REACH Journal of Special Needs Education in Ireland, Vol. 17.2 (2004), 81-92

Memory Skills and Specific Learning Difficulties

A study was undertaken to determine the relationship between auditory and visual sequential memory skills and reading and spelling ability in children with specific learning difficulties. Educational implications of the results of the study are identified and suggestions made to assist teachers in addressing memory deficits in this particular group of children.

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INTRODUCTION

The present study examined the relationship between auditory sequential memory (ASM), visual sequential memory (VSM), and reading and spelling ability for children with specific learning disabilities. The results of the study noted that lower scores on ASM were related to lower scores on reading and spelling. This was also the case for VSM. The results further noted that VSM increased with age for the sample; however, this was not the case for ASM. These results suggest that children with specific reading/spelling disabilities have particular deficits in auditory memory skills. Additional data obtained also highlights auditory/verbal deficits for this sample. The educational implications of these findings are discussed. Contributions to the debate surrounding the discrepancy definition of specific learning difficulties are made.

THE RELATIONSHIP BETWEEN MEMORY SKILLS AND READING AND SPELLING ABILITY

Auditory and visual memory

A body of research evidence exists demonstrating a relationship between memory deficits and specific reading disabilities. The most consistent research finding is that readers with dyslexia have difficulty recalling sequences of letters and numbers when presented in an auditory-verbal format (Shapiro, Nix, & Foster, 1990). Pollock and Waller (1994) note that individuals with reading difficulties may have poor short-term auditory memory and poor auditory discrimination. They may confuse words with similar sounds, mispronounce polysyllabic words, and place the stress on the wrong syllable. They may be unable to recall a set of instructions in the correct order or recall a sequence of events, story, etc.

Howes, Bigler, Lawson and Burlingame (1999) provide evidence in their studies for the existence of two subtypes of individuals with dyslexia, those with phonological difficulties and those with visual-spatial difficulties. They noted that both subtypes of readers with dyslexia demonstrated weak or impaired verbal auditory sequential memory.

Results for other measures of memory (e.g., visual memory) and their relationship to reading/spelling ability are less consistent (Bell, 1990; Watson & Willows, 1995).

Giles and Terrell (1997) compared the visual sequential memory skills of children aged 13 years who were poor spellers with those of children who were proficient at spelling. The results of the study noted that visual memory did not appear to differentiate between proficient and poor spellers unless mediated by verbal coding.

Integrating auditory memory and visual memory

Vellutino (1978) concluded from extensive research on dyslexia that the visual discrimination of individuals with dyslexia was perfectly accurate but the difficulty occurred at the memory and associational levels. He concluded that children who confuse *b/d* or *was/saw* do not literally see these letters or words as different, but because of one or more deficiencies in verbal processing, cannot remember which verbal label is associated with which symbol. Swanson (1984) compared the ability of 12-year-old children who were skilled readers and those who had a reading disability to draw meaningless angular shapes from memory. The results of the study showed that while both groups were similar in their ability to reproduce the shapes from memory, the children with a reading disability were at a disadvantage when verbal labels were added to the stimuli. When the shapes were given names, these confused the children with a reading disability but enhanced the performance of good readers. Gupta and Garg (1996) also found in their study that 6- to 9-year old children with reading disabilities had difficulty integrating visual and phonological information.

Are poor memory skills predictive of reading/spelling ability?

The research findings mentioned above indicate that there is a relationship between memory deficits and reading/spelling difficulties; however, more research is required to establish the direction of this link. Do memory deficits occur before reading difficulties or are memory deficits due to lack of reading experience? In a longitudinal study Grogan (1995) examined the relationship between cognitive abilities at age four and reading at age seven. Auditory sequential memory skills and visual sequential memory skills were measured using the Aston Index (Newton & Thomson, 1982). The results of this study support the idea that memory deficits (both auditory and visual) are predictive of reading difficulties. Auditory sequential memory skills were noted to be more predictive of reading ability. The results of this study suggest that verbal short-term memory is the most important cognitive factor at age four in predicting reading ability at age seven.

THE PRESENT STUDY

The present study examined the relationship between memory deficits and reading/spelling skills for children with specific learning disabilities, who were availing of full-time remedial tuition. Auditory sequential memory skills and visual sequential memory skills were measured using the Aston Index. Literacy skills assessed included reading ability as measured by the Group Reading Test (Young, 1989), and spelling ability as measured by the Schonell Spelling Test (a subtest of the Aston Index). Other variables examined included demographic information, I.Q., length in full time remedial education, medical conditions (e.g., ADHD,

epilepsy, asthma) and level of input from other professionals (e.g., speech and language therapist, audiologist, paediatrician and ophthalmologist). Family information, including history of family literacy difficulties, was also gathered from school files.

