemic awareness) were provided with small group (3 students) reading instruction for 50 minutes a day, four days a week, from October through May. This study was conducted only in schools in which the classroom teachers provided systematic and explicit instruction in phonics (also vocabulary, fluency, and comprehension) during the regular reading block, and the interventions were offered in addition to that instruction.

At the end of first grade, students in the strongest instructional condition scored at the 74th percentile on a measure of phonemic decoding (they had scored at the 4th percentile at the beginning of the year) and at the 67th percentile on a measure of reading accuracy. The percent of children obtaining scores below the 30th percentile on these measures was 12% (phonemic decoding) and 10% (reading accuracy). Using calculations similar to those applied to the previous study, the authors estimated that, if interventions and classroom instruction as strong as those provided in this study were available for all students who needed them, only 2% of students would remain seriously impaired in phonemic decoding and reading accuracy at the end of first grade.

Other recent intervention studies tell a roughly similar story. If strong interventions are provided to "at risk" students as early as kindergarten and first grade, the overall percentage of students who continue to struggle with basic reading skills can be reduced to under 5% (Mathes et al., 2005; Scammacca, et al., 2007; Torgesen, 2002). Of course, becoming a proficient reader by the end of third grade involves much more than learning to read words accurately and fluently. The ultimate goal of reading instruction is to enable students to comprehend the meaning of what they read. However, the examples provided in this section are relevant to a discussion of the prevention of serious reading problems in students with dyslexia because the "core difficulty" these students face involves learning to read text accurately and fluently.

These examples demonstrate that, if sufficiently powerful interventions are available, it is possible to maintain the word level reading skills of most students with dyslexia at roughly average levels during the early primary grades.

As another example of what can be accomplished in preventing reading difficulties with powerful instruction provided in the early primary grades, the experience of schools in the Kennewick, Washington, school district is instructive (Fielding, Kerr, & Rosier, 2007). In 1995, the 13 elementary schools in this district were challenged to have 90% of their students reading at grade level (as assessed by a good measure of reading comprehension) within three years. In the year prior to the initiative, the percent of students in 3rd grade reading at grade level was 48% in the district, and within 9 years, 9 of the 13 schools had accomplished the 90% goal. One of the stronger schools (Washington Elementary) accomplished the goal in 5 years, and in 2006, 98% of students at Washington were reading at grade level at the end of third grade. Washington had to make radical changes in the way they organized and delivered reading instruction in K-3 in order to accomplish this goal. They teach reading to all students in an uninterrupted two-hour block, and some students in first and second grade receive an additional 60 to 90 minutes of small group intervention in addition.

They accomplished part of the their goal by aligning instruction and working harder at third grade, but they didn't achieve their ultimate results until they began carefully monitoring reading growth in kindergarten through second grade and providing intensive interventions to students who were lagging behind.

HOW EFFECTIVE IS REMEDIAL INSTRUCTION FOR OLDER STUDENTS WITH DYSLEXIA?

Unfortunately, there are many students with dyslexia currently in our schools who did not receive timely and sufficiently powerful interventions to prevent the emergence of serious reading difficulties. When children with dyslexia have been in school three or four years and have not had sufficiently strong preventive instruction, they will show two obvious difficulties when asked to read text at their grade level.

First, they will not be able to recognize as high a proportion of the words in the text fluently or "by sight" as average readers. There will be many words they stumble on, guess at, or attempt to "sound out." The second problem is that their attempts to identify words they do not immediately recognize will produce many errors. They will not be efficient in using phonemic analyses in combination with context to identify unknown words. It also is the case that a small number of children with the most severe form of dyslexia will show these same weaknesses despite the provision of timely and powerful interventions.

Several years ago, a large study of special education in the state of Texas reported that students receiving reading interventions did not fall further behind with each year in special education, but neither did they close the reading gap to any meaningful degree (Hanushek, Kain, and Rivkin, 1998). This finding echoed earlier studies (Foorman, Francis, Fletcher, Winikates, & Mehta, 1997; Kavale, 1988; McKinney, 1990; Schumaker, Deshler, & Ellis, 1986; Zigmond, et al., 1995) showing that, at best, students receiving remedial reading instruction in special education make one year's growth for each year of instruction, but rarely do they make the substantial improvements (two or three years growth) that are required in order to help them eventually "close the gap" with their same-age peers.

A recent review of remedial instruction for older students with severe reading disabilities (Torgesen, 2005) indicated that we do know how to accelerate reading growth in older students with dyslexia, but that it is exceedingly difficult to bring them to grade level standards in all areas of reading skill. Further, the instructional conditions in studies that accelerate reading growth in older students are universally more powerful (smaller groups, more instructional time, highly trained teachers) than those typically available to students receiving special education services in our public schools.

One of the most powerful intervention studies to date with older dyslexic students was conducted in Gainesville, Florida, through the Morris Child Development Center (Torgesen et al., 2001). Sixty students with severe reading disability in grades 3-5 who had been receiving special education services for an average of 16 months were provided 8 weeks of very intensive reading instruction. They were taught 1:1 by highly skilled teachers in two, 50-minute sessions, five days a week for 8 weeks, for a total of 67.5 hours of instruction. During this time, in the strongest instructional condition, their scores in phonemic decoding increased from below the 1st percentile to the 39th percentile, their scores in text reading accuracy increased from the 4th to the 25th percentile, and their scores in reading comprehension increased from the 13th to the 27th percentile.

After the study, about 40% of the students were "staffed out" of special education, while the rest remained with no further intervention from the study. At the two year follow-up point, the students scored at the 29th percentile in phonemic decoding, the 27th percentile in text reading accuracy, and the 36th percentile in reading comprehension. The reading comprehension of these students was slightly higher than would have been predicted from the level of their general verbal ability, which was at the 29th percentile.

A finding from this study, which has been observed in other studies as well (Torgesen, 2005), is that the students' percentile rank in reading fluency did not improve nearly as much as the scores for other reading skills. At the beginning of the study, the students' reading fluency fell at the 3rd percentile, while at the two year follow up, it was at the 4th percentile. Although their fluency for lower grade level passages did increase dramatically (from 38 to 101 words per minute), when the students were asked to read passages at their grade level, there were still too many words that they could not recognize "by sight" so, although they could read them much more accurately following intervention, they still had to stop and "sound out" too many words. If students with dyslexia remain essentially "non readers" during the early part of elementary school, they miss out on enormous amounts of reading practice, and it is very difficult to close this practice gap once they become older, because their classmates are reading at such high volumes by that time.

To summarize, it is clear that we currently understand how to provide more powerful interventions to older dyslexic students than they may frequently receive in special education. It is also clear that it is possible for them to acquire useful phonemic decoding skills after third grade, if the instruction they previously received was not sufficient to help them in this area. Another recent review of interventions with older disabled readers has indicated that it can also be very helpful to directly teach these students reading comprehension strategies

(Scammacca, 2007). Both lack of early reading practice, and difficulties with word-level reading skills apparently interfere with dyslexic students' ability to acquire the range of strategies that good readers use to increase their comprehension. Although it is challenging to provide appropriately targeted instruction for older students with dyslexia who continue to struggle in reading, it may be even more challenging to provide *sufficient amounts of instruction, in small enough groups* to accelerate their development.

For older students with severe reading disability, assistive technology in the form of devices that decode print may be helpful in allowing them to acquire information from content classes such as social studies and science. It is important to continue to work to improve their functional reading skills, yet it does not make sense to allow a severe bottleneck in reading to preclude maximal acquisition of the knowledge about the world that is required to be an independent participant in society.

CONCLUSION

Scientific research has contributed substantially to our understanding of dyslexia and other forms of reading difficulty over the past 40 years. We now have a widely agreed upon definition, and we also have assessments that can accurately identify children with dyslexia as early as kindergarten. We also understand many of the instructional conditions that must be in place to prevent the emergence of the early word-level reading difficulties that are characteristic of students with dyslexia.

Further, we have demonstrations from successful schools and districts that illustrate ways to provide these conditions on a large scale. We also have research-based knowledge about the conditions required to accelerate the development of reading skills in older students with dyslexia, although the nature and duration of instruction required to "normalize" the reading ability of these students is not currently known. We clearly have enough knowledge about "what works" for these children to apply it on a large scale.
The most pressing problems at present are related to the twin challenges of implementing high-quality initial reading instruction in every classroom and identifying the resources and personnel to provide intensive reading interventions for all students that need them in schools. Within this broad set of challenges, a shortage of highly skilled intervention specialists and a lack of financial resources to support the additional instructional time and smaller instructional groups required by many students may be the most difficult.

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Are Specific Language Impairment and Dyslexia Distinct Disorders?

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Purpose: *The purpose of this study was to determine whether specific language impairment (SLI) and dyslexia are distinct developmental disorders.*

Method: *Study 1 investigated the overlap between SLI identified in kindergarten and dyslexia identified in 2nd, 4th, or 8th grades in a representative sample of 527 children. Study 2 examined phonological processing in a subsample of participants, including 21 children with dyslexia only, 43 children with SLI only, 18 children with SLI and dyslexia, and 165 children with typical language/reading development. Measures of phonological awareness and nonword repetition were considered.*

Results: *Study 1 showed limited but statistically significant overlap between SLI and dyslexia. Study 2 found that children with dyslexia or a combination of dyslexia and SLI performed significantly less well on measures of phonological processing than did children with SLI only and those with typical development. Children with SLI only showed only mild deficits in phonological processing compared with typical children. Conclusions: These results support the view that SLI and dyslexia are distinct but potentially comorbid developmental language disorders. A deficit in phonological processing is closely associated with dyslexia but not with SLI when it occurs in the absence of dyslexia.*

KEY WORDS: specific language impairment, dyslexia, phonological processing, phonological awareness, nonword repetition

In recent years, there has been considerable interest in the relationship between developmental disorders of oral and written language (Bishop & Snowling, 2004; Catts & Kamhi, 2005). The most widely investigated developmental written language disorder is dyslexia, which is characterized by a significant deficit in printed word recognition in the face of adequate instruction and general cognitive abilities (Lyon, Shaywitz, & Shaywitz, 2003). Research has shown that a phonological processing deficit underlies word-reading difficulties in many children with dyslexia (Fletcher et al., 1994; Gillon, 2004). In the case of oral language, the most frequently studied developmental disorder is specific language impairment (SLI). Children with SLI exhibit deficits in semantics, syntax, and discourse in the presence of normal non-verbal cognitive abilities (Leonard, 1998; Tager-Flusberg & Cooper, 1999).

At first glance, it would seem that SLI and dyslexia are two distinct developmental language disorders; SLI primarily represented by difficulties in semantics, syntax, and discourse, and dyslexia characterized by problems in phonological processing and word reading. However, recent findings suggest there may be a closer association between these developmental language disorders. Children with dyslexia have been shown to have early deficits in semantics and syntax (Gallagher, Frith, & Snowling, 2000; P. Lyytinen, Poikkeus, Laakso, Eklund, & Lyytinen, 2001; Scarborough, 1990, 1991; Snowling, Gallagher, & Frith, 2003), and children with SLI have often been noted to have phonological processing deficits and subsequent problems in word recognition (Catts, 1993; Snowling, Bishop, & Stothard, 2000). These findings have led some to conclude that dyslexia and SLI represent variants of the same developmental language disorder (Kamhi & Catts, 1986; Tallal, Allard, Miller, & Curtiss, 1997). However, in a recent review of behavioral, neurological, and genetic evidence, Bishop and Snowling (2004) concluded that SLI and dyslexia are best treated as two different but overlapping developmental disorders. In this article, we present the results from a longitudinal study that provide further evidence for a distinction between SLI and dyslexia.

DYSLEXIA

According to the International Dyslexia Association (IDA), dyslexia is a specific learning disability characterized by difficulties with accurate and/or fluent word recognition and spelling (Lyon et al., 2003). The IDA definition further proposes that these difficulties typically result from a deficit in the phonological component of language and are unexpected in relation to age and other cognitive and academic abilities. The phonological difficulty most often associated with dyslexia is a deficit in phonological awareness, one's sensitivity to, or explicit awareness of, the sound structure of language (Stanovich, 1988). It is generally argued that problems in phonological awareness make it difficult for children with dyslexia to learn how to apply the alphabetic principle to decode and spell printed words (Gillon, 2004). Numerous studies have documented a deficit in phonological awareness in children with dyslexia or in children at risk for this disorder (Bradley & Bryant, 1983; Gallagher et al., 2000; Fletcher et al., 1994;H. Lyytinen et al., 2001).

The phonological processing problems associated with dyslexia also extend to areas other than phonological awareness. Specifically, children with dyslexia often demonstrate problems in phonological memory (Brady, Shankweiler, & Mann, 1983; Vellutino & Scanlon, 1982). Among the phonological memory tasks with which children with dyslexia have difficulty is the nonword repetition task, in which participants must store and repeat a phonological sequence that could be a word in the language but is not. Research has shown that children with dyslexia consistently perform less well than control participants on nonword repetition tasks (Brady, Poggie, & Rapala, 1989; Catts, 1986; Hulme & Snowling, 1992; Kamhi & Catts, 1986; Snowling, 1981; van Daal & van der Leij, 1999; van der Bob & van der Pijl, 1997). Studies have also demonstrated that heritability for dyslexia is higher when the disorder is combined with a deficit in nonword repetition (Bishop, 2001; Bishop, Adams, & Norbury, 2004; Raskind, Hsu, Berninger, Thomson, & Wijsman, 2000). Finally, research suggests a link between deficits in phonological memory and phonological awareness in that both deficits may result from an inefficiency in the formation of phonological representations (Elbro, 1996; Metsala & Walley, 1998).

Other research indicates that the language problems in dyslexia may go beyond those in phonological processing. Studies show that children with dyslexia may also have problems in semantics, syntax, and discourse (Catts, Fey, Tomblin, & Zhang, 1999; McArthur, Hogben, Edwards, Health, & Mengler, 2000; Plaza, Cohen, & Chevrie-Muller, 2001). For ease of reference, these problems are referred to in this article as oral language difficulties and do not include a phonological processing deficit. Some of these oral language difficulties could be the result of reading problems themselves. Poor readers do not read as much as good readers do, and as a result may not have the same language learning opportunities as do good readers. However, a growing number of studies demonstrate that oral language difficulties are present in children at risk for dyslexia prior to school entry (Gallagher et al., 2000; P. Lyytinen et al., 2001; Scarborough, 1990, 1991). For example, Scarborough (1990, 1991) followed 20 children with a family risk of dyslexia from 30 months through second grade. The at-risk children who later developed dyslexia showed syntactic deficits in terms of reduced mean length of utterance and restricted use of syntactic structures during the preschool years. Whereas these oral language difficulties were present, they were typically not severe enough for children to have been identified as having SLI

(Scarborough & Dobrich, 1990). This has also been the case for other studies that have documented oral language problems in children with a family risk for dyslexia (e.g., Gallagher et al., 2000).

SLI

Specific language impairment represents a disorder in the development of oral language (Leonard, 1998). It is specific in that children with SLI have nonverbal IQ scores within normal limits and no hearing or socio- emotional deficits. The oral language problems observed in SLI include problems in semantics, syntax, and discourse (Paul, 2001). Particular attention has been given to deficits in morpho-syntax (Leonard, 1998). For example, children with SLI have been shown to have problems in the acquisition of tense marking, and this deficit has been posited by some as a psycholinguistic or clinical marker of SLI (Conti-Ramsden, Botting, & Faragher, 2001; Bedore & Leonard, 1998; Rice & Wexler, 1996).

Children with SLI have also been reported to have problems in phonological processing. These include deficits in phonological awareness (Briscoe, Bishop, & Norbury, 2001; Catts, 1993; Joffe, 1998; Nathan, Stackhouse, Goulandris, & Snowling, 2004; Snowling et al., 2000) and phonological memory (Bishop, North, & Donlan, 1996; Briscoe et al., 2001; Dollaghan & Campbell, 1998; Edwards & Lahey, 1998; Ellis Weismer et al., 2000; Gathercole & Baddeley, 1990; Kamhi & Catts, 1986). In fact, considerable attention has been paid to a link between SLI and deficits in phonological memory. Specifically, Gathercole and Baddeley (1990) observed that children with SLI performed poorly on measures of phonological memory, especially nonword repetition. On the basis of their results, they proposed that SLI involves a specific deficit in the phonological loop component of working memory, which causes difficulties in semantic and syntactic development. Furthermore, Bishop et al. (1996) proposed that difficulty in nonword repetition may be a good phenotypic marker for SLI (also see Conti-Ramsden et al., 2001).

Given the problems that children with SLI appear to have in phonological processing, it would be expected that these children would also have difficulties in word reading. Indeed, studies have shown that children with SLI often have problems in learning to recognize printed words (Bishop & Adams, 1990, Catts, 1993; Catts, Fey, Tomblin, & Zhang, 2002; McArthur et al., 2000; Snowling et al., 2000; Tallal, Allard, & Curtiss, 1988). For example, Tallal et al. (1988) found that approximately 67% of children with SLI at 4 years of age showed low achievement in word recognition at age 8. Silva, Williams, and McGee (1987) also reported evidence of low word reading achievement in children with SLI, but at a lower prevalence rate (approximately 35%). In addition, McArthur et al. (2000) found in a series of three studies that approximately 50% of school-age children with SLI concurrently had a specific reading disability characteristic of dyslexia. Snowling et al. (2000) also reported high rates of dyslexia in children with SLI.

RELATIONSHIP BETWEEN DYSLEXIA AND SLI

Given the documented overlap between SLI and dyslexia, what is the best way to characterize the relationship between these disorders? Three possible models of this relationship are depicted in Figure 1. According to Model 1, dyslexia and SLI are different manifestations of the same underlying cognitive deficit (Kamhi & Catts, 1986; Tallal et al., 1997). In this model, a phonological processing deficit is responsible for both disorders. The different manifestations (SLI vs. dyslexia), however, result from variations in the severity of the phonological processing deficit. If the deficit is severe, children will show problems in word reading as well as difficulties in oral language (i.e., SLI). If, on the other hand, the deficit is less severe, children will demonstrate problems in word reading and show limited or no problems in oral language (i.e., dyslexia). If Model 1 is correct, there should be a great deal of overlap between SLI and dyslexia. Children with SLI and those with dyslexia should have problems on tasks involving phonological processing and word reading; however, these problems should be more severe in children with SLI.

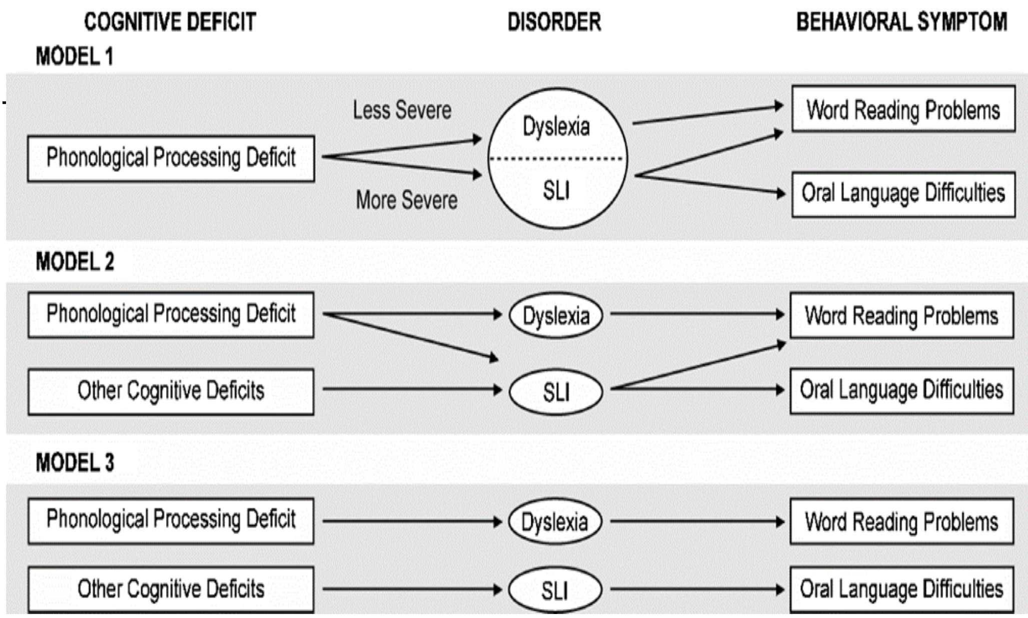

Figure 1. Models of the relationship between specific language impairment (SLI) and dyslexia.

Model 2 indicates that dyslexia and SLI are partially similar but distinct disorders. A model such as this was proposed by Bishop and Snowling (2004) in a recent review of the literature. According to Model 2, both disorders are similar in that they are characterized by a phonological processing deficit that underlies word-reading problems. Unlike Model 1, the severity of the phonological deficit is equal, on average, in dyslexia and SLI. The disorders, however, are different in that SLI involves an additional cognitive deficit or deficits, which operates independently of the phonological processing deficit and causes problems in the development of oral language. If this model is accurate, it would be expected that there would be considerable overlap between dyslexia and SLI in that both disorders would have similar problems in phonological processing and word reading. However, the disorders would be distinct in that children with SLI would have difficulties in oral language, and those with dyslexia would show normal or at least low normal development in this area.

Model 3 depicts a third possible relationship between dyslexia and SLI. According to this model, dyslexia and SLI are distinct developmental disorders with different cognitive deficits and behavioral manifestations. As shown in this model, a phonological processing deficit is the core deficit in dyslexia and is responsible for the word reading problems of children with this condition. Children with SLI, on the other hand, have a different deficit(s) at the core of their disability that causes problems in the development of oral language. Unlike Model 2, in which the overlap results from both disorders showing a deficit in phonological processing, the overlap in Model 3 is due to comorbidity (Caron & Rutter, 1991). That is, although the disorders are distinct, they are related and sometimes occur together in the same individual. If this view is correct, it would be expected that greater-than-chance overlap should be found between SLI and dyslexia. However, numerous cases should be observed of children with SLI who do not have word reading problems (and a phonological processing deficit) and children with dyslexia who do not have a history of oral language difficulties.

In this article we report the results of two studies that sought to determine which of the above models best characterizes the relationship between dyslexia and SLI.[1] In Study 1, we used a large longitudinal database to study the overlap between these developmental disorders. This database included measurements of oral language (and IQ) in kindergarten, second, fourth, and eighth grades and assessments of word recognition in second, fourth, and eighth grades. In our analyses, we examined the percentage of children with SLI in kindergarten

[1] *This study provides evidence concerning the relationship between dyslexia and SLI in English-speaking children. Although these disorders are thought to be constitutional in origin, the nature of the spoken language and/or orthography could influence the specific relationship between them.*

who had dyslexia in second, fourth, and eighth grades. Conversely, we also determined the percentage of children identified as having dyslexia in second, fourth, or eighth grades who showed SLI in kindergarten.

In both of the above cases, SLI was identified during kindergarten. The decision to identify SLI at this point was based on several factors. First, because SLI is characterized by problems in the development of oral language, it has traditionally been diagnosed during the preschool years (Leonard, 1998; Rice & Wexler, 1996). Second, it is preschool problems in oral language that have often been argued to be an early manifestation of dyslexia (Scarborough, 2005; Snowling et al., 2003; Tallal et al., 1997). Third, and perhaps most important, by identifying SLI in kindergarten, prior to formal reading instruction, we reduce the possibility that the oral language impairments associated with SLI are the result of dyslexia rather than an early manifestation of the disorder.

As noted above, children with dyslexia read less often and thus are not as able to take advantage of the language learning opportunities that accompany reading experience (Stanovich, 1986). This may in turn lead to the development of language problems during the school years (Share & Silva, 1987). Thus, by identifying oral language impairments in kindergarten, one can reduce the impact of poor reading on this diagnosis.

STUDY 1: OVERLAP BETWEEN SLI AND DYSLEXIA

METHOD

Participants

Children with SLI and children with dyslexia were selected from a population-based sample of children participating in a longitudinal study of language and reading development. The specific criteria used to select participants with SLI and those with dyslexia are described at the end of the Method section. In this section, the participant sample from which these children were drawn is described. This sample included 527 school-age children. These children originally participated in an epidemiologic study of language impairments in kindergarten children (Tomblin et al., 1997).

The epidemiologic investigation used a stratified cluster sample of 7,218 children. This sample was stratified by residential setting (i.e., rural, urban, suburban) and cluster- sampled by school building. The sample was 33% rural, 37% urban, 30% suburban; 51% male, 49% female; and 83% White, 12.7% African American, and 4% other. All available kindergarten children in selected schools were screened for language impairments using a test of 40 items taken from the Test of Language Development— 2: Primary (TOLD–2:P; Newcomer & Hammill, 1988). These items had been shown to have high sensitivity for the identification of SLI (see Tomblin, Records, &Zhang, 1996). Children who failed the screening, and a random sample who passed, were given a diagnostic test battery of language abilities and other measures. Data from this assessment were used to estimate the prevalence of language impairments in kindergarten children (Tomblin et al., 1997).

On completion of the epidemiologic study, a subsample of children was solicited to participate in a follow-up longitudinal investigation conducted by the Child Language Research Center (Tomblin, Zhang, Weiss, Catts, & Ellis Weismer, 2004). Because the primary purpose of the center is the study of language impairments, all children who displayed these impairments on the kindergarten diagnostic battery were asked to participate. Of the 642 children who met this criterion, permission to participate was received for 328. In addition to these children, a random sample of the children without impairments was recruited.

Permission to participate was obtained for 276 non-impaired children, yielding a total sample of 604 children. These children, segregated by diagnostic category, did not differ significantly in terms of demographic characteristics or language and cognitive abilities from those children who were not asked or did not choose to participate. All children were mono- lingual English speakers and had no history of sensory deficits or neurological disorders. In addition, no child had been diagnosed with autism or mental retardation in the epidemiologic study.

All the above 604 children completed the kindergarten and second-grade test batteries. Thirty-four children were lost to attrition by fourth grade and another 43 were lost by eighth grade. The latter 77 children did not differ significantly in language or nonverbal cognitive abilities from the remaining 527 children; however, the children who remained in the study throughout the project had significantly higher reading achievement in second grade than those who dropped out. This difference in reading achievement could have influenced the estimate of the prevalence of dyslexia in participants with SLI; however, analyses showed no evidence of such influence.

Children with SLI from the sample of 604 (N = 123) had rates of dyslexia in second grade (the only grade in which rates were available for both groups) almost identical to those of the subset of children with SLI who remained in the study through eighth grade (N = 106). Therefore, to better allow for comparisons across grades, children with SLI (and/or dyslexia) were drawn from the 527 children who completed testing through eighth grade.

MATERIALS

Language. In kindergarten, language abilities were assessed by five subtests of the TOLD-2:P (Newcomer & Hammill, 1988) and a narrative story task (Culatta, Page, & Ellis, 1983). Local norms were used to convert raw scores to z scores. These norms were based on data from 1,502 children who received the kindergarten test battery in the epidemiologic study. The z scores from the TOLD -2:P Picture Identification and Oral Vocabulary subtests were combined to form a vocabulary composite score. The z scores from the TOLD-2:P Grammatic Understanding, Grammatic Completion, and Sentence Imitation subtests were used to form a grammar composite score, whereas z scores from the comprehension and recall portions of the narrative task were used as a narrative composite score. To derive a receptive language composite score, z scores from the Picture Identification, Grammatic Understanding, and narrative comprehension tasks were combined. To obtain an expressive language composite score, z scores from the Oral Vocabulary, Grammatic Completion, Sentence Imitation, and narrative recall tasks were used. An overall language composite score was also calculated using the expressive and receptive language composite scores.

Intelligence. The criteria we used to identify SLI and dyslexia required estimates of nonverbal and Full Scale IQ. As part of the diagnostic battery in kindergarten, children were administered the Block Design and Picture Completion subtests of the Wechsler Pre- school and Primary Scale of Intelligence—Revised (Wechsler, 1989). These subtests were combined to form a composite measure of nonverbal IQ (Bishop & Adams, 1990; LoBello, 1991). Nonverbal IQ was assessed again in second and eighth grades. In second grade, the full Performance scale of the Wechsler Intelligence Scale for Children—III (Wechsler, 1991) was administered. In eighth grade, the Block Design and Picture Completion subtests from the Wechsler Intelligence Scale for Children—III were given.

Full Scale IQ was also estimated in second, fourth, and eighth grades. At each of these grades, the Peabody Picture Vocabulary Test—Revised (PPVT-R; Dunn & Dunn, 1981) served as an index of verbal intelligence. Scores on the PPVT-R were combined with those on tests of nonverbal IQ to form a composite z score to estimate Full Scale IQ at each grade. Because no measure of nonverbal IQ was available in fourth grade, we combined children's scores on the second grade measure of nonverbal IQ with that on the fourth grade PPVT-R to create an estimate of Full Scale IQ for fourth grade.

Word recognition. The Word Identification and Word Attack subtests of the Woodcock Reading Mastery Tests—Revised (Woodcock, 1987) were administered in second, fourth, and eighth grades. The Word Identification subtest measured participants' ability to accurately pronounce printed English words ranging from high to low frequency of occurrence. The Word Attack subtest assessed participants' ability to read pronounceable nonwords varying in complexity. To form a composite score for word recognition, the standard scores for these subtests were converted to z scores and combined to form a composite z score.

CRITERIA FOR SLI

The criteria we used for SLI were used in the original epidemiologic study (Tomblin et al., 1996). These criteria were developed to be consistent with research findings in child language disorders and to have high sensitivity and specificity when compared to clinical judgments of SLI. The criteria are also similar to those used by many others to identify the disorder (Paul, 2001; Silva, 1980). Our approach is based on a model of language that includes three domains of language (vocabulary, grammar, and narration) and two modalities (receptive and expressive). A composite score is calculated for each domain and modality of language. Children are identified as having a language impairment if their performance on at least two of five language composite z scores fall below –1.25 SD (approximately the 10th percentile based on local norms). This criterion is approximately equal to having an overall language composite z score of below –1.14 SD (Tomblin et al., 1996). Furthermore, children are considered to have a "specific" language impairment (SLI) if they also demonstrate normal or above-normal nonverbal IQ (>–1 SD) and normal sensory and socioemotional development (Stark & Tallal, 1981).

Data from the kindergarten diagnostic battery were used to identify children with SLI. When the above criteria were applied to these data, 106 of the 527 children in the sample were identified as having SLI. These children had a mean language composite standard score (based on local norms) of 76.9 (SD = 5.4) and a mean nonverbal IQ standard score of 99.4 (SD = 8.6) in kindergarten.

CRITERIA FOR DYSLEXIA

We used multiple sets of criteria for dyslexia to capture the variability in the way the disorder has been defined. Our most liberal definition of dyslexia required low achievement in word recognition ability alone (Siegel, 1989). This was referred to as the low-achievement definition. We operationalized low achievement as performance of at least 1 SD below the mean on the composite measure of word recognition. This cutoff value is consistent with that frequently used by other researchers in the study of reading problems in young children (McArthur et al., 2000; Meyer, Wood, Hart, & Felton, 1998; Snowling et al., 2003) and represents a compromise criterion level compared with that found in more liberal definitions (25th percentile; Fletcher et al., 1994; Stanovich & Siegel, 1994) or in more conservative definitions of reading disabilities (1.5 SD; Badian, McAnulty, Duffy, & Als, 1990). It is also comparable to the severity level of the overall language composite score reflected in our criteria for SLI.

Whereas dyslexia has occasionally been defined on the basis of low achievement alone, most traditional definitions require that low achievement occur in the presence of normal intelligence (Vellutino, Scanlon, & Lyon, 2000; Wimmer, Mayringer, & Landerl, 2000) or that a significant discrepancy exist between reading level and intelligence (Frankenberger & Fronzaglio, 1991; Rutter & Yule, 1975; B. A. Shaywitz, Fletcher, Holahan, & Shaywitz, 1993). Therefore, we used several definitions that referenced intelligence. First, in the IQ-cutoff definition, children were considered to have dyslexia if they had low achievement in word reading (G –1 SD) and scored above a cutoff value (–1 SD) in their measured intelligence. Separate analyses were undertaken using either estimates of Full Scale IQ or nonverbal IQ as the index for intelligence. Whereas Full Scale IQ is most often used in defining dyslexia (Pennington, Gilger, Olson, & DeFries, 1992; S. E. Shaywitz, Shaywitz, Fletcher, & Escobar, 1990), a few researchers have used nonverbal IQ in studies of the reading outcomes of children with SLI (e.g., Bishop & Adams, 1990). The latter approach, although less common, reduces the role of verbal intelligence in identifying dyslexia and therefore might be expected to lead to more children with a history of SLI being identified as having dyslexia than if Full Scale IQ is used.

Second, we used an IQ–achievement discrepancy definition. The IQ-cutoff definition assures that children with dyslexia have normal intelligence but does not always result in a significant discrepancy between reading ability and intelligence. To address this issue, it is common to use an IQ–achievement discrepancy approach, especially one that controls for the correlation between reading and intelligence (Snowling et al., 2000). In this approach, children are identified as having dyslexia if their achievement level is significantly below that predicted by their intelligence. In operationalizing this approach, we used regression equations based on data from the entire sample.

Estimates of Full Scale IQ and nonverbal IQ were each used to predict word recognition scores. Participants were identified as having dyslexia if their actual word recognition score was more than 1 SD below their predicted word recognition score. Finally, we also calculated prevalence rates for dyslexia using criteria that required that children not only show the above discrepancy but also have low achievement in word recognition. Such an approach has been suggested in order to eliminate children from the category of dyslexia who have normal word recognition, but at a level significantly below that predicted by their intelligence (Dykman & Ackerman, 1992).

RESULTS

In the first set of analyses, we examined the prevalence of dyslexia in second, fourth, and eighth grades among children with SLI in kindergarten. The percentages of children with SLI in kindergarten who met the various criteria for dyslexia at each grade are shown in Table 1. These results indicated that approximately one third of the children with SLI had low achievement in word recognition in second, fourth, and eighth grades; however, only about 19% to 21% of the children met the low achievement plus Full Scale IQ-cutoff criteria for dyslexia.

As expected, slightly higher prevalence rates (25%–26%) were found when nonverbal IQ rather than Full Scale IQ was used as the IQ-cutoff criterion. The prevalence rates and the difference between estimated Full Scale IQ and nonverbal IQ-based criteria were essentially the same when the regression-based IQ- discrepancy criteria were used. In addition, similar results were observed when the requirement of low achievement was added to the regression-based IQ-discrepancy criteria. The latter finding indicates that there were very few children with SLI who had reading achievement significantly below that predicted by IQ but still in the normal range.

Given the relatively low rate of dyslexia among children with SLI, it is important to ask if this rate is higher than the base rate of the disorder in the general population. Our calculations showed that the base rate of dyslexia (using the Full Scale IQ-discrepancy and low achievement criterion in fourth grade) in our sample of 527 children was 8.6%. A two-sample binomial test demonstrated that the observed prevalence of dyslexia among children with SLI (17%) was significantly higher than this base rate ($z = 3.1$, $p = .002$). Also, when similar criteria involving nonverbal IQ are used, the observed rate of dyslexia in children with SLI (24.5%) was significantly higher than the base rate of this condition in our population (9.7%; $z = 4.1$, p G .001). Results were similar when we compared rates based on dyslexia in second and eighth grades.

In a second set of analyses, we examined the relationship between SLI and dyslexia from the opposite perspective; that is, we determined the percentage of children with dyslexia in second, fourth, and eighth grades who met the criteria for SLI in kindergarten. For this analysis, we used the regression-based IQ-discrepancy plus low achievement criteria. Estimates of Full Scale and nonverbal IQ were used in separate calculations. Using criteria involving Full Scale IQ, we identified from our sample of 527 participants 72 children with dyslexia in second grade, 74 in fourth grade, and 68 in eighth grade. Using nonverbal IQ, we identified 85 children with dyslexia in second grade, 89 in fourth grade, and 75 in eighth grade. For each method, there was considerable overlap in those

Table 1. Percentages of children with specific language impairment in kindergarten (N = 106) who met various criteria for dyslexia.

Criteria	2nd Grade	4th Grade	8th Grade
Low achievement	33.0	31.1	35.8
Low achievement + IQ cut-off			
Full Scale IQ	18.9	19.8	20.8
Nonverbal IQ	26.4	25.5	26.4
IQ Discrepancy			
Full Scale IQ	17.9	17.0	18.8
Nonverbal IQ	25.5	27.4	29.2
IQ discrepancy + low achievement			
Full Scale IQ	17.9	17.0	17.9
Nonverbal IQ	24.5	24.5	28.3

Note. An estimate of Full Scale IQ was used that included the Peabody Picture Vocabulary Test—Revised as a measure of Verbal IQ.

children identified with dyslexia across grades. Approximately 70% to 75% of the children identified as having dyslexia at a given grade also met the criteria for dyslexia in at least one of the other grades.

To calculate the percentage of children with dyslexia who had SLI in kindergarten, we used weighted scores. Such a procedure was necessary to reduce the bias that is introduced by the fact that the sample from which we identified children with dyslexia (N = 527) had a higher percentage of children with SLI in kindergarten than would be found in the general population. This bias could lead to an overestimation of the prevalence of SLI in children with dyslexia.

To reduce this bias, we determined how likely it was that a child in our sample of 527 children with his or her gender, language, and nonverbal profile would have participated in the representative sample seen in the epidemiologic study. Then, each child's scores were weighted accordingly. In other words, although our sample contained more children with language impairments than would be found in a representative sample, the scores of these children were given proportionally less weighting to assure the representativeness of the results.[2]

Our analyses showed that a relatively small percentage of children identified with dyslexia in second, fourth, or eighth grades met the criteria for SLI in kindergarten. The data in Table 2 show that 14.8% to 16.5% of the children with dyslexia based on estimated Full Scale IQ discrepancy (and low achievement) had SLI in kindergarten. A slightly higher, but still low, rate (19%) was observed when dyslexia was based on nonverbal IQ-discrepancy and low achievement criteria. We again examined whether these prevalence rates were significantly higher than would be expected, given the base rate of SLI in our sample. A series of two-sample binomial tests showed that the observed rates of SLI in children with dyslexia based on estimated Full Scale IQ discrepancy plus low achievement were significantly higher than the base rate of the disorder in second and eighth grades (zs = 2.0 and 2.2, p G .05).

The difference between the observed rate and base rate at fourth grade approached but did not reach statistical significance (z = 1.9, p = .057). Significant differences were found between the observed rates and base rates at all three grades when the nonverbal IQ-discrepancy plus low achievement criteria for dyslexia were used (zs = 2.9–3.1, p G .005).

Table 2. Percentage of children with dyslexia in second, fourth, and eighth grades (based on IQ discrepancy and low achievement criteria) who had specific language impairment in kindergarten.

Discrepancy	2nd Grade	4th Grade	8th Grade
Full Scale IQ	15.4	14.8	16.5
Nonverbal IQ	19.4	19.1	19.3

Note. *An estimate of Full Scale IQ was used that included the Peabody Picture Vocabulary*

2 For example, the epidemiologic study estimated that boys with SLI (no nonverbal deficits) compose 3.9% of the general population. In our sample, however, these children composed 12.1%. To assure that the children from this group did not contribute disproportionately to our results, we adjusted their scores by weighting them by a constant that was equal to the expected prevalence of these children (3.9%) divided by their actual prevalence in our sample (12.1%; constant = .322).

DISCUSSION

These results demonstrate a somewhat limited but statistically significant overlap between dyslexia and SLI. About one third of children with SLI in kindergarten met the most liberal criteria for dyslexia in later grades. If more conservative (and more widely used) criteria involving reference to IQ were used, fewer children with SLI could be identified as having dyslexia. These data showed that 17% to 29% of children with SLI in kindergarten met IQ-referenced definitions of dyslexia in the school grades. A slightly higher rate of dyslexia was found when nonverbal IQ was used as a benchmark than when estimated Full Scale IQ was used. Again, this difference was expected because children with SLI generally have lower verbal than nonverbal IQs and thus should show less of an IQ–achievement discrepancy when an estimate of verbal IQ is included in the IQ benchmark.

The prevalence rates of dyslexia in children with SLI that we observed are lower than those found in many other studies (e.g., McArthur et al., 2000; Snowling et al., 2000; Tallal et al., 1988). Various differences between our study and those of others could account for this discrepancy. One primary difference concerns the way participants were recruited. We used a quasi-random approach to select children from a representative population- based sample. Most other studies in this area have used convenience sampling techniques to select participants largely from clinical populations (e.g., McArthur et al., 2000; Snowling et al., 2000). Whereas the latter procedures are common in clinical research, they often result in the recruitment of participants with more severe disorders and concomitant conditions than participants who are obtained through population-based sampling (Berkson, 1946). Thus, in the case of studies of SLI, this procedure could lead to the inclusion of children with more severe language impairments and a higher incidence of dyslexia than in the present investigation.

One other investigation has used a population-based sampling procedure like ours and reported data on the reading outcomes of children with SLI. In this study, Silva et al. (1987) identified children with SLI (at or below the 5th percentile on tests of language) from a population of approximately 1,000 three-year-olds. When these children were seen at ages 7, 9, and 11 years, 44.1%, 30.4%, and 30.6%, respectively, were found to show low achievement in word recognition. No data were provided concerning the proportion of the children that met IQ-referenced criteria for dyslexia. Nevertheless, the rates of low achievement that they report are comparable to those observed in the present study.

There is at least one other important difference between our study and some other investigations. In the present study, we examined the incidence of dyslexia during the elementary and middle school grades in children identified as having SLI in kindergarten. In the studies reported by McArthur et al. (2000), SLI and dyslexia were identified concurrently during the early elementary school grades. As such, the language problems observed in these studies could have been influenced in part by poor reading achievement, which in turn could have led to a higher overlap of the disorders. We chose to identify SLI prior to reading instruction to limit the impact that a reading disability could have on the development of language problems.

Besides examining the prevalence of dyslexia in children with SLI, we also looked retrospectively at the prevalence of SLI in children identified as having dyslexia. Our results indicated that only approximately 15– 20% of children identified with dyslexia (in second, fourth, or eighth grades) met the criteria for SLI in kindergarten. Such a prevalence rate is lower than that reported by some investigators. Specifically, McArthur et al. (2000) found in a series of four studies that an average of 55% of children with dyslexia also had significant oral language impairments (met criteria for SLI similar to ours). Again, this higher rate is likely influenced by the way participants were recruited. Children with dyslexia in the studies reported by McArthur et al. (2000) were selected by convenience sampling from clinical populations. Such a procedure could have led to participants with more severe reading problems and a higher rate of SLI.

McArthur et al.'s (2000) studies also used concurrent identification of dyslexia and SLI in school-age children. As noted above, such a design could result in a higher degree of overlap between SLI and dyslexia than was found in our study. This conclusion is supported by other studies that have used a design like ours, in which language problems have been observed during preschool prior to the emergence of reading disabilities (Gallagher et al., 2000; P. Lyytinen et al., 2001; Scarborough, 1990, 1991; Snowling et al., 2003). These studies identified children who were at high risk for dyslexia on the basis of a family history of reading disabilities. Results showed that at-risk children who later developed dyslexia often had oral language problems during the preschool years. These problems, however, tended to be rather mild and sometimes disappeared by school entry (Scarborough, 1990; Gallagher et al., 2000). Seldom were language problems severe enough for the children to be diagnosed as having SLI. For example, Gallagher et al. (2000) reported that only 9 of 63 (14%) at-risk children performed at least 1 SD below the mean in language abilities (no information was provided concerning nonverbal IQ). Whereas some of these at-risk children did not develop dyslexia in the school years, the proportion that had SLI is still quite low and, in fact, no greater than would be expected in the general population given the criteria they used.

Finally, a word of caution is warranted in terms of the implications of Study 1 for clinical/educational practice. Our findings of a limited overlap between SLI and dyslexia should not diminish the importance of oral language deficits in reading disabilities. This limited overlap was observed between two specific and rather narrowly defined clinical categories in children selected from a population-based sample. Children with SLI who are referred for services in the schools or in clinics are likely to have a greater incidence of dyslexia than we observed. In addition, many children with language impairments that co-occur with nonverbal cognitive deficits or are not severe enough to meet our criteria of SLI go on to have word reading problems like those seen in dyslexia. Many others experience significant problems in reading comprehension (Catts et al., 2002). As such, oral language deficits should remain an important early indicator of risk for reading disabilities and should be addressed with appropriate clinical/ educational intervention.

STUDY 2: PHONOLOGICAL PROCESSING IN SLI AND DYSLEXIA

The results from Study 1 showed a statistically significant overlap between SLI and dyslexia. However, this overlap was rather limited. Only a small percentage of children with SLI in kindergarten met the criteria for dyslexia in the school grades and, conversely, only a small percentage of children with dyslexia in the school grades met the criteria for SLI in kindergarten. Given that the overlap between SLI and dyslexia is limited, we are left with the question of how children with these disorders could be characterized by the same deficits in phonological processing. Recall that research has often shown that children with SLI and those with dyslexia have deficits in phonological awareness and phonological memory (Catts, 1993; Fletcher et al., 1994; Kamhi & Catts, 1986; Snowling, 1981).

One possibility for this puzzling set of findings may be that studies of phonological processing have often included heterogeneous samples involving a mix of children, some with both SLI and dyslexia and some with SLI only. Such studies could show differences between the target population and typically developing children when in fact a phonological processing deficit is primarily characteristic of one disorder and not the other. The disorder most likely to be associated with a phonological processing deficit is dyslexia. Recall that such a deficit is thought to be the proximal cause of word reading problems in dyslexia (Lyon et al., 2003). Children with SLI in the absence of dyslexia may not have problems in phonological processing; however, because of the partial overlap (and border- line cases of overlap) of SLI and dyslexia, it is likely that when a group of children with SLI are selected and compared to a group of typically developing children, significant differences might be found in phonological processing. In Study 2, we examined this issue by investigating phonological processing in children identified with SLI only, dyslexia only, both SLI and dyslexia, and neither of the disorders.

METHOD

Participants

The participants in this study were a subsample of those identified with SLI and/or dyslexia in Study 1. Four groups were selected. One subgroup (SLI only) consisted of all children with SLI in kindergarten who had normal reading achievement in fourth grade (word recognition composite score above the 40th percentile; N = 43). A second subgroup (SLI/dyslexia) was composed of all participants who had SLI in kindergarten and who also met the regression-based Full Scale IQ-discrepancy and low achievement criteria (N = 18). A third subgroup (dyslexia only) consisted of all children with dyslexia in fourth grade (same criteria as above) who had normal language in kindergarten (i.e., did not meet the criteria for SLI or a nonspecific language impairment; N = 21). A final subgroup (normal) included all children who had normal language in kindergarten (same criteria as above) and normal reading achievement in fourth grade (i.e., same criterion as above; N = 165). Fourth grade reading achievement was used for participant selection because it represented the intermediate point in our reading achievement data. The criteria for SLI and normal language status were again based on kindergarten language scores for the same reasons discussed in Study 1.

The language and word recognition scores of each of the subgroups are displayed in Table 3. The kindergarten language and fourth grade word recognition composite scores are shown to highlight group differences and similarities, some of which were imposed by subgroup selection criteria, while others were not. Analyses of variance (ANOVAs) indicated subgroup differences in language, $F(3, 243) = 102.7$, p G .01, and word recognition scores, $F(3, 243) =$ 243.1, p G .01. Tukey honestly significant difference tests for unequal Ns demonstrated that the SLI-only and the SLI/dyslexia subgroups had significantly lower language composite scores than the dyslexia-only (p G .01, ds = 0.81 and 0.82, respectively) and normal subgroups (p G .01, d = 1.73). Tukey tests also demonstrated that the dyslexia-only and SLI/dyslexia subgroups had significantly lower word recognition composite scores than the SLI-only (p G .01, ds = 1.94 and 2.41, respectively) and normal subgroups (p G .01, ds = 2.17 and 2.64, respectively).

Both of these sets of differences, of course, are expected on the basis of subgroup selection criterion. Other similarities and differences in group comparisons were not predetermined by participant selection criteria. Group comparisons showed that the SLI-only and SLI/dyslexia subgroups did not differ significantly in their language composite scores ($p > .05$, $d = 0.01$); however,

Table 3. Language and word recognition profiles of Study 2 subgroups.

	SLI only (*n* = 43)		Dyslexia only (*n* = 21)		SLI and dyslexia (*n* = 18)		Normal (*n* = 165)	
	M	SD	M	SD	M	SD	M	SD
Language (K)	77.0	5.6a	90.4	8.1b	76.9	5.9a	106.5	13.2c
Word recognition (4th grade)	105.7	6.1a	75.1	6.4b	67.7	12.1c	109.3	7.9a

Note. Means in the same row that do not share subscripts differ at p G .05 in Tukey honestly significant difference test for unequal Ns. SLI = specific language impairment; K = kindergarten.

the dyslexia only subgroup did have a significantly lower language score than the normal subgroup (p G .001, d = 0.92). In the case of word recognition, the SLI-only and normal control groups did not differ significantly (p > .05, d = 0.23), but a significant difference was observed between the SLI/dyslexia and the dyslexia subgroups (p G .05, d = 0.47).

MATERIALS

The same measures of language, intelligence, and word recognition that were used to identify children with SLI and dyslexia in Study 1 were used to select participants in this study. In addition, measures of phonological awareness and phonological memory were administered to the participants.

Phonological awareness. A syllable/phoneme deletion task was given to participants in kindergarten and second and fourth grades. This task required children to repeat a real word produced via live voice by a trained examiner. The examiner then instructed the participant to say the word again but to delete a designated syllable or phoneme. The kindergarten version included 21 items that required the deletion of the initial syllable or phoneme (Catts, Fey, Zhang, & Tomblin, 2001). In second and fourth grades, 9 additional items were added that required the deletion of a final consonant or member of a final consonant cluster. The score was the total number of items produced correctly.

In eighth grade, a more complex phoneme deletion task, adapted from Gayan and Olson (2003), was administered to participants. It required participants to repeat 46 nonwords individually and then delete a phoneme to derive a real word. The phoneme to be deleted was a singleton consonant or a consonant in a two or three- consonant cluster. Nonwords were presented via headphones and a high-quality audio recorder, and the participants' responses were recorded. The score was the number of items correct or partially correct (partial credit was given for responses that were incorrect but phonetically similar). The scores from both phonological awareness tasks were converted to standard scores based on the weighted means and standard deviations of the entire sample.

Phonological memory. A nonword-repetition task, which was administered in second and eighth grades, served as a measure phonological memory. This task was developed by Dollaghan and Campbell (1998) and consisted of 16 nonwords ranging from one to four syllables in length (four words at each length). Each of the nonwords was composed of early developing phonemes and contained syllables that did not correspond to English lexical items. The latter constraint was imposed to reduce the effects that differences in vocabulary knowledge might have on performance on this task (see Dollaghan & Campbell, 1998). The nonword-repetition task was administered to children via headphones and a high-quality audio recorder, and participants' responses were recorded. These responses were scored in terms of the percentage of consonants produced correctly. Scores were converted to standard scores based on the weighted mean and standard deviation of the available sample at second ($N = 604$) and eighth grades ($N = 527$).

RESULTS

The subgroups' performances on measures of phonological awareness are displayed in Figure 2. Univariate ANOVA procedures were used to examine group differences. Because tests (or items) used to measure phonological awareness varied at some grades, grade level was not evaluated as a repeated measure. The results indicated that there was a significant group difference at each grade, $Fs(3, 243) = 32.4–82.4$, p G .01. In kindergarten, Tukey honestly significant difference tests for unequal Ns showed that only the normal subgroup performed significantly different from the other subgroups (p G .001, ds = 1.03–1.29). In the other grades, both the normal and the SLI-only subgroups scored significantly better than the dyslexia-only and SLI/dyslexia subgroups (p G .001, ds = 1.08–2.09). The normal and SLI-only subgroups differed significantly from each other in second grade (p G .05, $d = 0.48$) but not in the fourth and eighth grades ($p > .05$, ds = 0.13–0.19). The dyslexia-only and SLI/ dyslexia subgroups did not perform significantly different from each other on the phonological awareness tasks at any grade tested ($p > .05$, ds = 0.11–0.44).

Data for the nonword-repetition task are shown in Figure 3. A 4 (group) x 2 (grade) mixed-model ANOVA was used to examine group differences at each grade. This analysis revealed a significant main effect of group, $F(3, 242) = 31.2$, p G .001, and grade, $F(1, 242) = 57.0$, p G .001. The Group x Grade interaction was not significant, $F(3, 242) = 1.2$, $p > .05$. Follow-up tests of group differences (collapsed across grades) indicated the dyslexia-only and SLI/dyslexia subgroups did not differ significantly from each other, $F(1, 242) = 1.0$, $p > .05$, but each did differ significantly from the normal subgroup, Fs(1, 242) = 45.4 and 55.3, p G .001. Results further showed that the SLI-only subgroup performed significantly better than the dyslexia-only subgroup, $F(1, 242) = 13.9$, p G .001, and the SLI/dyslexia subgroup, $F(1, 242) = 21.4$, p G .001, but less well than the normal subgroup, $F(1, 242) = 11.0$, p G .01.

Others have reported that language/reading group differences are most apparent on the nonword-repetition task at longer syllable lengths (Dollaghan & Campbell, 1998). Recall that our nonword-repetition task included 16 items ranging from one to four syllables in length (4 items at each length). To examine the possible interaction between group and syllable length, we ran a 4 (group) x 4 (syllable length) x 2 (grade) mixed-model ANOVA. The results showed a significant Group x Syllable Length interaction, $F(9, 726) = 11.2$, p G .001.

This significant interaction was reflective of group differences at the three- and four-syllable levels that were comparable in nature to those found on the overall measure and few group differences at the one- and two- syllable levels. This pattern was similar at both grades, and thus the three-way interaction failed to reach significance, $F(9, 726) = 1.7$, $p > .05$. Follow-up analyses (p G .01), collapsed across grades, indicated that at the one-syllable length the normal subgroup performed significantly better than the SLI/dyslexia subgroup; no other differences were significant. At the two-syllable length, no significant group differences were observed. Further follow-up testing showed that at both the three- and four-syllable levels the dyslexic-only and SLI/dyslexic subgroups did not differ significantly from each other, but each did differ significantly from the normal and SLI-only subgroups. Finally, we found that at the longer syllable levels the SLI-only subgroup performed significantly differently from the normal subgroup. The latter finding was indicative of the SLI-only subgroup showing mild deficits at the three- and four-syllable levels.

Several sets of post hoc analyses were undertaken to rule out factors that might have influenced subgroup differences in phonological processing. The first involved the dyslexic-only and normal subgroups. Recall that these subgroups

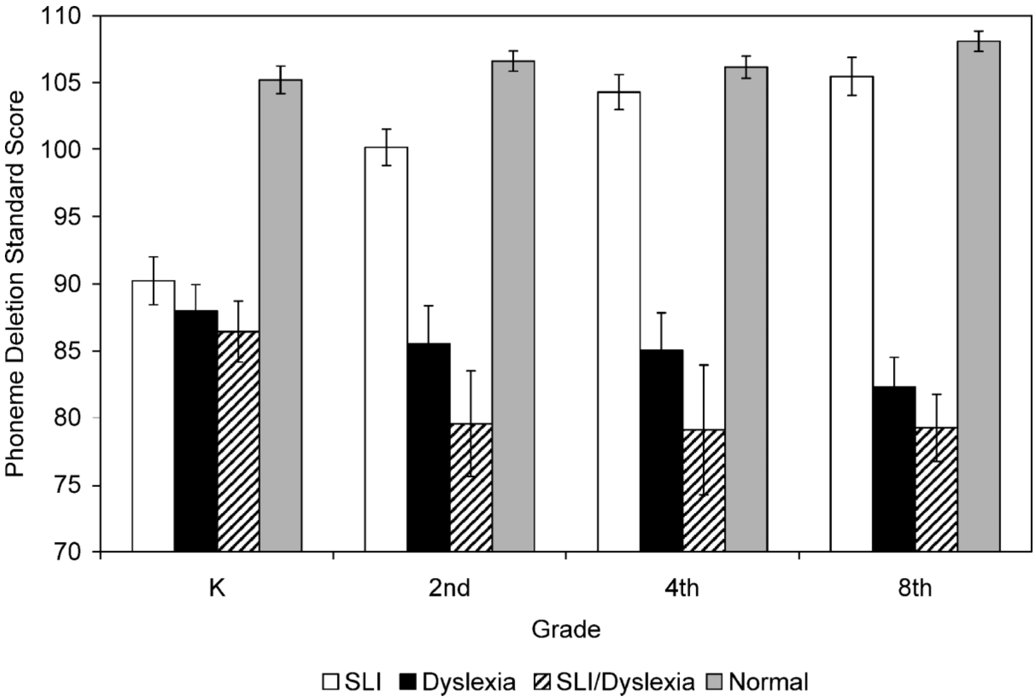

Figure 2. Phonological awareness performance of subgroups in kindergarten and the second, fourth, and eighth grades.

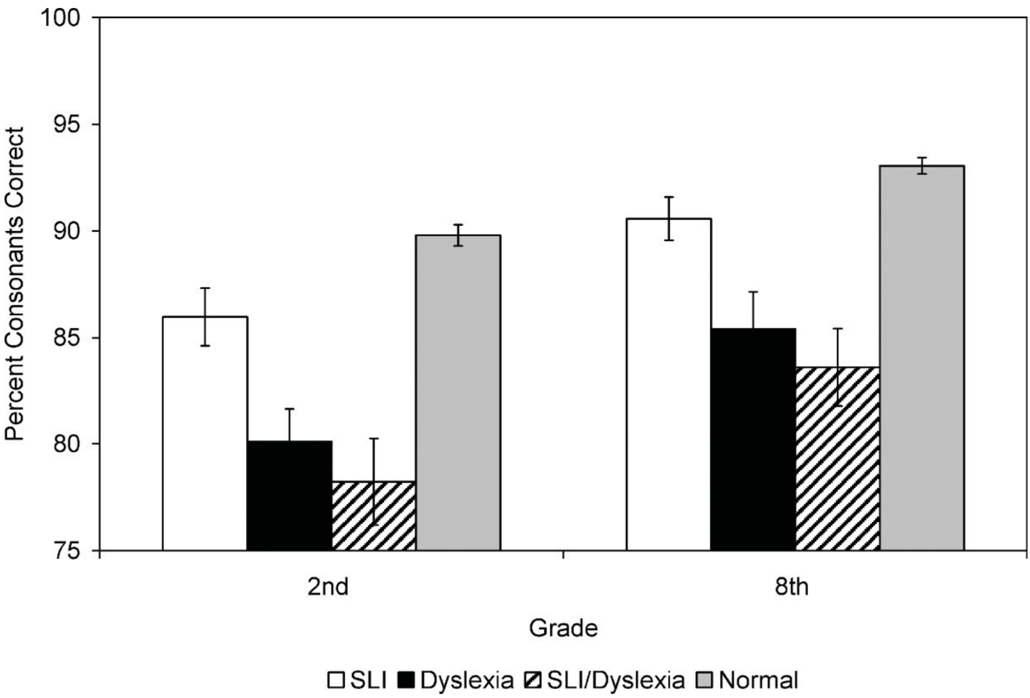

Figure 3. Nonword repetition performance of subgroups in the second and eighth grades.

differed significantly in terms of their mean kindergarten language composite scores. To control for this difference, we used an analysis of covariance (ANCOVA). Our results showed that when the kindergarten language composite score served as a covariate, the dyslexia-only and normal subgroups continued to differ significantly in phonological awareness, Fs(1, 183) = 13.04–60.7, p G .001, and nonword repetition, F(1, 183) = 29.6, p G .001.

In further analyses, we found that the normal subgroup performed higher on measures of IQ than did the other subgroups. The normal subgroup's nonverbal IQ was significantly higher than that of the SLI-only subgroup in second grade (p G .001, d = 0.82), and the normal subgroup's estimated Full Scale IQ was significantly higher than those of the SLI-only (p G .001, d = 1.18) and SLI/dyslexia subgroups (p G .01, d = 1.05) in second grade and those of all three subgroups in the fourth (SLI/dyslexia: p G .01, d = 1.06; SLI only: p G .001, d = 1.21; dyslexia only: p G .05, d = 0.74) and eighth grades (SLI/dyslexia: p G .01, d = 1.11; SLI only: p G .001, d = 0.78; dyslexia only: p G .05, d = 0.74). No significant differences in nonverbal (p > .05, ds = 0.02–0.40) or estimated Full Scale IQ (p > .05, ds = 0.05–0.65) were observed between the other subgroups.

To rule out the influence of IQ in comparisons involving the normal subgroup, we conducted ANCOVAs using fourth grade estimated Full Scale IQ as a covariate. The results of these comparisons were the same as those when no covariate was used, with one exception. The normal and SLI-only subgroups did not differ in nonword repetition in this ANCOVA; however, when a less restrictive measure of nonverbal IQ (either at second or eighth grade) was used as a covariate, these groups differed significantly, as they had in the original analysis.

Another set of post hoc analyses involved comparisons between the SLI-only and SLI/dyslexia subgroups. A primary finding in this study was that these subgroups differed in phonological processing. Given the significance of this finding, it is important to rule out other subgroup differences that may have influenced this result.

As noted above, the SLI-only and SLI/dyslexia subgroups did not differ in IQ. Also, recall that these subgroups did not differ significantly in terms of the severity of their language impairment in kindergarten. Whereas severity of language impairment was free to vary in these groups, they had almost identical mean language composite scores. Further post hoc analyses showed that these subgroups did not differ significantly on any of the language subtests that were used to form the kindergarten language composite score (p > .05, ds= 0.06–0.49). Kindergarten language data were also available on an experimental measure of grammatical tense marking (see Rice, Tomblin, Hoffman, Richman, & Marquis, 2004) for approximately 60% of the participants in these subgroups.

Analysis of these data indicated that the SLI-only and SLI/dyslexia subgroups performed comparably in this aspect of language ($p > .05$, $d = 0.41$).

Additional post hoc analyses indicated that these sub- groups did not differ significantly on language composite scores in second grade ($p > .05$, $d = 0.33$) or fourth grade ($p > .05$, $d = 0.40$). However, in eighth grade the SLI/dyslexia group had a significantly lower language composite score than the SLI-only subgroup (p G .05, $d = 0.72$). This latter difference could represent a difference in constitutional language abilities that was not apparent until a later grade. Alternatively, this difference could be the result of subgroup variation in reading achievement and experience.

Whereas the SLI-only and SLI/dyslexia subgroups did not generally differ in severity of language impairment, further post hoc analyses did suggest that there may have been differences in intervention history. Parents of participants with both SLI and dyslexia more often reported that these children had received clinical services in kindergarten and/or primary grades than had parents of children with SLI only, c2(1, N = 61) = 55.3, p G .001.

This result is not surprising given other research showing that in clinical samples (i.e., those receiving intervention) there is a high overlap between SLI and dyslexia. Last, although we could not rule out differences in environmental influences among sub- groups, we found no significant differences in mother's education between the SLI-only and SLI/dyslexia sub- groups ($p > .05$, $d = 0.33$).

DISCUSSION

In this study, we predicted that a phonological processing deficit would be more closely associated with dyslexia than SLI. Our results were consistent with this prediction. Children with dyslexia only and those with a combination of dyslexia and SLI (i.e., the SLI/dyslexia subgroup) performed poorly on measures of phonological awareness and nonword repetition across the grades. Children with SLI only, on the other hand, did not show significant deficits on measures of phonological processing. This subgroup, however, had lower scores than the normal subgroup on all measures of phonological processing. Although these differences were not statistically significant in all cases, they may indicate that children with SLI only, on average, have a mild deficit in phonological processing.

These various findings are consistent with a large body of research that indicates that a deficit in phonological processing is central to dyslexia (e.g., Fletcher et al., 1994). They are also in line with the most recent IDA definition of dyslexia, which proposes that a deficit in phonological processing lies at the core of the word recognition problems in the disorder (Lyon et al., 2003). Our results, however, appear to be in contrast to those linking SLI with a deficit in phonological processing. This is particularly true for the findings concerning nonword repetition. Recall that many studies have reported that children with SLI have deficits in nonword repetition (Dollaghan & Campbell, 1998; Gathercole & Baddeley, 1990; Kamhi & Catts, 1986). Furthermore, problems in nonword repetition have been argued to be a potential psycholinguistic marker of SLI (Bishop et al., 1996; Conti-Ramsden et al., 2001). Our findings, however, indicate only a weak association, at most, between SLI and problems in nonword repetition.

The discrepancy between our findings and those of others concerning a link between SLI and a deficit in phonological processing can be explained largely on the basis of the comorbidity between SLI and dyslexia. In Study 1, we found that the overlap between SLI and dyslexia was greater than expected given the base rates of the two disorders. This overlap indicates that a portion of children with SLI will also have dyslexia. Furthermore, if this comorbidity involves an overlap of deficits in abilities that are continuously distributed, we might also expect that children with SLI who do not meet the criteria for dyslexia to still be lower, on average, in word reading and phonological processing than children with normal language.

Thus, it seems quite possible that previous studies of SLI and nonword repetition have involved samples of children with SLI that included enough children who also had dyslexia or borderline dyslexic-like problems such that SLI groups, as a whole, would score significantly below that of control groups on nonword repetition. Indeed, in our longitudinal sample, which had rather limited overlap between SLI and dyslexia compared with other studies, the post hoc analysis indicated that when all children with SLI in kindergarten were combined (including those with SLI only, SLI and dyslexia, and those on the borderline of dyslexia; N = 106), they performed significantly below that of typically developing children in nonword repetition. Also, Ellis Weismer et al. (2000) showed that children from our same longitudinal sample who were identified as having SLI in second grade scored significantly less well on the nonword-repetition task than did typically developing children. Thus, in our sample and in others, comorbidity with dyslexia may account in part for why children with SLI, as a group, show poor performance in nonword repetition.

However, further post hoc analyses indicate that such comorbidity may not completely explain these results. These analyses showed that when we compared all children with SLI in kindergarten (N = 106) to all children without language impairment (N = 256) and covaried out differences in word reading, the groups still differed significantly in nonword repetition. This finding suggests that at least a portion of the low nonword- repetition performance of children with SLI results from factors other than comorbidity with dyslexia.

Additional results from our longitudinal database provide further converging evidence related to Study 2. Tomblin et al. (2004) reported that a factor analysis of the language scores of our sample at age 7 showed that performance on phonological awareness and nonword repetition loaded on a different factor than performance on semantic and syntactic tasks. This suggests that some children may have problems in phonological processing and not in semantics and syntax (i.e., dyslexia only), and others may show the reverse pattern (i.e., SLI only).

These findings are also consistent with the results of recent genetics studies. Bishop and colleagues (Adams & Bishop, 2002; Bishop, 2001, 2005), in a twin study of SLI, found high heritability for grammatical morphology and nonword repetition; however, heritability of each of these skills was independent of the other. Furthermore, Bishop and her colleagues reported a greater genetic association (i.e., bivariate heritability) between nonword repetition and dyslexia than between grammatical morphology and dyslexia (Bishop, 2001; Bishop et al., 2004). This latter finding converges well with our results demonstrating a link between deficits in non- word repetition and dyslexia.

Whereas our results appear to be consistent with the above related findings, two issues need further consideration. One issue concerns the age at which we identified children with SLI. Many studies that have examined the relationship between SLI and phonological processing have selected participants on the basis of language performance during the postkindergarten school years (e.g., Dollaghan & Campbell, 1998; Conti- Ramsden et al., 2001). We selected participants on the basis of a kindergarten language assessment (for reasons outlined in the beginning of this article); however, to be consistent with previous studies, we reanalyzed our results using school-age diagnostic criteria. In these analyses, the participants were reclassified into sub- groups using criteria based on second-grade language status and second-grade word reading scores. We also regrouped participants using criteria based on fourth- grade language and fourth-grade word reading scores. The results in both cases were essentially the same.

Children with dyslexia only and those with SLI/dyslexia had significant deficits in phonological processing, whereas those with SLI only had mild problems at most. Thus, it does not appear that the grade at which a language impairment is identified influences the nature of the relationship between SLI and phonological processing.

A second issue concerns the direction of causality between problems in phonological processing and dyslexia. We have argued that our results support the view that a deficit in phonological processing underlies the word reading problems in dyslexia. However, it is possible that at least a portion of the differences in phonological processing observed between participants with dyslexia (i.e., those in the dyslexia-only and SLI/ dyslexia subgroups) and those without (normal and SLI- only subgroup) was a consequence of poor word reading. Indeed, studies have shown that word reading ability itself can influence performance in phonological processing, especially phonological awareness (Hogan, Catts, & Little, 2005; McGuinness, McGuinness, & Donohue, 1995).

Our results showing that the SLI-only subgroup seemed to improve across grades in phonological awareness, whereas the dyslexia-only subgroup declined slightly across grades, could possibly be a reflection of the influence of reading on phonological awareness. Alternatively, this result might indicate that phonological awareness deficits are more specific to children with dyslexia than those with SLI only and, as such, are more stable over time.

GENERAL DISCUSSION

In the beginning of this article, we offered three alternative models concerning the relationship between SLI and dyslexia. Model 1 characterizes SLI and dyslexia as variants of the same developmental language disorder but differing in the severity of the disorder (e.g., Tallal et al., 1997). Model 2 proposes that SLI and dyslexia share a comparable deficit in phonological processing and word reading problems but differ in terms of the presence/absence of oral language deficits (Bishop & Snowling, 2004). Model 3 argues that SLI and dyslexia are distinct but comorbid disorders. The results from the present investigation are more in line with Model 3.

In Study 1, we examined the overlap between SLI and dyslexia. If either Model 1 or 2 is accurate, we should have found considerable overlap between SLI and dyslexia. Both of these proposals contend that children with SLI have problems in phonological processing and subsequent difficulties in word reading. Thus, most children with SLI should also be identified as having dyslexia. This was not the case.

Our results showed a statistically significant, but limited, overlap between SLI and dyslexia. Most children with SLI in kindergarten did not have dyslexia during the school years. This result is more consistent with Model 3. According to this model, most affected children will have either SLI or dyslexia. A small percentage of children, however, can have both disorders as a result of comorbidity. Model 3 is further supported by Study 2. This study showed that whereas dyslexia was associated with significant deficits in phonological processing, SLI alone was generally not.

RELATIONSHIP BETWEEN SLI AND DYSLEXIA

Taken together, the findings from the present investigation support the view that SLI and dyslexia are distinct developmental disorders. According to this view, dyslexia is a developmental language disorder that is characterized by problems in phonological processing and word reading deficits. SLI, on the other hand, is a disorder involving problems in oral language, including deficits in semantics, syntax, and/or discourse processing.

It is unclear from this investigation what factors may underlie SLI. The disorder may result from a specific morpho-syntactic deficit (Rice & Wexler, 1996) and/or from some other perceptual/cognitive impairment (Miller, Kail, Leonard, & Tomblin, 2001; Montgomery, 2000; Tallal, 2003). A problem in phonological processing, however, does not appear to be a major factor in SLI when it occurs in isolation from dyslexia.

Whereas dyslexia and SLI may best be viewed as distinct disorders, they appear to be comorbid in some children. Our results indicated that about twice as many children had both disorders than would be predicted given the base rate of either disorder. In clinical populations, we would expect even more overlap to occur. Children from the latter populations generally have more severe and widespread disorders and thus should more often meet the criteria of both disorders. Indeed, the studies we reviewed that sampled from clinical populations found a high level of overlap between SLI and dyslexia (e.g., McArthur et al., 2000; Tallal et al., 1997). Because the deficits that underlie SLI and dyslexia are likely to involve continuously distributed abilities (Dollaghan, 2004; S. E. Shaywitz, Escobar, Shaywitz, Fletcher, & Makuch, 1992), the comorbidity of the disorders should spread its effects to the borderline of each disorder. As a result, children with SLI alone may show low normal performance in phonological processing and word reading, and children with dyslexia alone may have low normal oral language abilities. However, despite the additional overlap on the borderline of each disorder, there should be many children who meet the criteria for one disorder but are well within normal limits in abilities related to the other disorder.

The fact that SLI and dyslexia are distinct disorders is supported further by a growing body of research on poor comprehenders, that is, children who demonstrate a deficit in reading comprehension despite normal or near-normal word recognition ability. It is estimated that perhaps as many as 5% to 10% of school-age children show this reading problem (Catts, Adlof, & Ellis Weismer, in press; Nation, 2005). Recent research indicates that these children have a wide range of deficits in oral language (Nation, Clarke, Marshall, & Durand, 2004; Nation & Snowling, 1997; Oakhill & Yuill, 1996; Stothard & Hulme, 1995). These deficits, however, are confined to non-phonological aspects of language and do not include problems in phonological awareness and phonological memory. Thus, these children appear to demonstrate the characteristics of children with SLI alone and are quite distinct from those with dyslexia. Indeed, studies have documented that nearly 50% of poor comprehenders have a history of oral language problems that are severe enough (and generally discrepant enough from nonverbal IQ) to meet the criteria of SLI (Catts et al., in press; Nation et al., 2004).

The concept of a poor comprehender is also central to one of the alternative models concerning the relationship between SLI and dyslexia. Specifically, Bishop and Snowling (2004) proposed that SLI and dyslexia typically share deficits in phonological processing and word reading but differ in that SLI is also characterized by significant oral language problems and dyslexia is not (i.e., Model 2). They acknowledged, however, that some children may have significant deficits in oral language abilities but have normal phonological processing abilities. They referred to the latter children as poor comprehenders rather than children with SLI only, as we do. Thus, the primary difference between their proposal and the one we favor is the choice of terminology. However, we believe our proposal is more consistent with traditional practice and current research findings.

The term SLI has traditionally been used to describe children with oral language deficits regardless of the presence or absence of phonological processing deficits (Leonard, 1998). It has also been used to characterize children's oral language development during the preschool years and has not been dependent on reading problems. Our results suggest that at least in a population-based sample there will be many children who meet the criteria for SLI prior to school entrance but who do not have a phonological processing deficit. It would seem more appropriate to refer to these children as having SLI and acknowledge that this condition can exist by itself in some children as well as be comorbid with dyslexia in others. In such a model, the term poor comprehender would be used to refer to children with a history of SLI (as well as those without) who have specific problems in reading comprehension during the school years.

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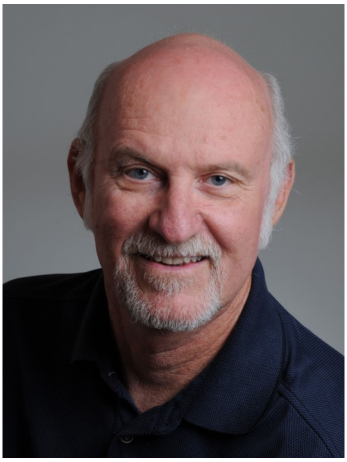

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Dr Catts research interests include the early identification and prevention of language-based reading disabilities. He is currently a investigator on two projects funded by the Institute of Education Sciences. One project involves a five-year longitudinal study that is designed to increase our understanding of the role of language skills in reading comprehension, and knowledge of how to effectively increase reading comprehension through systematic classroom-based instruction. The project involves a consortium of researchers from the Florida State University, University of Kansas, Ohio State University, University of Nebraska, Lancaster University (England) and Arizona State University. In the other project, Dr. Catts and his research team at KU are examining the effectiveness of Response to Intervention as a framework for the identification of kindergarten children at risk for reading disabilities. Both of these projects provide excellent opportunities for student research experience and training.

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The aim of the SES Chinese Programme is to help students with dyslexia become independent, inquisitive learners in the Chinese language.

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Components covered in a typical lesson:

1. Word Recognition
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3. Teaching of Sentence Structures

Comprehension and writing activities are also carried out for students who have good oracy skills in the language.

Application is open only to primary school students. Priority will be given to students who are not exempted from Chinese.

The Impact of Teaching Methods on Learning of Chinese Characters among English-Chinese Bilingual Children with Dyslexia

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It is commonly thought that the use of Hanyu Pinyin (or 'Pinyin') can promote the learning of Chinese characters as it assists learners to pronounce new characters via a sub-lexical route (Dai & Lu, 1985; Huang & Hanley, 1997). However, there are also studies suggesting that presenting a Chinese character with its Pinyin depresses the rate at which the Chinese word can be learned (e.g., Solman & Adepoju, 1995; Solman & Chung, 1996). In view of this, this study aims to explore the impact of Pinyin during instruction on the acquisition of Chinese characters by Primary One students with dyslexia. Employing a single case alternating treatments design methodology, two girls and one boy diagnosed with developmental dyslexia were taught to read Chinese characters using two methods. The Pinyin method of teaching involves the pairing of the Chinese character printed on a card with its respective Pinyin transcription together with the teacher reading the word aloud. The Stroke method of teaching presents the order in which the strokes of the Chinese character are written in Pinyin. All three participants recognized more words when presented with the Stroke method across all sets of words. The implications of these findings to the nature of dyslexia and to the language learning of English-Chinese bilinguals with dyslexia are discussed.

Keywords: bilinguals, teaching Chinese, Pinyin, dyslexia

This study sought to examine the implications of teaching Hanyu Pinyin (which we will refer to as 'Pinyin') on the learning of Chinese Language among English-Chinese bilingual children with dyslexia in Singapore. Reading is the process of understanding speech in its written form, with the purpose of gaining access to meaning. It occupies an important role in education as learning to read is an essential skill that forms the basis for subsequent learning. However, unlike speech, reading is not naturally acquired and it often requires deliberate instruction.

The ease within which single word (or morpheme) reading is learnt varies across languages. Languages with shallow orthographic depth (Frost, Katz, & Bentin, 1987), such as Spanish and Bahasa Melayu, are characterized by relatively straightforward grapheme-phoneme correspondence rules which are easier to acquire. In contrast, languages with deep orthographic depth such as Chinese have relatively little correspondence between the phoneme and its logographic representation. English is an alphabetic language with moderate orthographic depth as its alphabetic script allows the mapping of graphemes upon phonemes on some of its words but not others.

LEARNING TO READ IN ENGLISH AND CHINESE

In research literature studying the reading processes of bilingual children, the contrast between English and Chinese is interesting due to the contrast between the phonology, syntax, and orthography of the two languages (Gottardo, Chiappe, Yan, Siegel, & Gu, 2006). Although English is not considered an orthographically shallow language, the grapheme-phoneme correspondence is more direct than Chinese (e.g., Huang & Hanley, 1997).

The reading of Chinese characters, in contrast, requires a memorization of the logographic representation of a word. For example, 'mother' is represented by the (simplified) Chinese character (or logograph) '妈'. To complement the learning of Chinese characters, Pinyin has been introduced in China and Singapore, so that the word can also be represented using alphabets as 'mā'. The phonology of some Chinese words can be guessed from its phonetic radical, for instance '马' (read Shu & Anderson, 1997 for a fuller discussion) as in the case of '骂' or 'mà' (meaning 'scold') or '马' or 'mǎ' (meaning 'horse').

The rationale for the introduction of Pinyin is based on the assumption that it can promote the learning of Chinese characters via a sub-lexical route requiring less assistance from the teacher (Dai & Lu, 1985; Huang & Hanley, 1997). However, there is also evidence suggesting that the teaching of Chinese vocabulary with a simultaneous presentation of Pinyin depresses the rate at which Chinese words can be learned (e.g., Solman & Adepoju, 1995; Solman & Chung, 1996). The question of how Chinese is best taught remains an issue that is being debated.

There is also evidence suggesting that the processes underlying learning to read in these languages differ. For instance, Huang and Hanley (1994) compared the way in which children learn to read English with how they learn to read Chinese and reported that children learning to read Chinese employed more visual skills than children learning to read English. Likewise, Chen and colleagues (2002) as well as that of Guo, Peng, and Liu (2005) provided evidence for a difference in processing routes in reading Chinese characters and Pinyin. This implies that the process of learning to read in English is different from that of learning to read Chinese characters. Likewise, the reading of Pinyin appears to employ a different set of phonological processes.

DEVELOPMENTAL DYSLEXIA IN ENGLISH AND CHINESE

There is an established understanding that developmental dyslexia among alphabetic scripts is characterized by difficulties in learning to decode print (Vellutino, Fletcher, Snowling, & Scanlon, 2004). Vellutino and colleagues have argued that this phonological impairment is observed even among children with dyslexia who learn a non-alphabetic Chinese script. However, this view is by no means universal as there are also researchers who have proposed that orthographic (Ho, Chan, Lee, Tsang, & Luan, 2004) or morphological (Shu, McBride-Chang, Wu, & Liu, 2006) difficulties underlie Chinese dyslexia.

Consequently, it is likely that children diagnosed with developmental dyslexia in one language can possibly present with different or no difficulties in another language (Bishop & Snowling, 2004). By applying the same logic, developmental dyslexia is expected to have a differential impact upon different written forms of the same language (e.g., Chinese written logographs and Pinyin). This situates Singapore as an ideal location for the examination of this issue.

RESEARCH OBJECTIVES

All children in Singapore, with few exceptions, receive their education in the English medium and learn a second language, which is determined by their ethnic group. As ethnic Chinese children account for the largest group of children in the education system, Chinese is the most common second language learnt in Singapore. As part of the national curriculum for Chinese language, all children learn Pinyin during their first two years of primary education. However, this potentially poses a problem to students who have been diagnosed with developmental dyslexia in English language learning.

This study sought to understand the impact of Pinyin instruction alongside Chinese character instruction among Primary One students diagnosed with developmental dyslexia. It is hypothesized that the learning performance of Chinese characters with the co-presentation of Pinyin will be inferior to a method where only the characters are taught.

METHOD

DESIGN

Single case design was adopted as this design involves repeated measures of participants' results allowing a visual examination of patterns in the dependent variable over time. This controls major threats to internal validity and enhances external validity (Martella, Nelson, & Marchand-Martella, 1999). The complex nature of bilingualism in Singapore makes the grouping of participants difficult as although practically all children in Singapore are bilingual, the relative strength in English and Chinese varies across each child. Given the nature of single case design where each child serves has his or her own control (Kennedy, 2005), it is particularly suited for heterogeneous populations such as the ones in this study. Likewise, the heterogeneity of dyslexia and its associated conditions make comparisons between individuals difficult. Furthermore, the exploratory nature of this study makes an approach examining fewer participants more appealing. More importantly, the alternating treatments design allows the comparison of two teaching approaches in a small group of participants. These two treatments are alternated in rapid succession and changes are plotted on a graph to facilitate comparison (Cooper, Heron & Heward, 2007).

PARTICIPANTS

The three children who participated in this study are Cara, Lina, and Jack (two girls and one boy). They were attending Primary 1 at the point of recruitment and were recruited from the Dyslexia Association of Singapore (DAS) where they were receiving regular intervention (see Table 1). Although diagnostic information was not available, all children who receive support from DAS would have received a diagnosis of dyslexia from a psychologist. None were reported with any speech or hearing impairment or other diagnoses. All participants received between three to 12 months of intervention at DAS. They also come from English-speaking home environments and all were reported to be stronger in the use of English in comparison to Chinese. All participants learn Chinese as their mother tongue and none of them had previously learned foreign languages other than Chinese. In addition, Lina's mother provides extra time to support her in her learning of Chinese.

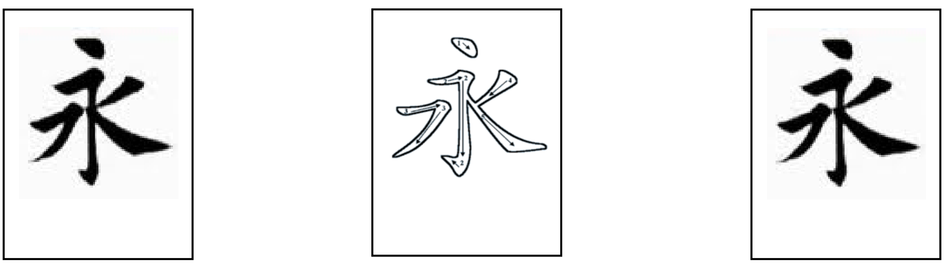
Table 1. Description of Study Participants

Participant	Gender	Chronological Age (in years)	Reading Age (in years)	Months of Remediation at DAS
Cara	Female	6	4	3
Lina	Female	7	5	7
Jack	Male	6	4	12

MATERIALS

The teaching materials employed in this study were developed based on the following procedure. First, a corpus of 100 Chinese characters with between 10 to 12 strokes per character ranging were selected from the Ministry of Education's primary school Chinese Language Syllabus Primary 1 and 2 wordlist. Following that, each participant was asked to recognize each of these characters. Only Chinese characters which were not recognized were adopted as teaching materials and the teaching materials were customized for each participant.

The teaching materials for this study comprised three types of character cards (see Figure 1): (a) cards that presented the Chinese characters and their respective Pinyin transcription (Character Pinyin for Treatment A: Pinyin Condition), (b) Chinese characters and their corresponding sequence of strokes (Character Stroke for Treatment B: Stroke Condition), and (c) cards which were used to elicit recognition of characters (Character Recognition) that consisted of



Character-Pinyin Cards (a) | Character-Stroke Cards (b) | Character-Recognition Cards (c)

Figure 1. Examples of Character Cards used for Teaching

Chinese characters printed on the cards. The grade level and level of complexity varied between sessions but the stroke complexity was held constant between conditions. All character cards were plain white cards 15.2cm x 10.1cm in size.

PROCEDURE

Approval to conduct this study was obtained from the university's Institutional Review Board before this study commenced. After parental consent and child assent was obtained, appointments were made for the participants to be assessed for their Chinese character recognition skills.

The Assessment *Phase* occurred only once before any teaching was conducted. During this phase, participants were tested on a corpus of Chinese characters drawn from the primary school curriculum. Each character was individually presented for five seconds or until a response was provided. Participants were asked to read them or to say "pass" if they did not know the answer. The teacher (the first author) did not provide any feedback on whether the words were read correctly during this phase. The correctly named characters read by the respective participants were excluded and the remaining characters were selected as teaching material for this study. Each participant hence had an individualized set of words that he or she learnt in this study.

This was followed by a *Teaching Phase* which consisted of eight teaching sessions. Each of the eight 20 minute teaching sessions employed either the Pinyin or the Stroke method. These teaching methods were alternated. Each teaching session introduced 10 new words to the participants. Different sets of words are used per session but word complexity (as measured by the number of strokes per character) was held consistent across respective teaching sessions. In the Pinyin Condition (Treatment A), each participant was presented with a character card of a Chinese character with its corresponding Pinyin printed under it. The teacher pointed to the Pinyin and said, "This character is pronounced as ________." The participant was asked to repeat the word, with the teacher underlining the Pinyin with her finger. A correct response was followed by the teacher saying, "Good". When the participant provided an incorrect response, the teacher would provide feedback saying, "Good try, but the character is pronounced as ________". Once the participant was able to repeat the word, the teacher then pointed to the Chinese character saying, "the meaning of ________ is ________". The participant was then asked to repeat the meaning after the experimenter. This method of teaching was repeated for each of the ten characters. In the Stroke Condition (Treatment B), the teacher introduced each word saying "This character is pronounced as _______". As with the previous condition, the participant was asked to repeat it, with the teacher tracing the Chinese character with her finger. The feedback procedure for correct and incorrect responses is similar to that of the Pinyin Condition.

The *Posttest Phase* occurs after each teaching session. The participant was presented with each character was represented with a Character-Recognition card (see Figure 1) for up to ten seconds and was encouraged to read the character on the card. No feedback regarding their responses was given, but the participant was informed of the total number of words they recognized.

RESULTS

The number of words identified correctly is presented on the y-axis for each respective participant in Figures 2 to 4. Each figure presents the learning accuracy for each of the four teaching sessions across the two conditions. The learning performance across each condition is presented as a line and a linear trend is also presented in the figures.

Visual analyses of Figures 2 to 4 reveal several trends. First participants consistently learn more words under the Stroke condition. Next, the trend line for the Stroke method is consistently positive and steeper when compared to the Pinyin method. The replication of these findings clearly across three English-Chinese bilingual children with dyslexia suggests that these children with dyslexia consistently learn better via the Stroke method of teaching.

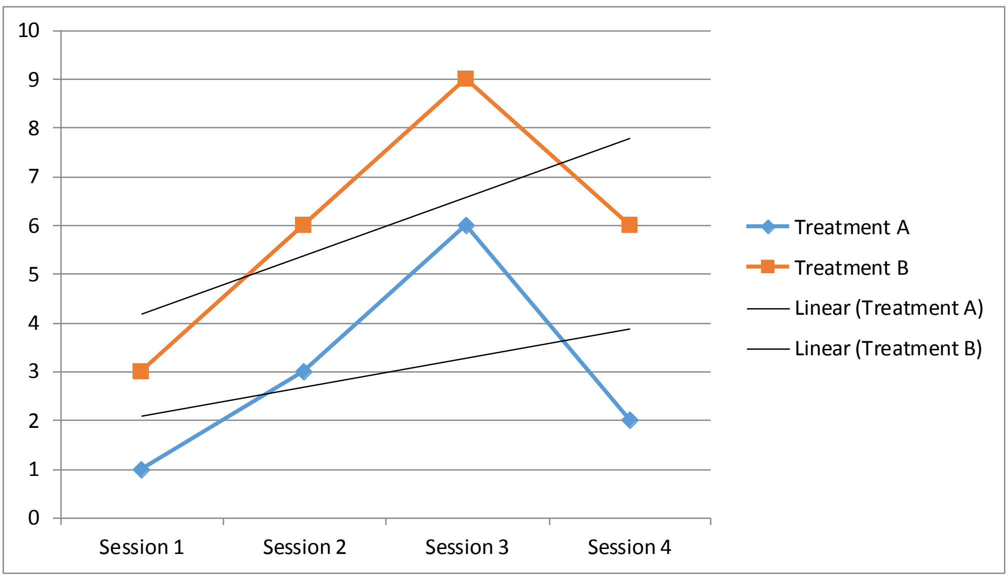


Figure 2. Graphic Representation of Cara's Word Recognition Under Each Condition

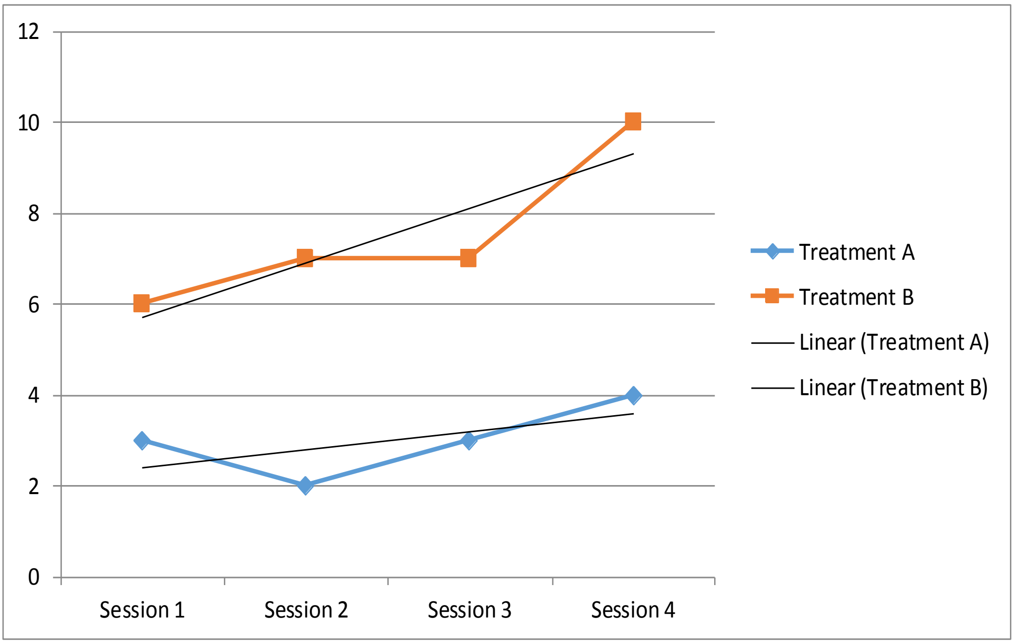


Figure 3. Graphic Representation of Lina's Word recognition Under Each Condition

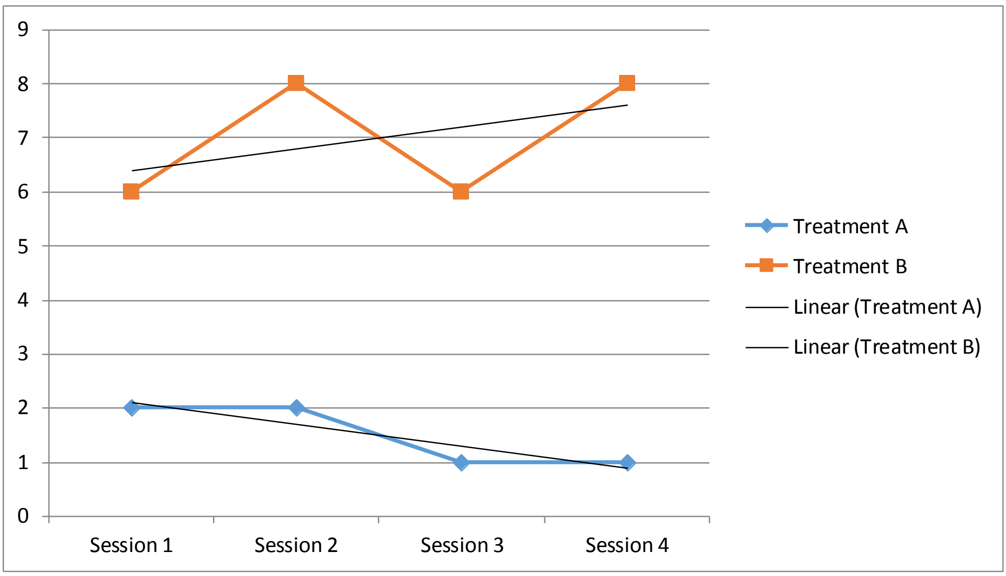


Figure 4. Graphic Representation of Jack's Word Recognition Under Each Condition

DISCUSSION

This study's findings lend support to the suggestion that Pinyin instruction can impede the learning of morphemes in Chinese among English-Chinese bilingual children with dyslexia. Consistent with the findings of earlier studies (Solman & Adepoju, 1995; Solman & Chung, 1996), the learning rate is lowered when a Chinese word is paired with its Pinyin representation. However, there is a second, possible explanation for the findings. It is also possible that the difficulties with phonological processing, consistent with dyslexia in English (c.f., Vellutino, et al., 2004) could have impeded the facilitatory impact of Pinyin. The findings are consistent with the core impairment underlying dyslexia among English learners is phonological processing and that Chinese language, being logographic and orthographically deep, requires not phonological but rather visual processing skills. It is also possible that both accounts could have an additive impact upon the poorer performance across the Pinyin condition. Thus, whilst there is a clear finding of learning was poorer among the Pinyin condition, this study was unable to explain the reasons underlying these findings.

The findings are also consistent with the findings that developmental dyslexia can be language specific such that phonological processing deficits associated with dyslexia of learning alphabetic scripts such as English do not seem to impact upon the learning of reading in scripts of deeper orthography such as Chinese (Shu, et al., 2006). It is therefore important, to be specific about the underlying processes when identifying bilingual learners with dyslexia.

Implications for practice

Reasons aside, these findings point at one important implication – that English-Chinese bilingual children with dyslexia in this study learn Chinese words more poorly when Pinyin is introduced alongside Chinese characters. However, a large part of the Primary 1 Chinese curriculum involves the introduction of Chinese characters alongside Pinyin. This study findings suggest that the introduction of Pinyin for English-Chinese bilingual children with dyslexia might reduce the learning of Chinese word recognition of these children such that they are likely to be disadvantaged in the learning of Chinese. As such, there is a need to examine the pedagogy of introducing Chinese to bilingual children with dyslexia and/or the content of Chinese curriculum. It also has implications for the common practice of accommodations provided to children with dyslexia in Singapore.

Although some children with dyslexia receive an exemption from having to take the Chinese subject, most receive the accommodation after a few years in primary school. The findings of this study suggest that it may be helpful to receive the accommodation earlier or to learn Chinese in a different way.

Limitations and directions for future research

Although this study findings, replicated across all three participants, seem compelling, the small number of participants in this study limits the extent to which the findings may be generalized. As such, the replication of this study with more participants within a quasi-experimental study may help in understanding the extent to which these findings may be generalized.

Moreover, we had earlier indicated that the exact mechanism involved in the poorer learning of the Pinyin method is still unclear. In addition, we made an assumption that the observed difference in learning is indicative of learning difficulties when Pinyin is introduced alongside the characters rather than learning being enhanced by the Stroke method. Future studies comparing the performance of children with dyslexia against that of typically developing children across a variety of tasks comparing learning across methods can shed some light on this.

It is also possible that the Pinyin method of teaching where the presentation of the Pinyin transcription below the Chinese character may have distracted the participant from the task at hand. It may be helpful in exploring the possibility by adding a third condition with the English translation of the word, and a fourth condition with 'XXXX' or 'OOOO' written under the Chinese character.

CONCLUSION

Dyslexia impacts upon learning in many ways. In this study, we highlighted the complexity of this issue within English-Chinese bilingual children learning Chinese Pinyin. Specifically, we highlighted how the difficulties of developmental dyslexia manifest themselves differently in different scripts. However, these findings have also identified many other questions. Do these findings get replicated in different aspects of Chinese Pinyin learning? How can these findings guide the pedagogy of children with dyslexia? These remain to be answered but it is hoped that this study is one step in that direction.

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Behavioural Self-regulation and its Contribution to Reading Among Chinese Poor Readers

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Abstract

This study investigated to which behavioural self-regulation and language skills could discriminate Hong Kong Chinese poor from adequate readers. A total of 78 Chinese first graders with 39 poor readers and 39 adequate readers participated and they were matched on age, parents' education levels and nonverbal intelligence (IQ). The two groups were tested on the measures of behavioral self-regulation (the Head-Toes-Knees-Shoulders; HTKS), vocabulary definition, phonological awareness, morphological construction, rapid digit naming, and sentence comprehension. Results showed that the poor readers performed less well than the adequate readers in all cognitive-linguistic and reading comprehension measures. Among these measures, the HTKS, morphological construction, and rapid digit naming showed the greatest power in discriminating poor and adequate readers. Self-regulation skills accounted for significant amount of unique variance in reading comprehension after controlling for the effects of age and IQ. Together, these findings highlight the potential importance of the process of learning to read in Chinese for shaping one's self-regulation skills.

Keywords: Behavioural self-regulation, phonological awareness, morphological awareness, rapid digit naming, and poor readers

INTRODUCTION

Although most children develop reading proficiency with appropriate education, some individuals may fail to acquire reading skills. Estimates indicate that between 5-10% of the school population may suffer from reading difficulties (e.g., Shaywitz, Shaywitz, Fletcher, Escobar, 1990). Reading acquisition is regarded as a multifaceted process and relies on the development of different cognitive-linguistic skills. Extensive research has investigated deficits in decoding skills, e.g., phonological awareness, letter-sound knowledge, rapid naming that may lead to reading problems (Goswami & Bryant, 1990; Storch & Whitehurst, 2002). More recently, behavioral self-regulation has been put forward as another important skill for reading acquisition (e.g., McClelland, et al., 2014; von Suchodoletz, 2013).

Self-regulation refers to the capacity of individuals to apply cognitive skills like cognitive flexibility (or attention), working memory, and inhibitory control to behavior. However, at the same time, deficits in these skills can be the possible cause of reading difficulties.

So far fewer attempts have been made to examine the relationships between self-regulation and other cognitive-linguistic skills in explaining individual differences in reading given that reading is viewed as the execution and integration of multiple cognitive-linguistic skills (Kendeou & Trevors, 2012; van den Broek & Espin, 2012). This is consistent with the simple view of reading (Gough & Tunmer, 1986; Hoover & Gough, 1990; Shaywitz, 2003) which posits that decoding, e.g. phonological skills, is coupled with a broad range of cognitive-linguistic skills. Thus, the present study is to investigate the contributions of cognitive-linguistic skills: self-regulation, phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming in distinguishing between poor readers and competent readers of Chinese and to examine their contributions to reading comprehension.

SELF-REGULATION SKILLS

Although behavioral self-regulation skills can be viewed as an individual's capability to regulate emotion, cognition, and behavior (Calkins, 2007), these skills are defined as the behavioral manifestation of the integration of cognitive flexibility, working memory, and inhibitory control (Wanless, McClelland, Tominey, & Acock, 2011).

These self-regulation skills, which may stem from executive functioning, have been found to be associated with academic achievement (McClelland, Acock, &

Morrison, 2006; Ponitz, McClelland, Matthews, & Morrison, 2009). For example, previous studies (e.g., Blair & Razza, 2007) have found that the ability to focus attention has a strong influence on children's academic outcomes. Cognitive flexibility often involves processes of shifting attention between sets of tasks or rules without distraction (Diamond, 2006).

Similarly, working memory, which refers to the capacity of an individual to hold and manipulate information over a short period of time (Baddeley, 2000), plays a vital role in the storage of information into long-term memory and the acquisition of reading-related skills. Working memory has been linked to the individual's reading attainment and has been found to make significant contributions to word reading and reading comprehension (Engel de Abreu & Gathercole, 2012; Swanson & Berninger, 1995). Individual differences in inhibitory control also explain variability in academic achievement (e.g., Clark, Pritchard, & Woodward, 2010).

Inhibitory control often includes the ability to focus attention and suppress irrelevant information in order to act appropriately (Diamond, 2006; Moutier, Plagne-Cayeux, Melot, & Houdé, 2006). Given that reading involves multiple cognitive-linguistic skills, self-regulation skills can be considered to be essential for reading acquisition and failure. Indeed, recent studies (e.g., Chung & McBride-Chang, 2011; Peng, Sha, & Beilei, 2013) have found that both components of working memory and inhibitory control uniquely predict reading variability in Chinese. Because Chinese orthography has many different graphic units and orthographic rules, and because thousands of characters and cognitive-linguistic skills are required to be learned (Chung & McBride-Chang, 2011), children may take all their elementary school years to learn and acquire these units, rules, knowledge, and skills to read Chinese. At the same time, however, children who fall behind in their development of self-regulation skills or exhibit poor self-regulation skills, are at greater risk of reading difficulties.

Perhaps poor self-regulation skills are also linked to weaknesses in other previously established cognitive-linguistic skills, namely phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming. This may in turn affect reading performance in poor readers. However, neither the present research on English nor studies on Chinese have examined such self-regulation skills in relation to other previously established cognitive-linguistic skills in explaining reading. Poor self-regulation may be another marker for children with reading difficulties. Thus, the measure of self-regulation skills was included in the present study.

PHONOLOGICAL SKILLS

Phonological awareness, which includes the ability to recognize spoken words, break down the words into sound units, and reflect upon and manipulate these units, has been recognized as an important predictor of children's reading achievement in English and Chinese as it facilitates awareness of the relationship between the sound and the printed word (Gottardo, Stanovich & Siegel, 1996; Muter & Snowling, 1998).

Previous studies concede that phonological awareness is a good predictor of word reading and reading comprehension, and is causally related to reading outcomes (e.g., Blachman, 1997; Muter & Snowling, 1998; Vellutino, Fletcher, Snowling, & Scanlon, 2004). Across a variety of languages, phonological awareness skills tend to develop by advancing from larger units of sound e.g., words and syllables to smaller units of sound e.g., onsets, rimes, and phonemes (Lonigan, Burgess, & Anthony, 2000). Because English differs from Chinese in some broad aspects of phonology, in that grapheme–phoneme mapping is involved in English, whereas whole-character to whole-syllable mapping is stressed in Chinese, syllable and onset–rime level awareness tend to be the most important aspect of phonological awareness in Chinese.

In Chinese, the syllable is the basic phonological unit of speech, and each syllable can represent a morpheme. Most Chinese characters are ideophonetic compounds consisting of a semantic and a phonetic component (or radical). For example, in a character (such as [dang1] 'lamp'), a semantic radical indicates the semantic category (fire) of the character (as one needed fire to light an oil lamp in the olden days), whereas the phonetic radical [dang1] 'climb' signifies the sound cues of the character. Such phonetic information tend to be encoded at the syllable and onset–rime level in Chinese rather than being assembled at the phonemic levels as in English. Therefore, Chinese children with reading problems sometimes manifest difficulties in processing phonological information (Ho, Leung, & Cheung, 2011; McBride-Chang, Tong, Shu, Wong, Leung, & Tardif, 2008c). However, other studies of dyslexia have revealed that deficits in phonological awareness are less prominent in Chinese readers (e.g., Chung, Ho, Chan, Tsang, & Lee, 2010, Ho, Chan, Tsang, & Lee, 2002, Shu, McBride-Chang, Wu, & Liu, 2006).

Therefore, it is necessary to consider further the influence of phonological skills on children's reading ability. In the present study, we included a measure of phonological awareness as these skills could be used to distinguish between the good and poor readers and to predict reading performance.

MORPHOLOGICAL SKILLS

Morphological awareness is another skill that could be used to distinguish between readers of differing ability. Morphological skills include the ability to reflect upon and manipulate morphemes, and apply word formation rules (Carlisle, 1995). Across different languages morphological skills are associated with word reading and reading comprehension in English (e.g., Carlisle, 2000; Deacon & Kirby, 2004; Nagy, Berninger, Abbott, Vaughan, & Vermeulen, 2003; Roman, Kirby, Parrila, Wade-Woolley, & Deacon, 2009) and in Chinese (e.g., McBride-Chang, Shu, Zhou, Wat, & Wagner, 2003; Wang, Yang, & Chen, 2009). Unlike English, Chinese is a morphosyllabic writing system with a rich morphological structure and many words consist of multiple morphemes by combining different morphemes. More than 75 % of Chinese words are formed through lexical compounding, which is an essential way of forming complex words.

Many words may therefore share the same morpheme. For example, 電話/din6 waa2/(tele-phone), 電報/din6 bou3/(tele-graph), 電視/din6 si6/(tele-vision). All of these words sharing the morpheme 電/din6/(tele) are semantically related as indicated by this morpheme. Also, Chinese contains a vast number of syllables that have more than one homophone, and every syllable has a different meaning (e.g., Packard, 2000; Zhou, Zhuang, & Yu, 2002). For instance, the syllable "san" has different meanings, e.g., [san1] 'new' (新), [san1] 'stretch' (伸), [san1] 'body' (身) and [san1] 'hard' (辛). Consequently, the ability to comprehend and use morphologically complex forms may be particularly vital for reading in Chinese.

Indeed, studies on Chinese have found that morphological awareness in the form of lexical compounding is a precursor to reading ability (e.g., Tong, McBride-Chang, Shu, & Wong, 2009) and a reliable discriminator for Chinese children with and without reading difficulties (e.g., McBride-Chang, Lam, Lam, Doo, Wong, & Chow, 2008; Shu et al., 2006). Thus, the present study tested the extent to which morphological awareness could distinguish between the good and poor readers, and predict reading ability.

VOCABULARY KNOWLEDGE

Previous studies have examined the relationship between vocabulary knowledge, particularly the use of oral word definitions and synonyms, and reading acquisition and impairment (e.g. Liu et al., 2010; McBride-Chang & Ho, 2005). For example, research conducted with English readers showed that vocabulary knowledge was a significant correlate of reading performance, and it continued an important predictor after controlling other cognitive-linguistic skills (Landi, 2010; Ouellette, 2006; Ricketts, Nation, & Bishop, 2007; Wise, Sevcil, Morris, Lovett, & Wolf, 2007). A similar association has also been found in Chinese (e.g., Liu et al., 2010; Zhou et al., 2014). Wang, Cheng and Chen (2006) was one of the few studies that investigated oral vocabulary together with phonological awareness, working memory and other reading-related skills. Oral vocabulary was found to be one of the best precursors for word reading in Chinese.

Similarly, studies conducted by Greenberg, Pae, Morris, Calhoon, & Nanda (2009) and Liu et al. (2010) found that many poor readers possess poor vocabulary knowledge and tended to fall behind their typically developing peers in vocabulary development. However, these studies have not usually examined such vocabulary knowledge in relation to other cognitive-linguistic skills in explaining variability in reading. Vocabulary knowledge measure was therefore included in the present study.

RAPID NAMING

Finally, rapid naming is also an important correlate of reading acquisition and impairment across a variety of scripts, including English (Wagner et al., 1997), German (Wimmer, Mayringer, & Landerl, 2000), Dutch (de Jong & van der Leij, 1999) and Chinese (Chung & McBride-Chang, 2011). The most commonly used measure of rapid naming is one in which readers are asked to name a series of stimuli e.g., numbers, letters, colours or objects as quickly as possible. Rapid naming is likely to tap into a number of skills, including phonological processing, involved in accessing and retrieving phonological representations from memory, visual sequencing and symbol processing (e.g., Wagner & Torgesen, 1987; Wolf & Bowers, 1999).

Moreover, as noted in a study by Manis, Seidenberg, and Doi (1999), Chinese character recognition is relatively 'arbitrary' and a rapid naming measure may tap into the ability to learn arbitrary links between print and sound. For example, in the rapid digit naming task, phonological codes can be directly derived from visual input i.e., digits thereby tapping into a highly arbitrary print to sound conversion. Chinese may be a writing system that is particularly strongly associated with a rapid naming measure. Previous studies have consistently shown that rapid naming predicts reading development in Chinese from preschool (Chow, McBride-Chang, & Burgess, 2005), continuing to late childhood (Pan, McBride-Chang, Shu, Liu, Zhang, & Li, 2011). It also predicts dyslexia perhaps because Chinese dyslexic readers tend to be less efficient in the naming process involved in arbitrary print to sound conversion and associated with poor quality of phonological representations of speech sounds and poor articulatory speed (Chung, Ho, Chan, Tsang, & Lee, 2011; Shu, et al., 2006).

Thus, in the present study, we extended our investigation to examine rapid naming in relation to the self-regulation and other cognitive-linguistic skills in order to obtain a fuller picture of the importance of rapid naming for reading performance.

THE PRESENT STUDY

Although the five cognitive-linguistic skills, namely self-regulation, phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming are linked with reading ability, relatively little investigation to date has examined the concurrent influence of multiple skills that may affect reading performance in Chinese readers, particularly in poor readers.

The purpose of this study has been twofold and is conducted in Hong Kong with Chinese speaking children in the first grade of primary school. We tested both for group differences in self-regulation and for associations of the four cognitive-linguistic skills with reading comprehension. The first aim of this study was to examine whether poor readers would display difficulties in self-regulation along with problems in phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming.

It was anticipated that poor readers would perform less well than the competent readers on tests of the five cognitive-linguistic skills. The second aim was also to examine whether self-regulation would make a contribution to reading performance, sentence comprehension independent of phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming. It was expected that self-regulation could explain unique variance in sentence comprehension beyond these other established cognitive-linguistic skills.

METHOD

Participants

The children for the present study came from a sample of 210 Hong Kong Chinese-speaking children recruited for a longitudinal study (112 boys, 98 girls) at age 5. The sample was fairly representative of different locations within Hong

Kong city. In the present study, seventy-eight first grade students were selected based on the standardized Chinese word reading subtest of the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-SpLD); Ho, Chan, Tsang & Lee, 2000). Local norms are available from 6 years 1 month to 10 years 6 months. The reliability coefficients of this subtest range from 0.92 to 0.99 across various age groups. Details of this test are further discussed in the Measures section.

The HKT-SpLD is commonly used to assess Hong Kong primary school children with literacy difficulties. The children were administered this test at around age 7. Thirty-nine children (22 boys and 17 girls) were selected as poor readers who scored at or below the 25th percentile in the Chinese Word Reading test. Another 39 children (16 boys and 23 girls) with average or above performance who scored at or above the 50th percentile in the test were selected as the control group.

In order to control for the possible effects of age, intelligence, and social economic status, the average readers were matched to the poor readers on age, parents' educational level, and nonverbal intelligence (Raven's Standard Progressive Matrices). Fathers' and mothers' education levels were also gathered based on a 7-point scale ranging 1 (lower than third grade), 2 (fourth to sixth grade education), 3 (junior high school), 4 (senior high school), 5 (some college), 6 (college graduate), and 7 (graduate education). Thus, the children in both poor readers and average readers groups did not differ in age or intelligence or parents' educational level (all $Fs<2.83$, all $ps>.05$). No emotional and behavioral problems such as autism or hyperactivity, and uncorrected sensory impairment were reported in either group.

MEASURES

GENERAL INTELLECTUAL ABILITY (IQ)

Raven's Standard Progressive Matrices was used to measure the children's nonverbal reasoning ability. This standardized test consisted of five sets of 12 items with a total of 60 items. For each item, participants were asked to select the best option from six or eight alternatives to fill in the missing part of the target matrix. Scoring was based on the local norm established by the Education Department of the Hong Kong Government in 1986.

WORD READING

The word reading measure was taken from the Chinese Word Reading subtest of the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (HKT-

SpLD) (Ho, Chan, Tsang & Lee, 2000). The HKT-SpLD is a standardized assessment battery developed for Hong Kong primary school children, and items in the Chinese Word Reading task are common two-character words used by Grade 1 to Grade 6 students. The Chinese Word Reading measure consisted of 150 two-character Chinese words arranged in increasing difficulty. In this task, children were asked to read aloud from the beginning of this task and stopped when they failed to read 15 consecutive items. One point was given for each word correctly read. Scoring was based on the established local norm. The reported reliability of this standardized measure among participants with ages ranging from 6 years 1 month to 12 years 6 months was (r = .92 to .99).

BEHAVIORAL SELF-REGULATION

The Head–Toes–Knees–Shoulders task (HTKS) was used to measure behavioral regulation by tapping in on cognitive flexibility, working memory, and inhibitory control (McClelland & Cameron, 2012). This measure was adapted from studies (e.g., Cameron Ponitz et al., 2008; Cameron Ponitz, et al., 2009; Becker, McClelland, Loprinzi, & Trost, 2014) to assess participants' behavioral regulation. A total of 30 test items and 4 practice items was used. There were two forms of the HTKS which includes Form A with two commands: head–toes commands (e.g., "touch your head" and "touch your toes") and Form B with additional commands: knees–shoulders commands (e.g., "touch your shoulders" and "touch your knees"). Form B, therefore consisted of commands to touch all four body parts. In this task, children were asked to perform the opposite of a response to different oral commands. For example, if the experimenters said, "touch your head," the correct response would be for the children to touch their toes.

Children were asked to respond to these commands as fast as they could. During the practice trials, the experimenters modeled the commands with actions, and feedback was also given. Each item was scored with 0 for an incorrect response (e.g., touching his or her head when requested to touch his or her head), 1 for a self-corrected response (e.g., firstly responding incorrectly, but correcting himself or herself), or 2 for a correct response (e.g., touching his or her toes when asked to touch his or her head). T

hus, the total scores ranged from 0 to 60. In order to assess inter-rater reliability, a random sample of children (n = 25) was videotaped whilst being administered the HTKS task. Videotapes were observed and marked by two experimenters who had not administered the HTKS task to the participants. Children's responses were rated by the two experimenters (interrater reliability=0.90), and the Cronbach's alpha of the measure was 0.91.

PHONOLOGICAL AWARENESS

The phonological awareness task was designed similar to the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen & Rashotte, 1999) in that it tapped into different phonological units with increasing difficulty. This measure was used in previous studies (Cheung, Chung, Wong, McBride-Chang, Penney, & Ho, 2010; Chung, McBride-Chang, Cheung, & Wong, 2013). In this task, syllable deletion, onset deletion, and rhyme production were used and were presented orally. For the syllable deletion, there were 15 three-syllable real and 14 pseudoword items.

Children were asked to take away either the first, second or third syllable and say aloud what was left. For example, participants were asked to say /hap6/ /coeng3/ /go1/ (合唱歌) without /hap6/ (合). The correct answer is /coeng3/ /go1/ (唱歌). In the onset deletion, 10 real and 12 pseudo one-syllable words were used. Participants were requested to delete the first consonant of each item and say aloud what was left. For example, say /coi3/ (菜) without the initial sound would be /oi3/ (愛). These stimuli strictly measured onset deletion only, rather than phoneme deletion more globally, because in Cantonese there are no consonant clusters and only few final consonants to consider. For the rhyme production, there were 16 items which consisted of three reference syllables sharing the same rhyme and tone on each item. The children were required to come up with and say aloud a Cantonese syllable having the same rhyme and tone as the references. For example, 'say a Chinese syllable which shared the same rhyme and tone as "書" (/syu1/ meaning ''book''). One acceptable answer would be "豬" (/zyu1/ meaning "pig")'. A composite phonological awareness score was calculated by summing the scores from the three tasks. The maximum composite score was 67 and Cronbach's alpha of the measure was 0.86.

MORPHOLOGICAL AWARENESS

Morphological construction task was employed to assess morphological awareness, as done in previous work on Cantonese-speaking children (Cheung et al., 2010; Chow, McBride-Chang & Cheung, 2010). This measure was administered at graded difficulty levels. Twenty-seven test items were organized into five subsets of varying difficulties. For each item, a scenario was presented orally by the experimenter, and the children were asked to construct words for the novel objects or concepts based on the scenarios given. For example, one description was "When someone eats more than is good for, this is called overeat. What could we call when someone drinks excessively?" The target response was overdrink. A target answer was awarded two points, and a partially correct answer was awarded one point. The Cronbach's alpha was 0.82.

RAPID NAMING

The rapid digit naming task consisted of 8 rows of 5 digits (2, 4, 6, 7, and 9) that were printed on a piece of white A4 sheet (Chung, McBride-Chang, Wong, Cheung, Penny, & Ho, 2008). These digits were arranged in random order. Prior to formal testing, children were asked to name each of the five digits individually to make sure that they could read them. The participants were then asked to name all digits on the sheet from left to right and from top to bottom as accurately and quickly as possible. This test was administered twice in order to obtain a test-retest reliability, and the average time was recorded. The test-retest reliability was 0.91.

VOCABULARY KNOWLEDGE

The vocabulary definition adapted from studies (e.g., Cheung et al., 2010; McBride-Chang et al., 2008) was used to assess participants' vocabulary knowledge. This test comprised 53 vocabulary items. In this task, children were orally presented with a word representing an object or concept and asked to explain or define this word. Each response was scored on a 3-point scale (from 0 to 2) for completeness. For instance, when "teacher" was given to the children, if she or he explained it as 'a person who teaches', two points would be given, whereas if she or he defined it as 'a person at school', one point would be awarded. The test was terminated if the children scored zero on five consecutive items. The Cronbach's alpha for this measure was 0.89.

READING COMPREHENSION

The sentence comprehension was developed and based on the studies (Chik, et al., 2012; Yeung, et al., 2011). There were 14 cloze sentences in which a noun, a verb or an adjective was missing. Children were requested to choose, from four choices, the word that best completed each sentence. The four choices were of the same word class but had different meaning and usage. One point was given for the correct answer in each sentence. The Cronbach's alpha for this measure was 0.81.

PROCEDURE

Head-Toes-Knees-Shoulders task (HTKS), rapid digit naming, morphological construction, vocabulary definition, phonological awareness, and word reading tasks were administered individually except for Raven's Standard Progressive Matrices. The parents' or guardians' consents for students' participation were obtained before testing. The children were given from 2 to 4 practice items for the cognitive-linguistic tasks before the formal testing. All assessments were conducted by trained experimenters.

RESULTS

Group Comparisons of Reading, Behavioural Self-Regulation, and Cognitive-Linguistic Measures

The poor readers were matched with the average readers as control readers as in Table 1 showing the means, standard deviations, ranges, *t* and Cohen's d values for all tests for reading, self-regulation and cognitive-linguistic measures. There were no significant differences in age, parents' educational levels, and Raven's scores as nonverbal intelligence (IQ) between the groups. The effect sizes (Cohen's d; Cohen, 1988) of all significant differences in sentence comprehension, behavioural regulation, and cognitive-linguistic measures between the poor reader group and control group were medium to large, as seen in Table 1.

The performance of the poor reader group was significantly lower than the performance of the control group on all the cognitive-linguistic measures: morphological construction [$t(76) = -7.18$, $p < .001$], phonological awareness [$t(76) = -8.37$, $p < .001$], vocabulary definition [$t(76) = -6.04$, $p < .001$], Head-Toes-Knees-Shoulders task [$t(76) = -8.08$, $p < .001$], rapid digit naming [$t(76) = 5.35$, $p < .001$], and sentence comprehension [$t(76) = -10.36$, $p < .001$].

Distinguishing Between Poor Readers and Average Readers

To examine the extent to which self-regulation and cognitive-linguistic measures could best distinguish the poor and good readers, logistic regression analyses were used to investigate the four cognitive-linguistic and self-regulation measures, taking each area into consideration once. In the logistic regression analyses, age and IQ were entered into the first step. When the five measures were entered simultaneously into the second step, the three final significant predictors were Head-Toes-Knees-Shoulders task $\chi^2(1, N=78) = 28.70$, $p < .001$, morphological construction, $\chi^2(1, N=78) = 12.85$, $p < .001$, and rapid digit naming $\chi^2(1, N=78) = 12.49$, $p < .001$.

With these three measures included in the analysis, an overall hit rate was 96.2%, with accuracy rates of both the poor readers group (97.4%) and control group (94.9%) being very similar to one another (see Table 3). The Head-Toes-Knees-Shoulders task, morphological construction, and rapid digit naming were found to be important indicators of poor readers.

Table 1. Descriptive statistics and t-test results for all measures

Task	Poor Readers (n = 39)			Average Readers (n = 39)				Effect size
	M	SD	Range	M	SD	Range	t	(Cohen's d)
Age	86.49	3.61	79.00 - 94.00	85.77	4.23	79.00 - 96.00	0.81	0.18
Parents' Educational Level	5.72	1.02	4.00 - 7.00	5.92	0.96	4.00 - 7.00	-0.91	-0.20
Nonverbal IQ	29.44	9.63	11.00 - 45.00	29.79	7.81	12.00-45.00	-0.18	-0.04
Head-Toes-Knees-Shoulders task	26.05	6.61	15.00-38.00	38.13	6.59	25.00 - 47.00	-8.08	-1.83
Rapid Digit Naming	26.28	6.82	16.42 - 41.12	19.40	4.23	13.74 - 29.62	5.35	1.21
Morphological Construction	10.82	3.90	3.00 -18.00	18.03	4.91	6.00 - 27.00	-7.18	-1.63
Vocabulary Definition	25.67	4.90	18.00 - 37.00	34.26	7.40	21.00 - 50.00	-6.04	-1.37
Phonological Awareness	20.26	7.53	7.00-37.00	35.74	8.76	21.00 - 52.00	-8.37	-1.90
Sentence Comprehension	8.10	1.43	5.00 -10.00	12.05	1.90	8.00 - 14.00	-10.36	-2.35

Table 2. Logistic regression analyses for distinguishing between poor and good readers (N=78)

Model No. 1 Model / Predictor	$\chi 2$	Nagel-kerke R^2	Correctly identified poor readers	Correctly identified average readers	Overall accuracy	β	Odds ratio	Wald
Forward stepwise	91.20	0.92	97.4%	94.9%	96.2%			
Age						-0.15	0.87	0.65
Nonverbal IQ						-0.13	0.87	1.80
Head-Toes-Knees-Shoulders task						0.47	1.60	6.48*
Morphological Construction						0.56	1.75	7.18**
Rapid Digit Naming						-0.38	0.68	4.80*

***p<0.001, **p<0.01, *p<0.05

Correlations Between Reading, Behavioural Self-Regulation, and Cognitive-Linguistic Measures

Table 2 presents the correlations among performance on the morphological construction, phonological awareness, vocabulary definition, rapid digit naming, and self-regulation, sentence comprehension for the whole sample (n=78) after controlling for age and IQ. Most of the cognitive-linguistic measures (morphological construction, phonological awareness, vocabulary definition, and rapid digit naming) were significantly correlated with each other. Among these measures, the rapid digit naming was not significantly correlated with the morphological construction and self-regulation, possibly due to our relatively small sample size. The self-regulation measure was significantly correlated with the cognitive-linguistic measures (morphological construction, phonological awareness, and vocabulary definition). All the correlations between cognitive-linguistic measures, self-regulation, and sentence comprehension measures were significant.

Table 3. Correlations among measures after controlling age and IQ

	1	2	3	4	5	6
1.Head-Toes-Knees-Shoulders task	-					
2. Phonological Awareness	0.41***	-				
3. Morphological Construction	0.36**	0.56***	-			
4. Vocabulary Definition	0.26*	0.44***	0.37**	-		
5. Rapid Digit Naming	-0.22	-0.35**	-0.22	-0.36**	-	
6. Sentence Comprehension	0.54***	0.56***	0.58***	0.43***	-0.35**	-

*p<0.05, **p<0.01, ***p<0.001

Table 4. Summary of hierarchical multiple regression for variables predicting sentence comprehension from behavioral self-regulation and cognitive-linguistic measures after controls for age and IQ (N=78)

Step	Predictor	R	R^2	ΔR^2	*Final step*		
					B	*SE B*	β
1	Age	.17	.03	.03	-0.05	0.06	-0.07
1	Nonverbal IQ				0.00	0.03	0.01
2	Vocabulary Definition	.46	.21	.18***	0.04	0.03	0.12
3	Rapid Digit Naming	.50	.25	.04*	-0.04	0.04	-0.11
4	Phonological Awareness	.62	.38	.13***	0.04	0.03	0.17
5	Morphological Construction	.68	.47	.08**	0.14	0.05	0.30**
6	Head-Toes-Knees-Shoulders task	.74	.54	.07**	0.09	0.03	0.31**

*p<.05, **p<.01, ***p<.001

Predicting Reading from Behavioural Self-Regulation, and Cognitive-Linguistic Measures

As shown in Table 4, hierarchical multiple regression analyses were performed on the combined data from all of the poor and average reader group given that the general patterns of results were similar in both groups, thereby enhancing statistical power. These analyses examine the extent to which the morphological construction, phonological awareness, vocabulary definition, rapid digit naming, and self-regulation measures explained variability in sentence comprehension.

In the regression analyses, age and IQ as the control variables were entered in the first step. The measures of the vocabulary definition, rapid digit naming, phonological awareness, morphological construction, and self-regulation were then entered in the second, third, fourth, fifth, and sixth steps. Vocabulary definition, rapid digit naming, phonological awareness, morphological construction, and self-regulation each made unique contribution to sentence comprehension. These significant predictors together accounted for 18.1%, $F(3, 74) = 6.51$, $p < .01$; 4.1%, $F(4, 73) = 6.09$, $p < .001$; 13.3%, $F(5, 72) = 8.96$, $p < .001$; 8.3%, $F(6, 71) = 10.34$, $p < .001$, and 7.3%, $F(7, 70) = 11.72$, $p < .001$ of the variance in sentence comprehension.

DISCUSSION

The present study represents a first attempt to investigate the cognitive-linguistic skills of behavioral self-regulation, phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming in Chinese poor readers. We also examined the relation between these skills and reading comprehension. The children with reading difficulties exhibited significantly impaired performance on the Head–Toes–Knees–Shoulders task (HTKS), phonological awareness, morphological construction, vocabulary definition, rapid digit naming and sentence comprehension measures, relative to the control group who were matched on age, IQ, and parent's education level.

In the logistic regression analyses, self-regulation along with rapid naming and morphological awareness significantly distinguished poor from adequate Chinese readers. Furthermore, self-regulation explained unique variance in reading comprehension beyond phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming. Our findings are consistent with the simple view of reading (Gough & Tunmer, 1986; Hoover & Gough, 1990), which proposes that reading acquisition and impairment may depend on the orchestration of interconnected, cognitive-linguistic skills. These results were further discussed below.

In the present study, self-regulation skills distinguished children with reading difficulties as compared to those without such difficulties. In particular, the poor readers showed pronounced deficits in the area of cognitive flexibility, working memory, and inhibitory control. Deficits in self-regulation skills may be closely linked with their deficits in cognitive-linguistic skills, which are the primary skills required by readers, and with which most poor readers struggle (Ho, Chan, Lee, Tsang, & Luan, 2004; Shu, Meng, & Lai, 2003).

As mentioned previously, Chinese orthography has numerous different graphic patterns and orthographic rules, and thousand of characters are required to be learned. For those readers who have not yet fully mastered the process of learning to read, each character may be learned individually as a kind of logograph or unique symbol. This may in turn place extra demands on the individual's cognitive flexibility, working memory, and inhibitory control. Furthermore, many poor readers may have difficulty concentrating on some aspects of linguistic information (e.g., pronunciation and meaning) and suppressing irrelevant information given the vast number of homophones and homographs in Chinese.

At the same time, these readers could have problems processing and recalling a large number of characters needed to develop strong character-semantic skills to discriminate different homophones and homographs in order to comprehend meaningful sentences and passage. Consistent with the research study on Chinese children (Chung & McBride-Chang, 2011; Peng et al., 2013), which found that at least both working memory and inhibitory control contribute to reading development and failure, a similar finding was found in our sample of poor readers. Poor self-regulation may be another possible marker for children with reading difficulties and dyslexia.

Phonological skills also discriminated the poor readers from adequate readers in the present study. The results showed that children with reading difficulties performed worse than the competent readers in all the phonological tasks. Thus phonological awareness deficits in the children with reading difficulties may reflect the lesser quality of phonological presentations of morphemes thereby possibly causing some problems in mapping from graphs to syllabic morphemes. As with the previous studies (e.g., Liberman, Shankweiler, & Liberman, 1989; Stanovich & Siegel, 1994), the current results have also shown that phonological awareness uniquely contributes to reading acquisition and impairment in a variety of languages. Deficits in phonological awareness were also found in poor readers and children with dyslexia (e.g., Liu et al., 2010).

Morphological skills in addition to phonological skills consistently distinguished the poor from the adequate readers. As in the previous studies (Chung et al., 2010; McBride-Chang et al., 2008a; McBride-Chang et al., 2008b), the children with reading difficulties in the present study also performed at a lower level than their typically developing peers on the morphological compounding measure. It may be that poor readers have not fully integrated the morphological unit and the structure of a word, so that their representations and organization of morphological units have yet to develop in order to discriminate morphemes, manipulate morphemic structures and generalize morpheme meaning. Consistent with the studies (Chung et al., 2010; Shu et al., 2006; Yeung, Ho, Chan, & Chung, 2014) morphological awareness was the best method to distinguish children with and without reading difficulties and dyslexia.

Apart from morphological skills, the poor readers also exhibited deficits in vocabulary knowledge. The vocabulary definition used in the present study required the children to define or explain the meaning of the words given. Perhaps the poor readers have relatively limited vocabularies or words in their mental lexicon so that they may have difficulty in recognizing and explaining the word meanings and/or understanding the words sufficiently well to be able to apply them in appropriate context. It is equally possible that an impoverished vocabulary may restrain the haste with which words could be mapped to print (e.g., Liu et al., 2010; McBride-Chang, Liu, Wong, Wong, & Shu, 2012). Therefore, collectively, these findings suggest that poor vocabulary knowledge may be an important cognitive indicator of reading difficulties not only for alphabetic languages but also for Chinese (Landi, 2010; Liu et al., 2010; Ouellette, 2006)

The children with reading difficulties in the present study showed significantly lessened performance on the rapid digit naming task relative to the average readers. These findings may reflect difficulties with generally weak phonological representations, less automatic processes of extraction and induction of orthographic patterns, less efficient lexical access and hence mirror one underlying cause of poor reading given that Chinese script has relatively arbitrary associations between print and sound. Deficits in rapid naming seem to suggest that, like those results for dyslexia in alphabetic languages such as English and German (e.g., Snowling, 2000; Wolf, Bowers, & Biddle, 2000), this cognitive deficit may be an impairment in children with reading difficulties and good indicator of dyslexia in Chinese (e.g., Chung et al., 2010; Ho et al., 2004).

In the present study, logistic regression analyses revealed that self-regulation, morphological awareness, and rapid naming were found to be the strongest cognitive-linguistic skills distinguishing poor readers from competent readers. These three skills could adequately be used to predict group membership of poor and average readers with an overall correct classification rate of 97.4%. Furthermore, digit rapid naming, vocabulary knowledge, phonological awareness, morphological awareness, and self-regulation were linked to reading comprehension when all these cognitive-linguistic skills were included in regression equations, supplying additional evidence of the potential importance of the sentence comprehension. Therefore, perhaps measures of the Head–Toes –Knees–Shoulders task (HTKS), morphological awareness, and rapid digit naming could be considered to be used for screening readers at risk of reading difficulties.

While the present findings provide a broader understanding of cognitive-linguistic skills relative to reading difficulties in Chinese, these results point to several new directions for future research. Given the paucity of studies that investigate the relationships among self-regulation, phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming, additional longitudinal studies are needed to replicate the present findings both at the group and at the individual level. Future studies conducted with a large sample of readers are therefore necessary to examine whether any causal link stands between different cognitive-linguistic skills such as self-regulation, syntactic, discourse, and pragmatic skills, and different degrees of reading difficulties. Moreover, studies with experimental manipulations and longitudinal studies tapping these skills over time relative to different sets of literacy skills such as text writing abilities will be essential for the future.

To conclude, the current study has demonstrated the potential importance of five cognitive-linguistic skills: self-regulation, phonological awareness, morphological awareness, vocabulary knowledge, and rapid naming, and these skills are strong correlates of reading comprehension in children learning to read in Chinese. Our findings also suggest that weaknesses in self-regulation, morphological awareness, and rapid naming are important markers of word reading difficulties among Chinese readers. Such findings may help to develop tools for the diagnosis and teaching strategies of this group of poor readers, and enhance the public awareness of children with reading difficulties.

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C

CONCRETE
- **Counters to add and subtract**
- **Fraction pies**

R

REPRESENTATIONAL
- **Number line**
- **Use of drawing**

A

ABSTRACT
- **Numbers notation, maths symbols**
- **Problem solving**

The Importance of Rapid Automatized Naming Skills as a Predictor of Reading Acquisition: A Theoretical Overview

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This article presents a theoretical overview of the concept of rapid naming skills as one of the critical sub-skills of reading acquisition. Rapid automatized naming is recognized as a relevant marker in early reading in addition to phonological awareness and verbal working memory. This paper describes how the relationship between rapid automatized naming and reading skills affects specific reading difficulties within the framework of existing developmental and cognitive research. Finally, future implications for research and applications in the educational field are provided.

Keywords: naming skills, rapid automatized naming skills, reading acquisition, specific reading difficulties

INTRODUCTION

The purpose of the current paper is to give a theoretical overview on the concepts of naming and rapid automatized naming (RAN). It is also important to show the connections between naming skills, reading skills and reading difficulties (RD). The aim is to emphasise the value of knowledge about the concept and development of naming skills, and possible developmental difficulties as crucial factors from both a scientific and practical perspectives.

These are important for the identification and assessment of reading progress and to potentially identify RD in children. It is proposed that rapid automatized naming is a useful method to include in both cognitive reading research and diagnostic tests. This overview is based on the neuro-cognitive, psycholinguistic and developmental research in the field.

Reading is a fundamental skill for successful performance in modern society and it is therefore hard to over emphasize its value. Considerable emphasis and efforts are focused on teaching and learning to read in educational institutions and society in general. Developed reading skills are the basis of further learning skills and academic success.

Reading includes the functions of both decoding and comprehension. For the purposes of this paper, the reading process is defined as decoding and RD as difficulties in decoding and does not consider the highly significant element of reading comprehension.

RD caused by biological, psychological and cognitive factors, despite adequate pedagogical environment, are considered as specific reading difficulties (SRD) / dyslexia. Cognitive and linguistic processes and reading predictors can be noticed in the pre-reading period and have significant predictive value in later reading performance. Reading ability, risks and difficulties are visible in the pre-reading period and can be efficiently predicted by the level of language skills (naming, rapid naming, phonological processing and awareness), working memory, visual and auditory perception, kinaesthetic perception and rhythm (Georgiou, Parrila, Manolitsis & Kirby, 2011; Furnes & Samuelsson, 2011; Holopainen, Ahonen, Lyytinen, 2001; Lervåg & Hulme, 2009; Norton & Wolf, 2012; Nation, 2005; Pastarus, 1999; Shaywitz, 2003; Van der Leij, Lyytinen & Zwarts, 2001; Wolf, 1999).

NAMING

Naming, which is one of the basic linguistic processes, is defined as the attribution of a linguistic equivalent (symbol) to an object, characteristic, action, and the use of it (Luria, 1962). Different terms express various aspects of the Naming skill concept. *Word finding* and *word retrieval* refer to the ability to retrieve the word from memory capacity and to use it properly. *Lexical retrieval* and *lexical access* refer to lexical and semantic aspects, i.e. aspects of meaning (Salmi, 2008; Tuovinen, 2003).

From the neuropsychological point of view, naming ability, including rapid naming, is a multiple-phased cognitive phenomenon guaranteed by the human neurobiological structure. The Naming process is provided by cooperation between different areas of the brain. Readiness of the visual area of both hemispheres is crucial for the perception of objects. Subsequently, the language areas of the posterior part of the frontal and temporal lobes of the left hemisphere are activated. In these areas of the brain phonemes and the meanings of words are analysed. The motor areas of the frontal lobe guarantee the activation, i.e. they generate the motor program for oral performing (Laine, 1995; Lehtonen, 1993; Luria, 1962; Wolf, 1982, 2008; Wolf & Bowers, 1999). Automatization of cognitive processes, including speech and language processes is provided by the function of the cerebellum (Nicolson & Fawcett, 1999, 2008).

Several researchers have demonstrated that word finding is guaranteed by different neurological structures within the brain and activation of the specific brain areas depends on the type of stimuli presented (serial or discrete presentation). These researchers have ascertained that naming discrete stimuli is related to occipital and frontal lobes and naming serially presented stimulus is linked to the pre- and anterior parts of the frontal lobe (Messer & Dockrell, 2006; Wiig, Zureich & Chan, 2000).

It has been established that naming different stimuli activates brain regions at different levels of activation. Naming letters has been observed to cause more activation in the angular gyrus, parietal and occipital lobe than naming pictures. Naming pictures activates the frontal lobe more strongly. This pattern of activation pattern suggests that there are stronger links between reading and letter naming than between reading and picture naming (Misra, Katzir, Wolf & Poldrack, 2004). Wolf (1986, 2008) has explained the phenomenon in terms of the automatization processes. Wolf`s research shows that naming pictures can be automatized less than naming letters (alphanumerical stimuli generally), and the latter requires greater activation of brain.

According to Luria (1962), the difficulties in naming are caused by damage or dysfunction of different parts of the brain: pre-motor area of the frontal lobe (efferent motor aphasia), superior and medium part of the temporal lobe (acoustic-amnestic aphasia) and posterior part of the temporal lobe (semantic aphasia).

Damasio and her teams (Damasio, Grabowski, Tranel, Hichwa & Damasio, 1996; Damasio, Tranel, Grabowski, Adolphs & Damasio, 2004) have extended knowledge about the neuropsychological basis for the Naming process. They have proven that word retrieval in naming faces, animals and tools is correlated with separable neural sites within different higher-cortices of the temporal regions in left hemisphere outside classic language areas and are correlated with noting objects. Additionally, strong activation was found to be visible in other parts of the brain: motor region, orbital frontal lobe, occipital lobe, anterior temporal lobe and supra marginal gyrus. These researchers showed that recognition of the naming task was evenly distributed across the two hemispheres. The researchers' claim is that impaired retrieval of words denoting actions is related to damage of the left prefrontal and/or premotor regions. This confirmed the partial segregation of naming for different word categories. The usage of these brain parts depends on the task performed (to name or to recognize) and the conceptual category of the item (unique, common or familiar). Impaired word retrieval was not visible in the right hemisphere.

All naming tasks investigated related to temporal regions showed significant blood increase for naming tasks relative to the control no-naming tasks. They summarised that for optimal retrieval of words from different categories, different anatomically separable regions are involved and there are dissociations relative to the type of words and anatomical locus. In short, as language is both a left and right hemisphere function, this assumption should be extended to the rapid naming concept as well, and regarded as underpinned by the cooperation of both hemispheres.

Adult brain imaging studies show that the relevant regions of the brain, that underpin reading and naming, involve very closely related neural circuits. It is logical to assume then that (especially single word) reading and naming processes are performed in the same way. Common neural mechanisms and the integrity of left hemisphere circuits sub-serve the development of rapid automatized naming and reading thereby underpinning the relationship between early rapid naming skills and reading skills. However, the relationship between rapid automatized naming and reading seems to be unidirectional in its development. Difficulties in efficiency with the naming circuits constrain development of reading skills, but increased reading skills do not correlate as increased naming skills per se. Development of naming skills is mainly considered as a function of age and cognitive ability (Karlep, 2003; Laine, 1995; Lervåg & Hulme, 2009; Luria, 1962; Messer & Dockrell, 2006).

Rapid automatized naming could be affected by the magnocellular system. Clarke et al. (2005) demonstrated that good readers paused less than poor readers in rapid naming tasks and that their pauses resembled strategic pauses specific to reading. The authors associated the phenomenon to eye fixations, that occur in the reading process. The magnocellular deficit hypothesis states that SRD readers present difficulties with precision of visual perception and eye moving control (Misra et al., 2004). This is questioned by Hutzler, Kronbichler, Jacobs and Wimmer (2006) who did not notice any differences in eye movements between SRD and normal readers in letter perception and therefore did not associate difficulties in reading with magnocellular deficit.

Moreover, RAN difficulties could be partially caused by inherited genes. Berninger, Abbott, Billingsley and Nagy (2001) found in their study ($n > 100$ SRD students and their parents) that 83.3% of children and 56% of parents presented rapid naming difficulties. Two longitudinal researches (Jyvaskyla Longitudinal Study and Dutch Study) have shown that children with RD and/or familial dyslexia risk lower achievement in naming tasks than children without any dyslexia risk (van Bergen, de Jong, Regtvoort, Oort, van Otterloo & van der Leij, 2011; Lyytinen, Ahonen, Eklund, Guttorm, Laakso, Leinonen, Leppänen, Lyytinen, Richardson & Viholainen, 2001; Torppa, Lyytinen, Erskine, Eklund & Lyytinen, 2010). Many researchers have evaluated the relationship between RAN and heredity and have found it to be medium to strong ($r = 0.40...0.60$). These findings suggest that because reading ability in the primary school is affected by genes that rapid naming may also be affected by genes (Byrne, Olson, Samuelsson, Wadsworth, Corely, DeFries & Willcut, 2006; Deutsch & Davis, 2010; König, Schumacher, Hoffmann, Kleensang, Ludwig, Grimm, Neuhoff, Preis, Roeske, Warnke, Propping, Remschidt, Nöthen, Ziegler, Müller-Myhsok & Schulte-Körne, 2010; Grigorenko, 2004; Samuelsson, Byrne, Quain, Wadsworth, Corley, DeFries, Willcutt & Olson, 2005).

Various sets of instruments have been developed in order to explore naming skills. Naming tests are designed to assess the time taken, based on age-related norms, for word finding, semantic and phonological precision and articulation of the named words, assuming the child does not have any speech or language pathology or mental retardation. There are two basic types of naming tests: tests with serially presented stimuli and discrete stimuli.

As mentioned above, naming and reading are underpinned by the same psychological basis. By exploring a person's naming skills one can easily then draw conclusions about his or her reading skills, therefore naming tasks are often included in reading tests.

1. RAPID AUTOMATIZED NAMING (RAN)

Rapid Automatized Naming occurs in everyday life when reading where the correspondence between phonemes and graphemes is a form of rapid naming. During the reading process the rapidly changing grapheme sequence (visual stimuli, letters) has to be decoded into the form of phoneme sequence (sounds).

At the cognitive level, RAN assumes cooperation between many processes: perceptual, attention, memory, reasoning, lexical-semantic and articulatory. Visual, auditory and verbal processes are involved in RAN skills in the context of timing and sequencing. Difficulties in one or more of the aforementioned aspects could cause rapid automatized naming difficulties (RND). RAN and reading skills are found to be correlated at the medium level (n = 1550, r = .45) and Rapid naming deficits are associated with Specific Reading Difficulties (Ahonen, Tuovinen & Leppäsaari, 2003; Denckla & Rudel, 1976a, 1976b; Swanson, Trainin, Necochea & Hammill, 2003; Norton & Wolf, 2012; Waber, Wolff, Forbes & Weiler, 2000; Wolf, 1982, 1991, 1999; Wolf, Bally & Morris, 1986).

Research has shown that RAN has an especially high predictive value for reading results of marginal readers, i.e. those readers who remain under the 10th percentile for reading and above the 90th percentile for slowness of naming (Araujo, Pacheco, Faisca, Petersson & Reis, 2010; Frijters, Lovett, Steinbach, Wolf, Sevcik & Morris 2011; Lervåg, Bråten, & Hulme, 2009; Meyer, Wood, Hart & Felton 1998). According to numerous studies, Rapid Naming predicts reading results up to Grade 4 (Badian, Duffy, Als & McAnulty 1991; Frijters et al., 2011) or even to Grade 6 (Vaessen & Blomert, 2010).

When measuring RAN, the most relevant criteria are naming speed and accuracy/precision. Research suggests that slow naming speed and/or the amount of mistakes in naming tasks predict RD in both regular and irregular orthographies. However, the relation between RAN and reading is considered stronger in regular orthographies than irregular ones (Araujo et al., 2010; Badian et al., 1991; Denckla & Rudel, 1974; Furnes & Samuelsson, 2011; Korhonen, 1995; Salmi, 2008; Wolf, 1986). This is because it is easier to learn to read in a language which is transparent, and therefore speed of reading is the key to diagnosis, by contrast with accuracy in irregular languages. RAN speed has more diagnostic value than accuracy in regular orthographies (Aro, 2004, Holopainen et al., 2001; Lervåg, Bråten, & Hulme, 2009; Misra et al., 2004; Wolf, 1986; Wolf & Bowers, 1999). Studies on Chinese language have shown a strong correlation between RAN and reading in Chinese, i.e. in uniquely different logographic systems of reading.

RAN is identified as a significant and stable predictor of reading in Chinese up to Grade 5 and presents the most dominant type of cognitive deficit in Chinese-speaking children with dyslexia (Ho, Chan, Lee, Tsang & Luan, 2004; Kang, 2004; Yeung, Ho, Chik, Lo, Chan & Chung, 2011). A few studies have examined the predictive power of RAN in Arab and Persian languages. These studies found, that despite having different orthographies in comparison with English, RAN could predict reading skills in these languages as well (Sadeghi, Everatt, McNeill & Elbeheri, 2009; Taibah & Haynes, 2011). Although the lowest in range, RAN increased steadily and was strongly fixed by Grade 3 (when basic decoding skills become automated) and even exceeded the predictive power of phonological awareness in Arabic (Taibah & Haynes, 2011). A Malay language screening test has also identified RAN as a contributory predictor to reading, in addition to phonological deficits (Lee, 2008).

The most well known RAN tests are the *Rapid Automatized Naming Test*, (Denckla & Rudel, 1974; Wolf & Denckla, 2005), *Rapid Serial Naming Test* (Wolf and Denckla, 1986) and *Rapid Automatized Naming Subtest* (Wiig et al., 2000). Speed, as the most valuable and distinctive characteristic of the process, is assured by changing the stimuli in a RAS serial presentation to make the task more challenging. The number of errors are a secondary consideration in RAN tasks. The aim of naming tasks is to name presented stimulus (alphanumerical, non-alphanumerical or mixed versions) as fast as possible and move ahead to the next stimulus.

The most widely used stimuli are numbers, letters (alphanumerical), pictures, colours, geometrical shapes (non-alphanumerical) and mixed versions. The traditional naming test consists of 4-8 subtests, each subtest contains 5 and 10 randomly presented stimuli repeated over the page (Ahonen et al., 2003; Clarke, Hulme & Snowling, 2005; Denckla & Rudel, 1974, 1976a, 1976b; Wolf, 1982, 1991, 1999; Wolf, Bowers & Biddle, 2000).

A list and summary of selected research using RAN/RAS tests is presented by Wolf and Denckla (2005). This summary, intended for researchers, highlights samples, ages/grades and results gathered between 1972–1995. Most of these investigations have involved children (primary school) and teenagers (basic school); a few studies engaged preschoolers or adults. Two studies explored RAN skills in kindergarten children. Regular readers completed samples as controls, and the experimental groups were described as dyslexic readers, slow learners, ADD students and impaired readers. Two of the studies listed were conducted in German. These studies elaborated on normative data for RAN measurement, investigated RAN and reading relationship and compared RAN results in controls with experimental groups.

The normative data findings from these studies have allowed subsequent years of RAN investigations to delve more deeply into this field of study. The most challenging research questions concerned the neuro-cognitive and genetic relationship between RAN and reading, the role of RAN in the reading process and the connection between Rapid Naming Deficits and Specific Reading Difficulties. Educational and practical implications are very relevant issues in the context of assessment and remedial instruction for struggling readers.

Most of the researchers suggest that there is a stronger and more specific correlation between alphanumerical stimuli and reading than non-alphanumerical stimuli and reading (Misra et al., 2004; Pham, Fine & Semrud-Clikeman, 2011; Wolf, 1991; Wolf, 1999, 2008; Wolf et al., 1986). Savage and Fredricson (2005) and Compton (2003) discovered that the naming of alphanumerical stimuli has predictive value in relation to decoding, reading precision and speed.

In accordance with this body of research, picture naming does not present a predictive value to reading. Savage and Fredricson (2005) have discussed the following: picture naming requires semantic access, which is not inevitable for the naming of non-alphanumerical stimuli. The automatization process in naming alphanumerical stimuli depends on age, cognitive capacity and reading instructions. The decrease in predictive value of picture naming, as an age-related function, is explained by the non-automatization processes of picture naming (Arnell, Joanisse, Klein, Busseri & Tannock 2009; Luria, 1962; Misra et al., 2004; Wolf, 2008; Wolf et al., 1986). Contrary to these notions, some research has demonstrated that picture and colour naming are stronger and more persistent (up to age 18), in relation to reading speed and comprehension, than naming alphanumerical stimuli (Arnell et al., 2009; Cronin, 2011; Denckla & Rudel, 1974; Lervåg & Hulme 2009).

The results of numerous studies have shown that RAN contributes substantially to reading fluency across all six primary school grades. Indeed, the relationship between RAN and word reading fluency increases gradually as a function of reading experience (Breznitz, 2006; Vaessen & Blomert, 2010).

The relationship between RAN and reading comprehension has not been explained unambiguously and the need for further research is articulated (Arnell et al., 2009; Compton, 2003; Denckla & Rudel, 1974; Li, Kirby & Georgiou, 2011). Some research confirms that RAN also predicts reading comprehension. It has been claimed that reading comprehension and number and letter naming might be related to the articulation pause time rather than pure articulation time. The latter relationship is found in Grade 6, but not in Grades 2 or 4 (Li, Cutting, Ryan, Zilioli, Dencla & Mahone 2009; Li, Kirby & Georgiou 2011). Chinese reading comprehension has been found to show a statistically significant (albeit small) contribution from RAN (letters and numbers) (Leong, Tse, Loh & Hau, 2008).

Briefly, research has confirmed that RAN predicts reading performance. The speed of alphanumerical RAN performs as an especially strong predictor in transparent orthographies.

There are clear developmental changes in the speed of RAN, based on the mean and standard deviations for the RAN/RAS Tests at 14. Age intervals and correlations with age are represented in the RAN/RAS Examiner Manual (Wolf & Denckla, 2005). The data presented show evenly decreasing testing time from age 5 to 18. The mean time recorded at age 18 is two to three times less than the mean time at age 5, accordingly: objects 74 sec and 35 sec, colors 73 sec and 34 sec, numbers 74 sec and 27 sec, letters 83 sec and 28, 2-set letters and numbers 97 sec and 31 sec, 3-set letters, numbers and colors 94 sec and 32 sec. Variability, as expressed in Standard deviations decreased between age 5 to 12 (mean variability 30.5 and 10.6), but persisted to age 15 and increased somewhat between age 16—17 (mean 9.1) and showed the smallest deviations by age 18 (mean 8.8).

RAN mean times were moderately correlated with age, with correlation coefficients between .48 and .64, significant at $p < .0001$ level. Similar developmentally determined findings were reported by Li et al. (2011) who measured RAN articulation and pause times in both English and Chinese and noticed both decreased by age, but the pause time decreased faster than articulation time. These developmental changes in articulation and pause times show that pause time is the more sensitive indicator of language proficiency.

These results confirm that RAN time decreases as function of age. These results are in line with theoretical knowledge about improving reading acquisition in preschool and primary school and stating that reading acquisition to be mainly completed by ages 12-13.

2. NAMING DIFFICULTIES

Several terms are used to refer to naming difficulties: naming deficit, word finding disorder, lexical look-up problems, dysnomia and anomia.

It is justified to consider Naming Difficulties as a persistent problem (reflecting low- or non-automated processes) in word selection, retrieving and producing processes. Naming Difficulties reflect the inability to name a real or imagined object or to find the word necessary to continue a conversation as well as incorrect or improper usage of a word, slow retrieval of words from memory or emerging secondary markers (e.g., extra words, gestures etc.). Naming Difficulty does not implicitly include word comprehension difficulties But rather retrieval diffculties (Constable, 2007; German & Newman, 2007; Luria, 1962; Tuovinen, 2003; Messer & Dockrell, 2006).

Naming Difficulties can be combined with other developmental disabilities. Children with Naming Difficulties are noticably linked with specific language impairment, dysphasia, dyslexia, learning difficulties (LD) and stuttering (Araujo, Pacheco, Faisca, Petersson & Reis, 2010; German & Newman, 2007; Tuovinen, 2003; Messer & Dockrell, 2006; Rapin & Allen, 1983). There is adult Naming Difficulties have been related to aphasia, dementia, Alzheimer syndrome and Parkinson disease (Luria, 1962; Taler & Phillips, 2008), but these are usually acquired rather than developmental. Naming Difficulties have been observed to be very persistent and can be transmitted from childhood to early adulthood (Ahonen et al., 2003; Arnell et al., 2009; Constable, 2007; Holopainen et al., 2001; Korhonen, 1995; Meyer et al., 1998; Salmi, 2008; Wolf, 1999). The type of Naming difficulty most frequently observed in children with Specific learning difficulties includes word retrieval problems coupled with circumlocution.

2.1. RAPID NAMING DIFFICULTIES

Rapid Naming Difficulties, described as inconsistent and slow or delayed development and abundance of mistakes, are characteristic of specific language impairment (SLI) and other developmental disorders. Rapid Naming Difficulties are usually assessed based on the standard deviation 1, 5 or 2 depending on the naming speed and amount of mistakes (Ahonen et al., 2003; Denckla & Rudel, 1976a; Wolf et al., 1986).

Rapid Naming Difficulties can be observed at both developmental and behavioural levels. At the developmental level, difficulties appear as inconsistencies, i.e. noticeable relapses and nonlinear growth curves. Difficulties at the behavioural level are demonstrated by slow naming speed and an abundance of mistakes. In the following section, the problems with RAN will be explored in greater depth, presenting a range of comparative data.

Ahonen et al. (2003) have explored and described the characteristics of Rapid Naming Difficulties in three independent groups of children aged 6-12. The research included a control group (normal development, no special teaching), part-time special teaching of students in mainstream schools (mild reading difficulties, *n* = 235) and full-time special teaching of students (severe speech and reading difficulties, *n* = 85). RAN development in both of the special groups is characterised as inconsistent and dependent on specialist support in the learning process.

Students in special groups showed delay, achieving approximately similar results to the control group in naming speed (especially with colours and objects) one to three years later. For example, the colors-letters-numbers subtest naming speed in the age 8 control group (51,0 sec) was obtained by students in the part -time special teaching group at 9 years (46,7 sec) and by students in the full-time special teaching group at 10-11 years (48,2 sec).

Moreover instability and relapses were noticed in the development of naming skills for the students in special groups. For example, the special group students' numbers-letters and colors-numbers-letters RAS naming speeds at 10 years were measured respectively at 41,8 sec and 44,6 sec, while at 11 years they were respectively 44,2 sec and 51,7 sec. This seems to indicate that they were becoming slower and more variable with age.

One noteworthy finding is described by Ahonen et al. (2003), namely that special group students passed the objects subtest faster at 8 years than normal development students. These results confirm those previous results demonstrating RAN development peculiarities in children with aberrational speech development.

The amount of mistakes in RAN tests are connected to age and cognitive development. A decreasing number of mistakes and an increasing number of self-corrected mistakes are considered age-related functions, as with naming speed. The aforementioned research by Ahonen et al. (2003) revealed nonlinearity between age and correction of mistakes and dependence on special teaching. The authors found that special group students tended to self-correct their naming mistakes less often than normal group students. Both part-time special group students and control group students tended to correct their mistakes, approximately 60-87%. The range of corrected mistakes of full-time special teaching group students stayed at 44-82, 1%.

Similarly, in a comparative study by Araujo et al. (2010) about dyslexic and normal readers, RAN tests with different results were found. They measured significant differences between dyslexic and normal readers in RAN speed, accordingly – 1.2 ± 1.3 and 0.7 ± 0.87, $p < 0,001$.

A Dutch investigation by van Bergen et al., (2011) reported additional different results in RAN tests comparing at-risk dyslexics, at-risk non-dyslexics and controls. Comparisons revealed that in Grade 1, the at-risk non-dyslexics were significantly slower than the controls, but surprisingly, significantly faster than the at-risk dyslexics. The phenomenon is worth further exploration. After half a year of reading instruction, at-risk dyslexics were slower in the naming of letters compared with the at-risk non-dyslexics, who were slower than the controls, and scored accordingly, 0.82, 0.96 and 1.18, $p < 0.001$. By the end of the first school year, at-risk non-dyslexics had reached the same level as the controls, scores for at-risk dyslexics were 1.24, at-risk non-dyslexics and controls 1.01, $p < 0.001$.

Ho, Chan, Tsang & Lee (2002), research showed that 50% of dyslexic Chinese children had difficulties in rapid naming, which is a major problem for orthographic and visual processing (36,7%) (cited by Kang, 2004).

In conclusion, the features of Rapid Naming Deficit are inconsistent development; slow naming speed and large amount of mistakes. Rapid Naming Difficulty is a characteristic problem for SRD/dyslexia and those at risk for it.

2.2. DOUBLE DEFICIT HYPOTHESIS (DDH)

Based on findings drawn from connections between RAN skills, phonological awareness and reading skills, Wolf, (1986) developed the Double Deficit Hypothesis (DDH) which combines a single or combined RAN speed deficit and a phonological deficit in children with SRD. According to this theory readers may be divided into four subgroups. The first subgroup is composed of children with a naming speed deficit but intact phonological awareness. They read slowly but without phonological mistakes. The second group has a phonological awareness deficit but intact naming speed. These children read fast but with many phonological mistakes. Both groups show mild to moderately impaired reading skills and comprehension which is not persistent, especially where they are supported by relevant treatment and special reading instructions. The third group of readers has both naming speed and phonological awareness deficits, i.e. double deficit. These children have severely impaired reading skills and a reading comprehension deficit in combination with a slow verbal ability and they would be classified as classic dyslexics. The fourth group has no problems in naming speed, phonological awareness and reading or reading comprehension. Single deficit occurs among ~ 15-20% and double deficit for ~ 60% of children with SRD. Wolf and Bowers have suggested that RAN difficulties are characteristic of children with SRD but not children with mental retardation (Wolf, 1986; Wolf, 1999; Wolf & Bowers, 1999; Wolf et al., 2000).

Consistent with the aforementioned double-deficit hypothesis, similar subtypes of dyslexic readers were found in Araujo et al. (2010) research in a Portuguese sample: 18.2% showed a single deficit in either RAN or phonological tasks and 50% co-occurrence of both. Based on their research results Araujo and colleagues stated that a RAN deficit seems to be more persistent in impaired readers with intact phonological skills. Papadopoulos, Georgiou and Kendeou (2009) have noted that the single phonological-deficit subtype, showed reading results consistent with their age group by Grade 2, but not the single naming-deficit group. Inter alia, these findings seem to confirm the role of RAN to be more important in regular orthographies (Araujo et al., 2010).

This double-deficit theory was replicated in Cronin's (2011) longitudinal study from preschool up to Grade 5 in order to verify the hypothesis and RAN (besides PA) as a reading predictor. The results showed that the RAN object scores of preschool and kindergarten children predicted reading at every age level and offered support for the double-deficit hypothesis and Lervåg's and

Hulme's (2009) neuro-developmental theory. It was concluded that both RAN and PA predict reading disabilities in English, throughout the elementary school years, and that the early assessments of these variables were more diagnostic than measures used at later ages. Kang's (2004) study in Chinese proved that RAN speed was the most significant predictor of good readers for Grade 1 and Grade 3. Additionally, RAN speed was the most significant predictor for reading failure for Grade 5.

Contrary to Double Deficit Theory, some critics have controlled for the double deficit statistically. They have argued that RAN and phonological awareness are sequenced sub processes from a larger phonological representation and cannot be observed separately (Ramus, 2003).

3. RAPID AUTOMATIZED NAMING, COGNITIVE PROCESSES AND READING

The naming process is a verbal-cognitive complex consisting of cognitive, perceptual and linguistic sub processes all underpinning the reading process. The research stresses that these common processes characterize both naming and reading: retrieving and utilising a linguistic equivalent in accordance to presented stimuli as quickly and precisely as possible. Naming skills are considered important in reading acquisition, especially in alphabetic-phonetic orthographies (Denckla & Rudel, 1976a; Furnes & Samuelsson, 2011; Goswami, 2000; Georgiou et al., 2011; Wolf, 1991, 1999). Incorrectness and slow naming speed refer to SRD, and are characteristics of both SRD and general learning difficulties (Messer & Dockrell, 2006; Heikkilä, Närhi, Aro & Ahonen, 2008; Waber et al., 2000).

The following overview of the cognitive processes, underpinning naming and reading processes, is based on Salmi (2008) and supplemented by the author of this paper. This review reflects published concepts and discussions on this field.

Although the relationship between RAN and phonological skills has been researched and explored, there is no consensus on explanations of the precise mechanism behind it. Some researchers claim that RAN and phonological skills are independent processes measuring different aspects of reading (Närhi, Ahonen, Aro, Leppäsaari, Korhonen, Tolvanen & Lyytinen, 2005; Savage & Fredricson, 2005; Wolf, 1999; Wolf & Bowers, 1999; Wolf et al., 2000). These views were confirmed by Araujo et al. (2010) who identified a group of dyslexic children with intact phonological processing but poor in RAN skills. Other researchers have defined RAN as efficiency of phonological code retrieval and a component in large-scale phonological and memory processing. These researchers e.g. Ramus claim that slow naming speed is related to slow phonological processing and they consider the decreased naming speed to be a part of the phonological representation (Ramus, 2003; Vellutino, Fletcher, Snowling & Scanlon, 2004; Swanson et al., 2003; Vukovic & Siegel, 2006; Wagner & Torgesen, 1987).

Naming skills are based on speed of information processing. However, it is still not clear whether naming skills are related only to verbal information processing speed or could be related to general information processing speed. According to the verbal information processing theory, naming speed is related only to language processing speed. A connection has been found between slow naming speed and unusual language processing deficiency, associated especially with decreased timing and orthography (Li, Kirby & Georgiou, 2011; Lervåg & Hulme, 2009; Messer & Dockrell, 2006; Neuhaus, Foorman, Francis & Carlsson, 2001; Wimmer, Mayringer & Landerl, 1998).

According to general information processing theory, decreased naming speed reflects general information processing deviation independently of age and reading experience. The special difficulties of dyslexic readers in managing rapidly changing or presented stimuli, in both visual and auditory tasks, have supported this theory (Catts, Gillespie, Leonard, Kail & Miller, 2002; Denckla & Rudel, 1976b; Kail, Hall & Caskey, 1999; Kleine & Verwey, 2009; Nicolson & Fawcett, 2008; Wolf, 1991; Wolf & Bowers, 1999; Wolf et al., 2000). In 1976, Denckla and Rudel had already described the difficulties experienced by dyslexic readers in timing when performing both linguistic and non-linguistic tasks. Some authors presume that there is a strong correlation between general information processing speed and RAN (Logan, Schnatschneider & Wagner, 2009).

Automatization theory stresses that learned skills accumulate through the process of repeated practice and become more and more fluent until intentional thinking about skill performance is no longer needed. Both naming and reading automatization are defined by fast and short reaction times. Automatization of naming skills is considered to be a fast and effortless level of processing, that provides access into phonological, semantic, lexical and syntactical components and requires some or no awareness at all (Catts et al., 2002; Logan, 1997; Logan et al., 2009; Meyer et al., 1998; Nicolson & Fawcett, 2008; Neuhaus & Swank, 2002; Norton & Wolf, 2012; Wolf et al., 1986; Wolf et al., 2000). Tests consisting of serially presented pictures are treated as a relevant tool for measuring the automatization aspect of RAN skills (Meyer et al., 1998).

It has been claimed that automatization deficits affect skills more widely than just those involved in language and literacy, and that all skills that demand expert performance will be compromised (Nicolson and Fawcett, 2008). Children with RD have been found to present automatization difficulties in timing and sequencing tasks, gross motor and balance tasks (Kleine & Verwey, 2009; Nicolson & Fawcett, 2008).

Contrary to the automatization theory, some studies have shown that general automatization difficulties do not cause SRD. The results that dyslexic children achieved in motor and balance tasks and other non-verbal tasks differed very little from the results of control children of appropriate age (Wimmer et al., 1998; Kasselimis, Margarity & Vlachos, 2007; Ramus, 2003).

There are also contradictory results and explanations about RAN and working memory: some authors confirm the connection between RAN and working memory, others show the instability and/or weakness of the connection, while a third contingent relates a connection with orthography. The need for further research is widely expressed by all (Ackerman, Dykman & Gardener, 1990; Georgiou, Das & Hayward, 2008; Närhi et al., 2005; Salmi, 2008).

There is now a limited number of recent studies that have investigated articulation as an underlying factor for RAN. The research evaluated explicit articulation time and pausing between two stimuli as two distinct processes. The process more relevant to RAN and the reading relationship is pausing time as it refers to language-specific associations between visual and verbal codes, speed of lexical access and progress forward speed (Araujo, Inacio, Francisc, Faisca, Petersson & Reis, 2011; Georgiou, Parrila & Kirby, 2006; Lervåg & Hulme, 2009; Li, Cutting, Ryan, Zilioli, Dencla & Mahone 2009; Li, Kirby & Georgiou, 2011; Salmi, 2008, Wolf, 1999 Wolf & Bowers 1999). Li et al., (2009, 2011) has figured out that colour and letter naming pause time and number naming articulation time were significant predictors of reading fluency. In contrast, the same investigation showed that number and letter pause variability were predictors of reading comprehension. In summary, RAN pause time and total naming time were related to reading comprehension by Grade 6, but not in earlier grades.

Naming skills are related to lexical-semantic processes (Salmi, 2008). However, researchers have found that naming skills and semantic skills are weakly connected statistically and that semantic problems do not include naming difficulties implicitly (Constable, 2007; Swanson et al., 2003). Serially presented stimuli tests investigate RAN sub-skills and discretely presented stimuli tests measure lexical-semantic aspects. Children with SRD tend to have difficulties in RAN tasks rather than unusual deficiencies in vocabulary skills. Consequently, serial RAN could be more strongly related to reading than discrete RAN (de Jong, 2011; Meyer et al., 1998). Wolf (1991) has pointed out that children with SRD have shown difficulties in naming discretely presented stimuli, that relates to the weakness in reading acquisition and in access to the lexical-semantic features.

The differential value of RAN tasks is noteworthy when viewed in the context of developmental disorders. RAN and diverse learning difficulties are probably related in several various ways. The differences in rapid naming RAN, especially in picture naming, have been noticed to discriminate between children with RD and attention deficit hyperactivity disorder (ADHD) (Savage & Fredricson, 2005) and also children with SRD and general learning difficulties (Denckla & Rudel, 1976a, 1976b; Heikkilä et al., 2008; Torppa et al., 2010). Conversely, Waber et al. (2000) found that RAN made a more visible difference in LD, but was inefficient in separating SRD children from LD children. The discussion on RAN as general or language specific phenomena is still an open one, and more research is needed.

EDUCATIONAL AND FUTURE IMPLICATIONS

In summarising materials referenced and analysed on the role of RAN in the reading process, it is possible to propose some implications for future scientific research and educational practice.

By necessity, future research into RAN needs to be accompanied by heterogeneous and relevant knowledge about reading complexity, the underlying processes of reading and reading difficulties. Increased depth of understanding about RAN's role in the reading process assumes the continued incorporation of information from brain imaging and/or genetics. More in depth understanding of the role of RAN in reading processes assumes that the incorporation brain imaging and/or genetics should be continued.

Understanding the relationships and the sequence of cause and result sequences is crucial for effective early identification and remediation arrangements. In the reading research conducted so far, there have been various sets of instruments and variables used. Educators need reliable, easy-to-use and time-efficient approaches and methods to detect reading status, reading difficulties and the risk for it in children at preschool and school age. RAN tests administered in the early years of reading (from preschool up to Grade 3) have been shown to have high diagnostic value and so, the inclusion of RAN tasks into reading assessment instruments is justified by these numerous investigations.

By detecting potential difficulties in reading acquisition, as early as possible, we can prevent further academic, behavioural, emotional and social problems (Byrne et al., 2006; Katzir, 2008; Kim, 2004; Norton & Wolf, 2012; Wolf, 2003).

Struggling readers need access to effective and science-based educational remediation programs. Understanding the different types of challenges children face in learning to read is important in developing and delivering accommodated instruction practices to children. Children with reading problems benefit from specified remediation programs directed toward their cognitive and language abilities, including naming and fluency problems that underlie reading disabilities. Children with special naming and fluency deficits may not benefit from traditional intervention programs (Byrne et al., 2006; Katzir, 2008; Norton & Wolf, 2012; Wolf, 1999).

It is debated whether RAN presents limited implications in practice to improve reading skills and it has been noted that training for RAN (letter) has little effect on either RAN or reading training. This evidence suggests that RAN taps into a more basic index of cognitive and language processing (Lervåg & Hulme, 2009; Norton & Wolf, 2012).

Wolf (1999), and colleagues have investigated using reading sub-skills to demonstrate methods for improving reading fluency. The essential consequences and implications of the Double Deficit Theory can be demonstrated using the RAVE-O program (retrieval, automaticity, vocabulary-elaboration, and orthography). RAVE-O meets the needs for reading fluency and automaticity at two levels: in reading behaviors (word identification, word attack, and comprehension) and in the underlying component processes, including visual and auditory recognition, orthographic pattern recognition, lexical-retrieval and semantic processes. Tasks in this program have been used to address the need to increase visual scanning speed, orthographic pattern recognition, auditory discrimination and word identification, which share the same cognitive processes with RAN.

The principle concept of the practice is that one retrieves fastest what one knows best. Norton and Wolf (2012), stated that differential treatment studies are critical in determining whether subtypes of children with processing-speed difficulties are benefited by the targeting of specific word recognition skills or by placing more comprehensive emphases on fluency across all the underlying components.

The results of existing studies indicate that remedial training programs need to be specific to a reader's subgroups (by DDT) and the language in which reading improvements are sought (Li et al., 2011; Wolf, 1999; Wolf & Bowers, 1999).

Recent developments in visual media have inspired researchers to consider how reading using new and electronic media affects early reading instructions and reading automaticity and fluency comprehension (Norton & Wolf, 2012).

SUMMARY

Previous research has shown that naming skills provide two basic functions of language – naming and generalisation. It is essential for everyday living to be able to retrieve necessary words from memory and to present them as fast and correctly as possible. Disturbances (slow speed and crucial amounts of mistakes) in these processes suggest Naming Difficulties and are related to SRD (Denckla & Rudel, 1976a, 1976b; German & Newman, 2007; Luria, 1962; Messer & Dockrell, 2006; Tuovinen, 2003; Wolf & Bowers, 1999).

Valuable knowledge has been obtained about RAN, one of the naming sub-skills. RAN is considered a verbal-cognitive skill that is comprised of visual and auditory perception, articulation and lexical processes of language, as well as, sequencing and timing processes. RAN tasks simulate the reading process and they have the same origins. Therefore, results from RAN tests are able to predict later reading performance including both as SRD and the risk of SRD. Researchers have shown that Naming Difficulties have persistent connections to SRD. Naming Difficulties observed before the beginning of formal reading instruction (age 6-9) persisted through adolescence, so that reading was performed more slowly and more mistakes were made in both naming and reading tasks, than by their peers.

Despite the progress that has been made in understanding the phenomenon of RAN and connections to the reading process, future investigations are required. More research is needed to elaborate on causal mechanisms between RAN and reading involving cognitive and executive processes. Furthermore, the relationship between RAN and phonological processing needs further investigation. We look forward to the continued analyses of the two concurrent approaches still under discussion in the field: whether the issue is language specific or a more general deficit. The double deficit hypothesis and the three proposed groups of RD are not clearly established yet. There is a lack of investigations about double deficit hypothesis in different languages and orthographies. The stability of RD groups is still under question and requires more detailed research.

Practical experience in the use of RAN in the diagnostic process is still not fully reflected in published research. There must be lot of essential information for scientific approach and researches in generalisation of practice.
RAN as a treatment has value and merits more attention. Its widely known title of *'easy to measure, hard to improve'* makes it a worthy matter for both theoretical and practical application.

In conclusion, contemporary research into the area of RAN skills are essential for different languages and cultures in focusing on the nature of RAN and its casual relationship to different developmental difficulties regarding further theoretical and practical statements.

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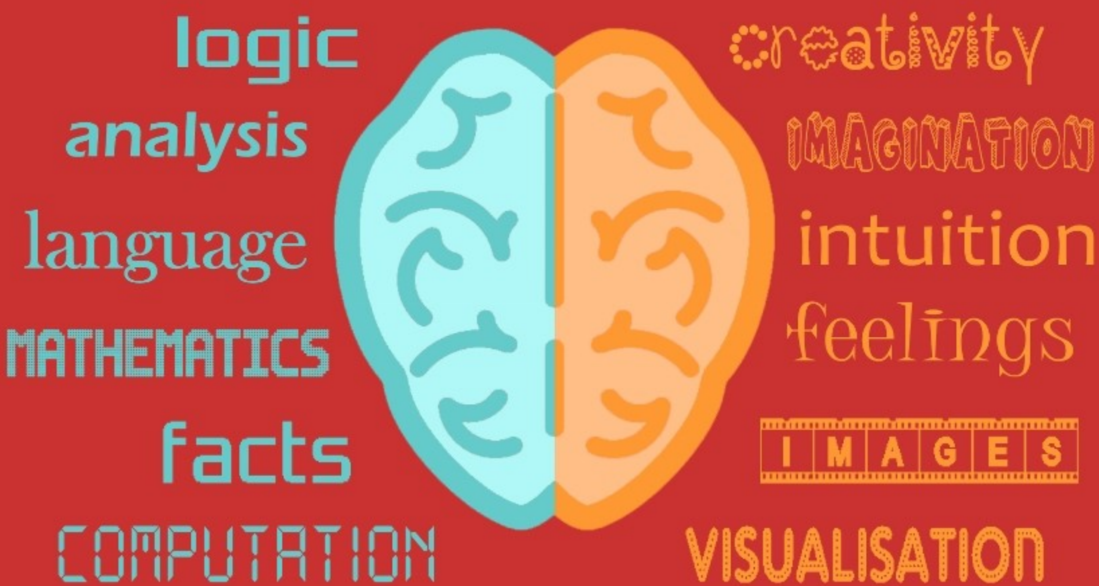

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Could Preschool Eye Movements Contribute to Diagnosis of Reading and/or Dyslexia? A Longitudinal Case Study

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The author studied the relationship between eye movements of a preschool child (boy) and his subsequent development as a reader. The aim was to contribute to findings about whether there is information within eye movements about future reading development and its anomalies. The case report showed that long-term, partial weakening of eye movements correlated with long-term, partial weakening of reading development. With caution it can be stated that examinations of eye movements may contribute to prognostic considerations in the field of reading development and may become part of preschool screening.

Keywords: dyslexia, reading, eye movements

Diagnosis code 315.0 in DSM-IV-TR specifies the following criteria for dyslexia: A. Reading performance is significantly lower than expected for that particular chronological age, IQ and education; B. The reading disorder interferes with school performance or general activities which require reading skills; C. In differential diagnostics, it is necessary to eliminate the following from the list of reading disorder causes: mental retardation, sensory disorders, neurological illness and other general health ailments, including emotional neglect.

The etiology of dyslexia is still unclear. The prevailing opinion is that the disorder is of neurobiological origin (e.g. Bakker, Van Strien, & Licht, 2007; Bucci, Brémon-Gignac, & Kapoula, 2008; Galaburda, 2005; Wiseheart, Altmann, Park, & Lombardino, 2009).

According to phonological theory, the essential problem is so-called phoneme awareness (Liberman, 1984). This is the ability to identify parts of a word, phonemes, in the word as a phonetic whole. Each phoneme has a particular grapheme (i.e. letter) assigned to it. While reading, a child must identify a specific grapheme from others and add sound to it (known as grapheme – phoneme correspondence). Dyslexics have difficulty identifying phonemes and are therefore unable to orientate themselves with respects to grapheme – phoneme correspondence, and with their deformed phonological key they are not able to access meaning which is coded within the graphic representation of words.

Eye movements of the so-called phonological dyslexics (see Rayner, 1998, 2009) are highly erratic but only while reading a text adequate to their chronological age. When reading a much easier text, their eye movements become renormalised. In non-reading tasks, i.e. those not requiring linguistic processing, their eye movements do not significantly differ from the controls. The cause for the failure among linguistically oriented dyslexics to read correctly then does not originate from incorrect eye movements but from imperfect linguistic or phonological processing instead.

Visual dyslexics are quite different to phonological dyslexics. Visual dyslexia is associated with the theory of visual deficit or magnocellular theory (Eden, Stein, Wood, & Wood, 1994; Eden, Van Meter, Rumsey, & Zeffiro, 1996; Galaburda, Menard, & Rosen, 1994; Livingstone, Rosen, Drislane, & Galaburda, 1991; Ray, Fowler, & Stein, 2005; Stein, 1991, 2001; Stein & Fowler, 1984; Stein, Richardson, & Fowler, 2000; Stein & Talcott, 1999; Wilmer, Richardson, Chen, & Stein, 2004). Advocates of the theory of visual deficit argue that the nature of the problems dyslexics have need not necessarily be of linguistic origin, as problems may also occur in a non-verbal situation.

Presumably, the problems are accountable to changes in the magnocellular system. Proponents of the visual and magnocellular theory ascribe significance to differences in eye movements between dyslexics and control groups while performing non-verbal tasks. They claim that the eye movements of dyslexics are normal but they are unable to process visual images and spatial information as such. Supposedly, eye movements are not the cause of poor reading. The theory of visual deficit does not deny the validity of phonological problems. The above mentioned authors (e.g., Eden et al., 1994; Ray, Fowler, & Stein, 2005, etc.)

merely try to demonstrate the fact that dyslexia is a far more diverse problem than generally believed and that the problems of dyslexics reach beyond the limits of traditionally-defined language deficits stemming from impaired phoneme awareness.

A specific approach to the eye movements of dyslexics is expressed in the cerebellar theory. Its proponents note that many dyslexics have, in addition to the reading and language problems described in the phonological theory, non-linguistic problems, such as imbalance or motor and sensorimotor discoordination (Brookes & Stirling, 2005; Finch, Nicolson, & Fawcett, 2002; Nicolson & Fawcett, 2011; Nicolson, Fawcett, & Dean, 2001; Reynolds, Nicolson, & Hambly, 2003; Stoodley, Fawcett, Nicolson, & Stein, 2006). The cerebellum plays a significant role in controlling oculomotor behaviour – i.e., cerebellar dysfunction manifests itself through eye movements and affects a person's reading aptitude.

The share of visual-spatial problems among dyslexics remains an unanswered question. Under the strong influence of phonological theory, it was generally believed that the language-deficit type was more prevalent, whereby visual or visuo-spatial disorders were considered complementary. Researchers estimated that at least two thirds of dyslexics have had problems with the phonological conversion of orthographic symbols (Rayner & Pollatsek, 1989; Castles & Coltheart, 1993). However, this was conclusion was challenged by the visual theory followed by the magnocellular theory. Stein (2001) pointed out that in his studies only one third of dyslexics have mostly phonological problems, one third mostly visual-orthographic problems, and in the remaining third both types of problems are more or less equally prevalent.

Despite a great number of studies focusing on links between eye movements, reading and dyslexia, published in the last three decades, the role of eye movements is still unclear. The aim of this study, therefore, is to help clarify the role that eye movements play in reading and/or dyslexia.

In one of our studies (Jost, 1992), we came across the case of a boy who had above average phoneme awareness, yet below average reading development. This case is the subject of the following study.

METHOD

Participants

The boy was part of a sample group of cca 100 children which we observed from preschool age to the end of sixth grade. The aim of the study was to determine to what extent eye movements could be used to predict reading development. All the children had attended kindergarten from the age of 5 to 6 and had then started to attend primary school (children in the Czech Republic start school in September after they reach the age of six).

All the children had an identical curriculum and were subjected to identical teaching methods. The children's native language was Czech. None of the children's families were registered with the social support system on suspicion of the child abuse and neglect syndrome (CAN), alcoholism, any form of addiction, criminal behaviour or financial poverty.

During the five-year monitoring, none of the children underwent any neurological or psychiatric treatment. None were assessed as ill by a paediatrician. No sensory defects were detected from among the children, that is to say, visual defects had been amended.

EYE MOVEMENTS

We used an infrared head mounted eye tracker developed by Pavlidis at the University of Thessalonike, Greece. Eye movements were measured with 100 Hz temporal and 0.2° spatial resolution. The recordings were monocular (taken from the left eye only). The reason for this was the need to simplify the apparatus. The device was not able to register vergence; nevertheless, the recordings of saccades were not affected in any significant way.

Despite that the subjects perceived the tasks binocularly. The child was seated in a chair and his/her head was stabilised by a chin and/or head rest. The eye tracker was calibrated using a three-point routine. The output data were subjected to an online check that enabled the subject to be encouraged continuously to perform to the best of his oculomotor ability. Fixations and saccades interrupted by blinks were excluded from further analysis.

We used two non-reading tasks to examine eye movements:

1) In the so-called sequential task, the child watched a horizontal row of six lights which lit up gradually from left to right and back, right to left, etc. This task stimulated horizontal saccades.

2) The child fixed its vision on a target drawn on a piece of paper. This task tested fixation stability.

MEASURES

In the preschool period we gained information from parents about the personal and family history of their child, and from kindergarten teachers we gained information about the hyperactivity of the child using the shortened version of Connors' Rating Scale.

In the primary school period we recorded the child's successes, administered tests on reading, intelligence (WISC), graphomotorics, attention, sociometric position, self-concept and Connors' Rating Scale for hyperactivity and examined speech with regard to articulation dyspraxia.

Reading

This was measured by a standardised test and described by the amount of correctly read words within a time interval. Speed of reading in the Czech linguistic environment (i.e., in a phonetically highly consistent spelling system) correlates with comprehension (Matejcek, 1998a, 1998b). The reading test was administered at the end of the 1st, 2nd, 3rd and 5th grades. The purpose was to describe the development of the children's reading. What usually occurs (Bakker, 1990) is that within the first two years of school attendance (the phase of initial reading), children preferentially process text using the right cerebral hemisphere. Between second and third grade, they switch to the left hemisphere and begin to use this one preferentially. In fourth or fifth grade, reading development should be stabilised (the phase of advanced reading). Average pupils in Czech schools are able to read fluently and with comprehension any unknown text in their native language adequate to their age after the first term of school attendance.

Graphomotorics

This is measured using a standardised test (Matejcek & Strnadova, 1974). The child copies geometric shapes according to those supplied, e.g. circle, diamond, the intersection of a five-pointed star and a pentagon, etc.

Pupil's self-perception

Measured by SPAS (Student's Perception of Ability Scale) from Boersma and Chapman (Matejcek & Vagnerova, 1987). This test measures overall level of self-appraisal and enables the comparison of a pupil's self-appraisal in the subjects of Czech language (i.e. native language) vs. mathematics.

Visual concentration

This is measured using a standardised test (Jirasek, 1975) during which the child is presented with a table containing randomly arranged numbers from 1 to 25 and the child's task is to find the numbers in sequential order as quickly as possible. The task is repeated ten times and the time is measured each time.

Pupil's popularity
This is measured by the pupil's score on the sociometric test L-J from Long and Jones (Musil, 1977) using a like-dislike scale.

RESULTS

EYE MOVEMENTS

Figure 1 shows the characteristic course of the boy's eye movements at preschool age (6 years, 7 months).

It is evident from the report that the child fixates each light and adheres to the required sequence. With regards to this characteristic alone, the child's eye movements are within normal limits. A striking feature of eye movements which stand out from the norm is dysmetria, which means an imbalance between the size of an eye movement and the movement of its stimulus. Dysmetria takes the form of hypermetria or hypometria. During hypermetria, or 'overshooting', the eye movement is greater than the movement of the stimulus from one position to the other; the eye must return in order to reach the correct position – this is known as a corrective regressive saccade (Ciuffreda & Tannen, 1995; Leigh & Zee, 1987). In Figure 1 we can see hypermetric saccades *a, c*, and *i* (saccades *b, d*, and *j* are regressive corrections). During hypometria, or 'undershooting' (Ciuffreda & Tannen, 1995; Leigh & Zee, 1987), it is reversed; the saccadic movement is shorter and the subsequent correction is progressive. In Figure 1 we can see hypometric saccade *e* (*f* is a progressive correction). Dysmetria is a reflection of the precision of saccades. In a pathological context, dysmetria may signify a cerebellar disorder, possibly a disorder of the brain stem, or a sign of a visual disorder, e.g. hemianopia. Dysmetria is also studied in relation to reading disorders (Ciuffreda & Tannen, 1995; Leigh & Zee, 1987).

In our boy's case, the overall percentage of dysmetric saccades was equal to 20.7% and the percentage of overshoots was 18.5% out of the overall number of saccades. In terms of z-score, this represents a value of 2.77 which is well above average. The boy´s eye movements were significantly hypermetric. The above average proportion of dysmetria induced an increased variability in eye movements during fixation which we expressed using a variation coefficient (V = standard deviation during fixation / average time of fixation). Its value was equal to 42%.

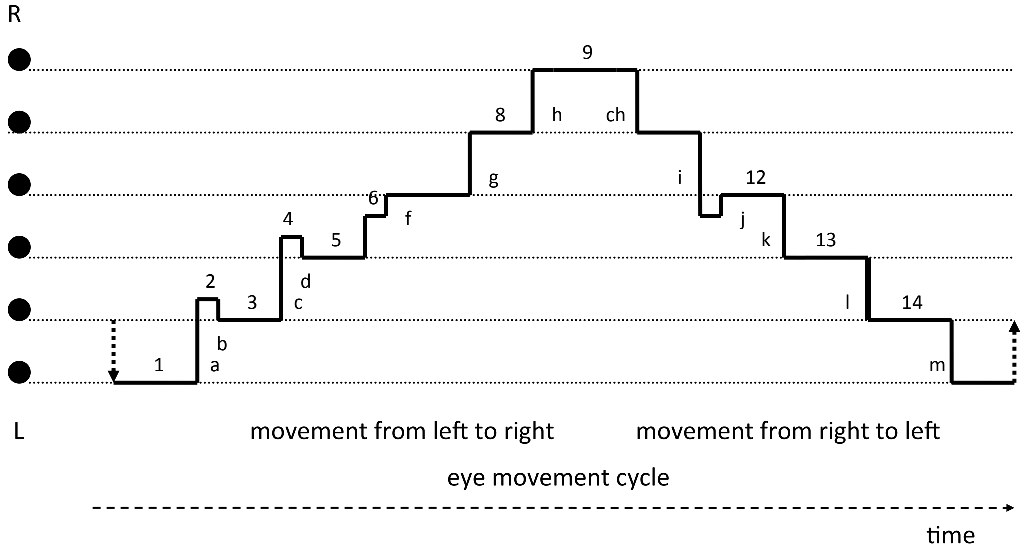

Figure 1. Eye movements of the observed child in the sequential task. Numerals signify fixations (horizontal lines), lower-case letters signify saccades (vertical lines). The capital letters 'L' and 'R' indicate left and right edges of the row. Lights were turned on and off gradually from left to right and back, from right to left, etc. As one light was turned on, the previous light was switched off. The light period was constant and lasted for 0.5 seconds. The distance between lights was an angle of approx. 3°.

The boy's eye movements were characterised by *regular fixations* as well as *auxiliary fixa*tions which induce greater variability in fixation times (both terms, regular fixations and auxiliary fixations, are working terms). We identified auxiliary fixations as those which followed dysmetric saccades and then led to regular fixations. In Figure 1 auxiliary fixations are numbered 2, 4, 6 and 11. All other fixations in Figure 1 are regular. We did not observe any *chaotic fixations* (working term) during which one or more stimuli (lights) would have escaped the child's attention and seriously undermined the sequence of eye movements and introduced chaos.

To express the temporal stability of eye movements, we split each recording in half and compared the two halves. An entire recording lasted approximately 40 seconds so each half was 20 seconds long. Although at first glance this may seem like a short period of time, this approach has proved itself in preschool children. The boy's performance was characterised by a decrease in oculomotoric efficiency. If, in the first half of examinations, he overshot at a rate of 15% out of the overall number of saccades, which is typical for boys, then in the other half it was over 18%.

To express right-left orientation, we distinguished between the direction of left to right and right to left, see Figure 1. In the boy's case, dysmetric saccades were oriented unevenly from right-left: from left to right we observed about 16% dysmetria while in the opposite direction, from right to left, it was only 4.3%.

In the second oculomotoric task, the fixation of a stationary point, we observed a good performance. The boy managed to eliminate eye movements and kept his eyes in one position. Therefore, we were able to exclude fixation instability.

PSYCHOLOGICAL VARIABLES

Phonological awareness
At preschool age the child was able to break apart and assemble words according to individual speech sounds, even with respect to their correct order in words. He was also able to break apart and assemble words using syllables with respect to their order in words. He was able to correctly identify the initial, middle and end sounds in words including vowels. He was able to correctly identify words that rhyme and was able to actively construct a rhyme to a particular word. He was able to correctly identify alliteration which is the repetition of a particular sound at the beginning of a series of different words and/or phrases. According to such findings, uncomplicated reading development of the child was predicted.

Personal history
We found no significant factors. The mother's pregnancy was without complications, the baby was carried to full term, there were no perinatal incidents, the child's birth weight was 3,000g / 50cm, postnatal development was normal, the child was not examined neurologically, underwent common childhood illnesses, there was no serious illness. There were no sensory defects.

School history
The child began attending primary school on schedule and without delay (children begin school at the age of six in the Czech Republic). The child did not repeat any school year and did not change schools or attend specialised classes. The child was observed from the mid-80s – at that time there was a single kind of primary school with a single common programme for all children. Reading was taught via an analytic-synthetic method.

Family history
The family was complete, functional. The father was a university student, teacher; the mother was a high school student. The family spoke Czech, both parents had

Czech nationality. The child had an older sister who flourished with excellent results in linguistic and non-linguistic subjects.

Success
An average grade was calculated from marks in a final report covering grades 1-6 inclusively. The average grade for both Czech (native) language and mathematics was 2.00. In the Czech Republic, a classification system of 1-5 is used where 1 represents the best performance and 5 the worst.

Intelligence
In the WISC test, the child's verbal performance outweighed non-verbal (verbal IQ = 113, performance IQ = 101).

Reading
At the end of first grade, the boy was able to read 20 words/min., i.e. the verbal IQ – reading discrepancy equalled 1.80 SD. The percentage of errors was 4.8%. At the end of second grade, the boy was able to read 33 words/min., i.e. the verbal IQ – reading discrepancy equalled 1.87 SD. The percentage of errors was 5.7% which is on the borderline of sten 4 and 5. At the end of third grade, the boy was able to read 47 words/min., i.e. the verbal IQ – reading discrepancy equalled 2.13 SD. The percentage of errors was 5.1%.

At the end of fifth grade, the boy was able to read 67 words/min., i.e. his verbal IQ – reading discrepancy equalled 1.73 SD. The percentage of errors was 2.9%, i.e. on the borderline of sten 4 and 5. Reading comprehension was satisfactory, storyline context was clear to him, and he reproduced substantial parts of the plot. However, he needed lead-in questions. When reading he complained of visual wobble (letters blur, move and hurt his eyes).

Reading pace acceleration
Reading pace acceleration (*Ac*) was expressed by the formula *Ac* = the number of correctly read words in the second minute / the number of correctly read words in the first minute (%). Acceleration is a parameter with which we evaluate the uniformity of reading performance. A significant decrease in Ac can be ascribed to, e.g. increased fatigue which may in turn be caused by a weakened CNS. At the end of second grade (after two years of schooling), the result of the reading test was *Ac* = 83, i.e. a decrease in reading tempo which within the reference sample of children (N = 85) was average (z = 0.03). At the end of third grade (after three years of schooling), the value was Ac = 52 which corresponded to the value z = -2.23, i.e. well below average.

Concentration
The child's performance corresponded to sten 5 (weak average zone). Pace acceleration corresponded to sten 5 (weak average zone).

Graphomotorics
The child's performance was found to be in sten 5 (weak average zone).

Speech
The child's speech from preschool age was fluent and articulate with no lisp. The child expressed his ideas very well. During second grade, we examined the child's clumsy articulation / speech dyspraxia with negative findings. But even in this respect, his language developed very well.

Self-perception
We administered the SPAS test during fifth grade. The overall result corresponded to sten 5 (weak average zone). Following are the results of each subtest: general skills (sten 6), confidence (sten 6), mathematics (sten 5), reading (sten 5), spelling (sten 3-4), writing (sten 8).

Hyperactivity
Connors' Rating Scale of hyperactivity was administered to teachers during the child's preschool years and a second time during grade three. In both cases the child was assessed as being very calm and focused.

Sociometry
During third grade we gave the children the L-J questionnaire which measures social rank by popularity–unpopularity. The test showed a slightly increased popularity index and ruled out unpopularity.

Findings after 18 years. The same child's eye movements were examined after a period of 18 years, at the age of 23, using the same method as in his preschool years. At the time, the boy had graduated from secondary vocational school. After finishing primary school, he had initially enrolled at high school but had transferred to vocational school during his first year of study. He did not enjoy reading and tended to avoid reading. If he reached for a book, it was usually comics. When reading he complained of visual wobble (letters blur, move and hurt his eyes) and headache. He was able to read 70 – 80 words/min; his rate of reading was decelerated. Reading comprehension was satisfactory, he reproduced substantial parts of the text, however, without details.

A recording of eye movements showed similar characteristics as were present when he was of preschool age: extensive dysmetria and subsequent corrective saccades, without chaotic fixations.

DISCUSSION

Eye movements in the monitored subject showed long-term stability, i.e. continuous dysmetric saccades with the exclusion of fixation instability.

This finding corresponded with the following psychological findings: the structure of intellectual performance was less uniform; verbal performance outweighed non-verbal performance in the child. This dominance could be interpreted as being due to an over-stimulating family environment (father: university student/ teacher, mother: high school student), but when taking into account eye movements, reading development and even some findings in attention tests and drawing tests, it is more probable that the cause was neurobiological.
The findings in attention tests and drawing tests were non-pathological and without defects, however, the child's performance was within the range of average, or rather, weaker average. In contrast, the child's potential level of development was higher as can be inferred by his performance in the verbal part of the intelligence test (above average).

Attention test and graphomotoric test performances both correspond to findings in the non-verbal part of the intelligence test which was also within the range of average. Reading development was generally slower in relation to the norm. Even after primary school, reading probably played a serious role in the further educational development of the child. The child had intellectual needs, applied to a high school which he left within the first year to attend a less challenging vocational school – the child should be seen as a 'less demanding reader'. We saw a noticeable decline in reading pace which, when taking into account the child's weak performance in the non-verbal part of the IQ test and the pace distribution in the attention test, supported the possibility that the child was easily fatigued.

The attention test indicated performance was in the lower part of the average range and acceleration rate was also reduced. In reading, in non-verbal subtests of the IQ test and even in the attention test, the child worked in a visual environment in which he had to orientate himself. Similar requirements were placed on him during the oculomotor task. The child had problems in all these tasks, his performance was delayed intraindividually – in relation to his developmental level as estimated by the IQ test, or interindividually in comparison with his peers.

These findings contrast strikingly with the high level of phonological skills observed in preschool age. It is precisely this above average level of phonological skills together with above average performance in verbal parts of the IQ test and a stimulating family environment that led us to believe that the reading development of the child would be smooth and at least average. This conclusion was fully consistent with the phonological theory of dyslexia.

However, reading development did not confirm this hypothesis. It was probably not a case of deep dyslexia. We may consider the child´s reading difficulties to have been objective, not caused by the child himself or his family or school. The most probable cause were CNS peculiarities of a prolonged nature, These peculiarities included the child's reduced ability to orientate himself in a visual environment in which a subject must process different visual forms and be able to manipulate them, putting them into sequences or syntaxes and finding relationships and regularities between them.

The boy's problems could have escalated if the boy had lived in a linguistic environment which was characterised by non-transparent orthography. Non-transparent orthography is particular to the English environment where spoken and written forms of language differ greatly. The Czech language, with its transparent orthography, probably offered the boy more favourable circumstances for reading development despite his deficit of non-phonological nature (see also analogous experiences from the field of the German language, Wimmer & Schurz, 2010).

The child is unlikely to have ADHD. The child was calm and focused throughout kindergarten and primary school. In oculomotor behaviour, we observed good fixation stability. Findings in personal history were negative. Motor coordination problems were not observed. Speech was pure and without clumsy articulation.

In our case study, long-term partial weakening of eye movements (dysmetria) coincided with long-term partial weakening of reading skills at decoding level. It was difficult to determine whether this was a case of comorbidity or a close relationship. If it was a close relationship, dysmetric eye movements were probably not induced by poor reading and poor linguistic processing of text. Eye movements of preschoolers were tested using non-reading tasks, where the influence of language was absent. Eye movements were also tested in the period before the commencement of reading education. It was possible to judge from the results that eye movements were not the only factor controlling reading ability and were probably not the dominant factor.

A causal relationship between eye movements and reading was found to be improbable. The findings in this study suggest there is a common factor affecting eye movements and reading ability. It could be an imbalance within the central nervous system, as referred to by Bakker (Bakker, 1990; Bakker, Van Strien, & Licht, 2007). This imbalance could be reflected in eye movements. Bakker's Balance Model is based on the specialised functions of each brain hemisphere:

the visual processing of text is largely the function of the right hemisphere while the allocation of meaning to graphemes is largely the function of the left hemisphere.

The model assumes that the foundation of dyslexia is disrupted co-operation between the two brain hemispheres: the perceptual type is characterised by the tendency to process information in the right hemisphere. This type is able to decode graphemes quite well but has difficulty in assigning them meaning. Reading is slow with few mistakes. In contrast, the linguistic type is characterised by a disruption to the visuospatial factor.

Reading is characterised by substantive errors (the reordering of letters and syllables, omission of speech segments and syllables, the addition of words and their distortion) and in relation to decoding, this type has a greater ability to understand what is read. Both types of dyslexia were examined oculomotorically (Donders & Van der Vlugt, 1984). Eye movements of the perceptual type were characterised by a greater number of fixations, short saccades and a low number of regressions. In contrast, eye movements of the linguistic type were characterised by a large variation in fixation times and a large number of regressions. Our case study resembled the linguistic type from a reading and oculomotoric point of view.

Reading is a multifactor skill in which eye movements are one of many influences. Based on our case study it was not possible to compare the influence of eye movements of preschoolers on reading development with the influence of phonological awareness and family environment. If dysmetric eye movements had at least a hypothetically adverse effect on reading development in our case, then this effect was probably compensated in part by good phonological awareness and a linguistically stimulating and literacy-rich family environment.

CONCLUSION

The case report showed that long-term, partial weakening of eye movements correlated with long-term, partial weakening of reading development. With caution it can be stated that examinations of eye movements may contribute to prognostic considerations in the field of reading development and may become part of preschool screening.

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ABOUT DAS 2014

About DAS

Lee Siang

Chief Executive Officer
Dyslexia Association of Singapore

The DAS Handbook Early Intervention reflects the specific growth DAS has made in the area of early intervention. I would like to congratulate the Specialised Educational Services (SES) team who have worked hard to bring this information together to make a difference to those who serve preschool learners.

The Preschool Programme was started to help preschoolers who are potentially at risk of dyslexia or has developmental delay in early literacy. The programme aims to help preschool learners develop skills and strategies to become confident achievers when they enter primary school. Besides the Preschool Programme, DAS also has other programmes supporting learners of primary and secondary school levels.

Presently, there are 3,000 students enrolled in the 13 DAS Learning Centres and more Ministry of Education schools with the School Dyslexia Remediation Programme. However, there could be as much as 20,000 students in preschools, primary and secondary schools with not just dyslexia, but dyslexia severe enough to warrant intervention. So, we are still just the tip of the iceberg in terms of the number of students the Ministry of Education and DAS should be helping.

Another area of need is expanding support to other age groups. Currently, DAS provides services to primary and secondary school students. We have only just begun our work with preschoolers and we still need to reach out to post-secondary and adult dyslexics.

DAS must continue to expand in scope and size to be able to cater for older children and higher order literacy skills, help our students in their academic subjects and well as in life skills. Additionally, we must provide support for dyslexics who have associated learning differences such as ADHD, dyspraxia, dyscalculia, etc.

> "… we are still just the tip of the iceberg in terms of the number of students the Ministry of Education and DAS should be helping."

Our region, as a whole, still lacks sufficient support for dyslexics. As we develop our programmes and services in Singapore they will be of interest to our colleagues in neighbouring countries and we must be responsive to their enquiries to further spread awareness about dyslexia and associated learning differences.

Building a pool of expertise in dyslexia and associated learning differences in Singapore is a main objective of DAS. DAS staff must not underestimate the experience and expertise we have already accumulated and we must continue to invest and give our colleagues, many of whom are below the age of 30, the opportunity to pursue professional development and gain exposure.

Most research into dyslexia is still originating in the UK and US. Our database of several thousand children with dyslexia has tremendous potential for research. This is especially true in our unique multi-lingual, multi-ethnic environment where there is tremendous emphasis on academic excellence.

Here are some highlights of some recent DAS expanded efforts:

- DAS Specialised Educational Services (SES) Preschool Programme doubled its enrolment in the past year to over 250 students.

- SES has also begun to conduct psychological assessments and specialist tutoring for young adults.

- The Ministry of Education-aided DAS Literacy Programme (MAP) has introduced an expanded integrated curriculum to provide for the literacy needs of a much wider range of students.

- To complement our Essential Maths Programme and Speech and Language Therapy, SES introduced a Chinese Programme, an English Exam Skills Programme and the Speech and Drama Arts Programme in 2013.

- From 2014, SES also introduced a series of school holiday programmes covering creative writing, presentation skills, social skills, goal setting and maths word skills workshops.

- We have responded to requests from Malaysia, Indonesia and Philippines with DAS subsidiary DAS International staff making several visits to provide psychological assessments and speech and language therapy to our international clients.

- To further expand the academic pathway for professional development in our field in Singapore, DAS Academy, another DAS subsidiary, launched a new MA in Special Educational Needs in partnership with the University of South Wales in 2013.

- DAS Educational Therapists have also taken on the challenge to broaden their expertise and become “Dual Specialists” by training to teach both Literacy and Maths or both English and Chinese, for example

- DAS has compiled for the first time an Annual Programme Evaluation report for 2013 for all major programmes.

- The SES Chinese Programme Team prepared a research paper based on the findings of their programme which was subsequently published in the July 2014 issue of the Asia Pacific Journal of Developmental Differences.

- The SES Chinese Team, SES Preschool Team and the MAP Team made presentations based on the results of their programmes at the International Dyslexia Association’s Conference in San Diego, USA in November 2014.

These efforts reflect the breath and complexity of the needs of our clients with dyslexia and associated learning differences. It also defines and demonstrates the vibrancy and energy of DAS staff which is critical as we continue to be in pioneering country in almost everything we do as we strive for benefit of our clients.

With all of this in mind, the DAS strategy for the next five years is clear - To build and deliver a comprehensive and holistic range of programmes and services for our dyslexic clients. I am more than confident that the research and articles in this first issue of the DAS Handbook of Early Intervention will encourage DAS staff, Preschool teachers, parents and all stakeholders to further explore dyslexia and support the young learners that need it,

“Our region, as a whole, still lacks sufficient support for people with dyslexia. Building a pool of expertise in dyslexia and associated learning differences in Singapore is a main objective of DAS.”

ABOUT THE AUTHOR

LEE SIANG
Chief Executive Officer
Dyslexia Association of Singapore

Mr Lee Siang assumed the post of Chief Executive Officer on 1st September 2014. He oversees the work of the DAS HQ Branches operations, supervises the management of the three DAS Divisions, namely the MOE aided DAS Literacy Programme (MAP), Specialised Educational Services (SES) and the Learning Centres and Outreach Division. He also sits on the Board of DAS subsidiaries, DAS Academy and DAS International. Siang is a member of the US - based International Dyslexia Global Partners Committee. He has 25 years of experience in leadership and management of which 15 years is at senior level in non - profit organisations.

Siang observes that "unlike other industries, work in a non-profit organisation gives you immense satisfaction that your efforts are helping clients who need your support and who are likely to not receive it otherwise!"

Siang joined the DAS in December 2001 and has played a key role in the rapid growth of the DAS Family into a thriving social enterprise with a multi-disciplinary professional work force that provides a continuum of psychological, educational and training services . He emphasises that the DAS must view itself as a social enterprise and management "must strive to fulfil our social mission by combining entrepreneurial and business skills with the philanthropic characteristics of non-profit organisations".

Siang obtained his Bachelor's Degree from the National University of Singapore via the sponsorship of a Singapore Armed Forces Training Award. He also has a Postgraduate Diploma in Financial Management from the Singapore Institute of Management, a Masters in Business Administration from the University of Western Australia, a Certificate in Dyslexia Studies, a Postgraduate Certificate in Teaching and Learning in Higher Education from the London Metropolitan University and a Postgraduate Certificate in Specific Learning Differences, also from the London Metropolitan University. It is this unique balance of experiences and qualifications that has allowed Siang to oversee the diverse services and functions of the DAS Family.

Our Journey

In 1993, the DAS had one learning centre, one teacher and 12 dyslexic students. Today, the DAS employs over 240 staff, who jointly support over 3,000 school students in 13 centres through the MOE-aided DAS Literacy Programme (MAP).

What's more, the enhanced MAP curriculum appreciates local requirements, bringing us closer than ever to achieving our mission. And all our MAP Educational Therapists are graduates with a Specialist Diploma in Special Education to ensure that learners with dyslexia receive quality assistance.

What seemed like an incredible task two decades ago has quickly become a reality as an appreciation of the dyslexic difficulties and their unique gifts is now prevalent in Singapore. There is much they can achieve, when given the right support which is our MAP to success.

With an estimated 23,000 dyslexic children in local preschools, primary and secondary schools, efforts to reach these children must and will continue. In the words of Camus "every achievement is a servitude. It compels us to a higher achievement." And so MAP will continue in its mission, with you by our side.

We reflected on our past, prepared for our future by looking at our profiling and placement of students as well student progress monitoring mechanisms. In recognition of the increasingly sophisticated needs of dyslexic learners, a MAP Curriculum Matrix was designed to assist in the identification of what components work best with each unique learner. The Matrix contains the full range of the MAP curriculum, is based on the student profile and banding, and assists educational therapists to define the needs of the learners by targeting specific knowledge and skills. And by doing so, it also encourages educational therapists to be mindful of the subsequent stages for the child and to be more aware of the progress (or the lack of) that the students make.

Enhanced & developed the MAP curriculum so that it now offers individualised group lessons modified in view of local requirements. In accordance to MOE's Professional Practice Guidelines, the Rose Report and the National Reading Panel, an appropriate literacy programme should include phonemic awareness, phonics, fluency, vocabulary and comprehension. And so, the MAP integrated curriculum follows Singaporean, US and UK guidelines for good practice. Based on the Orton-Gillingham approach, the MAP integrated curriculum also makes reference to a range of programmes and strategies in order to support the development and improvement of each learner.

Increased awareness of the dyslexic needs and strengths through a variety of efforts such as awareness talks in schools, free mass computerised screening efforts as well as open house events. Through these means, we are confident of increased awareness resulting in an increase in support to dyslexics.

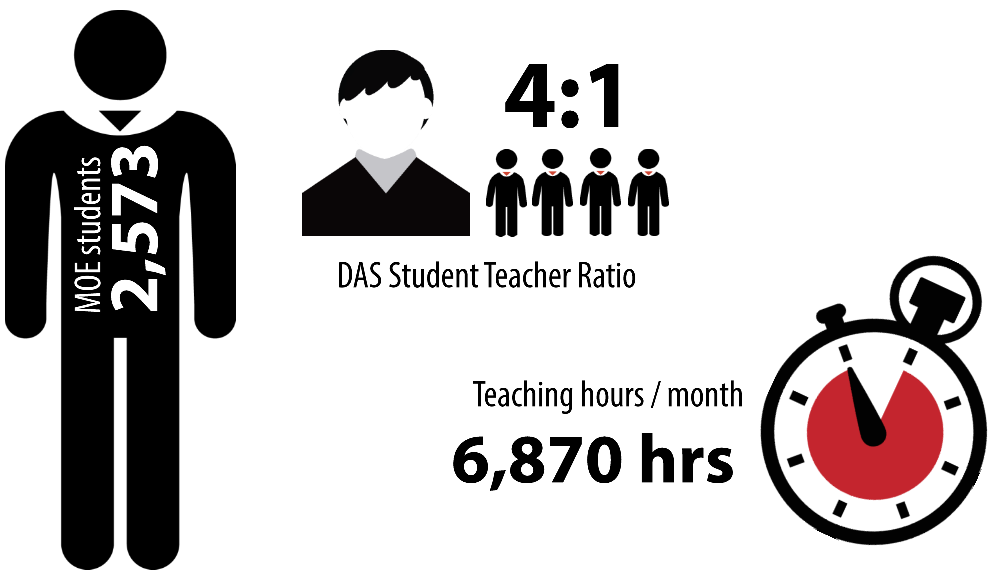
Upgraded facilities by increasing the number of learning centres as well as updating the classrooms by adding smart boards and projectors.

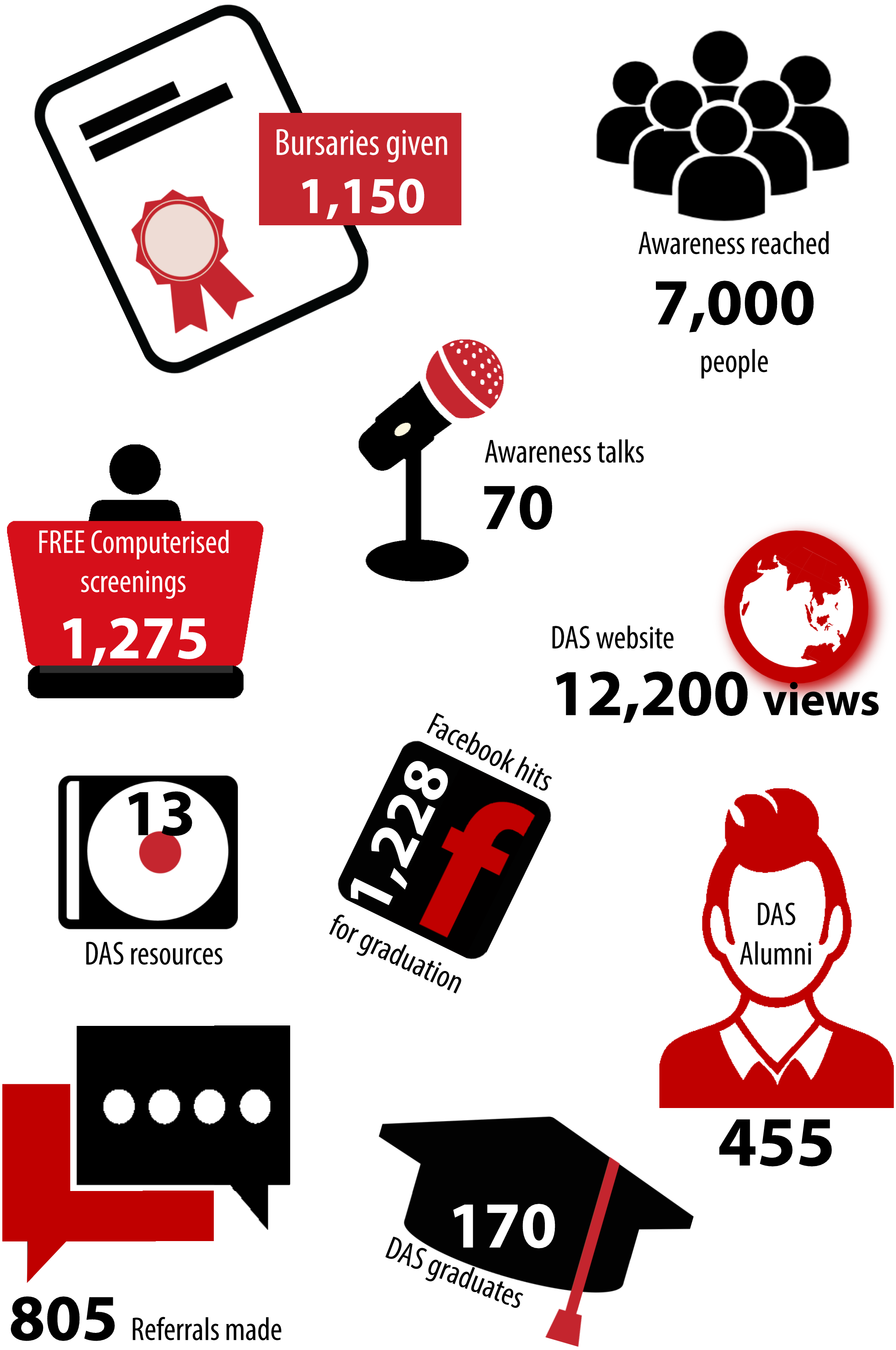
Increased use of technology can facilitate students with specific learning differences to learn and lead productive lives. MAP therefore invests in equipment and software to add to the learning experience in our classes and infuses assistive technology into the lessons as a complementary teaching approach to enhance students' academic success and independence as well as to personalise lessons and skills enhancement to each learner.

Specialised Educational Services (SES), a division DAS, was created with the aim to uncover the true strengths of individuals with learning differences and empowering them with the necessary skills and strategies to succeed. We are a team of professionals who are committed to delivering a quality service focusing on the needs of the individual, at a price which is competitive. All of our professionals are highly qualified and specially trained to help persons with learning differences who may be struggling in the different areas of their lives. We have a good understanding of the curriculum and the demands that today's education systems place on a person and strive to bring out the best in every individual that we see.

2014: A year of ***firsts*** and more...

- Admissions recommended over 1335 students for placement and all of the 426 referrals received from MOE were recommended for placement in MAP.
- 170 students graduated from the programme, a number that has grown incrementally year by year.
- Teams Teaching Teams, a 2-day collaborative learning carnival, was organised for the first time with 27 one hour sessions.
- To guarantee quality of instruction, an annual quality assurance audit of instruction in MAP has been initiated
- Successful launch of the Asia-Pacific Journal of Developmental Differences, showcasing increased emphasis on local research




Bursaries given
1,150
Awareness reached
7,000
people
Awareness talks
70
FREE Computerised screenings
1,275
DAS website
12,200 views
13
DAS resources
Facebook hits
1,228
for graduation
DAS
Alumni
455
805 Referrals made
170
DAS graduates

DAS Learning Centres

1	**Ang Mo Kio** Anderson Primary School 6 Ang Mo Kio Ave 2, Singapore 569948	**6451 5582**
2	**Bedok** Fengshan Primary School, Indoor Sports Hall 307 Bedok North Road, Singapore 469680	**6444 6910**
3	**Bishan** 9 Bishan Place, #06-03 Bishan Junction 8, Singapore 579837	**6250 0526**
4	**DAS Assessment Services** 133 New Bridge Road, #04-01 Chinatown Point, Singapore 059413	**6538 1658**

4	**Chinatown Point** 133 New Bridge Road, #04-01 Chinatown Point, Singapore 059413	**6538 1658**
5	**Chua Chu Kang** Blk 17 Teck Whye Lane, #01-167 Singapore 680017	**6464 8609**
6	**Jurong Point** 1 Jurong West Central 2, #05-01 Jurong Point, Singapore 648886	**6594 0331/2**
7	**Parkway Parade** 80 Marine Parade Road, #22-01/02 Parkway Parade, Singapore 449269	**6440 0716**
8	**Queenstown** Queenstown Primary School 310 Margaret Drive, Singapore 149303	**6475 9535**
9	**Rex House** 73 Bukit Timah Road, #05-01 Rex House, Singapore 229832	**6643 9600/1**
10	**Sengkang** Blk 257C Compassvale Road, #01-545 Singapore 543257	**6881 2072**
11	**Tampines** Blk 163 Tampines St 12, #01-257 Singapore 521163	**6786 0838**
12	**Woodlands** Blk 165 Woodlands St 13, #01-567 Singapore 730165	**6269 0730**
13	**Yishun** Blk 932 Yishun Central 1, #01-101 Singapore 760932	**6451 5582**

DYSLEXIA ASSOCIATION
DAS
OF SINGAPORE

EMBRACE DYSLEXIA

Commitment

1. Raise awareness for Embrace Dyslexia by:
   - Sharing information about dyslexia in the workplace
   - Inviting DAS to conduct Awareness Talks
   - Including information about dyslexia in the staff handbook
2. Explore opportunities to work with the Dyslexia Association of Singapore:
   - Workplace Giving or Volunteering initiatives
   - Mentoring DAS Alumni for internships or work experience
3. Champion dyslexic individuals:
   - Recognising their strengths and understand their weaknesses
   - Providing appropriate support and encouragement
4. Donate to DAS Programmes to help low-income families with bursaries
5. Advocate for Embrace Dyslexia by signing this commitment

EMBRACE DYSLEXIA

DYSLEXIA ASSOCIATION

DAS

OF SINGAPORE

unlocking potential

Students with dyslexia struggle in the education system each and every day. DAS believes that each student is unique in their own way and have strengths that will see them through their education and into a successful career.

At the Dyslexia Association of Singapore we EMBRACE DYSLEXIA and know that every child will unlock their potential to succeed.

DYSLEXIA ASSOCIATION OF SINGAPORE

DAS HANDBOOK OF EARLY INTERVENTION 2015

A collection of articles, research and practical information on early intervention to aid the support of children with specific learning differences, their families and for the professionals who work with them.

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