Participants

Participants were 69 students attending a school for children with specific learning difficulties (61 males and 8 females). Mean age was 12.09 years. The mean length of time spent in full-time remedial education was 1.47 years. Average Full Scale IQ of the sample was 89.53 (SE mean 1.52). From the entire sample (N=69) six (8.7%) had been diagnosed with ADHD, 11 (15.9%) with asthma and two (2.9%) with epilepsy. Over 40 percent of the sample (n=30) had a history of family literacy difficulties (learning disability, specific learning difficulty or diagnosed dyslexia) as noted from school files.

Procedure

All students (N=69) were tested individually on three subtests of the Aston Index, i.e., Visual Sequential Memory (Pictorial) (VSMP), Visual Sequential Memory (Symbolic) (VSMS) and Auditory Sequential Memory (ASM). Duration of the testing was approximately 20 minutes.

The Young Group Reading Test* and The Schonell Spelling Test was administered in the classroom setting. All children were tested in their own classroom and the test was administered and scored by the class teacher.
Additional information was taken from school files and compiled with the assistance of school personnel. All data was analysed using SPSS (9.0) for windows.

* *Although norms for this test are provided for children up to 12 years, it was felt that this test was most suited to this study as all children had reading levels well below their chronological age.*

RESULTS

Table (i) HERE: Description of the present sample (based on full sample N=69)

Table (i) describes the participant sample. Average age was 12 years. IQ was within normal range. The children had spent on average 1.47 years in full-time remedial education. Days missed at school on average was 25.5 years.

Table (ii) HERE: Scores on Aston Index, Reading and Spelling (N=69)

Table (ii) presents the overall mean scores of the Aston Index sub-tests. The mean reading age for the sample was 8.04 years, and the mean spelling age was 7.38 years.

Table (iii) HERE: Correlations between Aston Index scores, Reading and Spelling

Table (iii) presents the results of correlations between VSM(P), ASM and VSM(S) with reading and spelling ages. There were significant positive correlations between ASM and reading/spelling ages ($p<.01$). Lower scores on ASM were related to lower reading and spelling ages. There were also significant positive correlations

between VSM(S) and reading ($p<.01$) and spelling ($p<.05$). Lower scores on VSM(S) corresponded with lower reading ages and spelling ages. There was a stronger relationship between ASM and spelling than between VSM(S) and spelling. No significant correlations were found between VSM(P) and reading/spelling contrary to what was predicted.

Table (iv) HERE: Correlations between Age and Memory Skills

Table 4 presents the results of the correlations between the three subtests of the Aston Index and age. Table 4 demonstrates that there were significant positive correlations between age and VSM(P) and between age and VSM(S). An increase in age was associated with higher scores on VSM(P) and VSM(S). It is interesting to note that there was no significant correlation between ASM and age; in other words, Auditory Sequential Memory did not improve with age.

Table (v) HERE: Memory skills intercorrelated

As can be seen from Table 5 there were significant positive correlations between VSM (S) and VSM (P). Higher scores on VSM (S) were related to higher scores on VSM (P). Auditory Sequential Memory was not significantly correlated with VSM (S) or VSM(P), i.e., there was no relationship between auditory skills and visual skills for children in this sample.

Table (vi) HERE: Number of students who received outside professional input (as recorded in school files)

Table (vi) presents the different types of professionals the students attended outside the school setting. Twenty-one students (30.4% of the sample) attended a speech and language therapist, i.e. the same number of students (n=9) attended an ENT specialist, a paediatrician and an ophthalmologist.

Table (vii) HERE: Number of students with a history of family literacy difficulties (as noted from school files)

As can be seen from Table (vii), 30 students (43.5% of the sample) had a history of family literacy difficulties.

Table (viii) HERE: Correlations between IQ and Reading and Spelling

As can be seen from Table (viii) higher Full Scale IQ scores were related to higher scores on reading. When IQ was examined further it was noted that it was the Verbal IQ scores that appeared to be causing this effect, i.e. higher Verbal IQ scores were significantly related to higher scores on reading. No significant relationship was noted between Performance IQ and reading ability. In addition Verbal IQ was significantly correlated with spelling, i.e. higher Verbal IQ scores were related to higher scores on spelling. There were no significant relationships noted between Performance IQ and spelling or Full Scale IQ and spelling.

DISCUSSION

The main finding of the present study noted that a relationship existed between memory skills (i.e., auditory sequential memory and visual sequential memory) and reading/spelling skills for this sample of students with specific literacy disabilities. As can be seen from the results, lower scores on Auditory Sequential Memory (ASM) and Visual Sequential Memory (Symbolic) (VSM[S]) were related to lower scores on reading and spelling, as measured by the Young Group Reading Test and the Schonell Graded Spelling Test respectively. Students whose auditory memory skills and visual memory skills (symbolic) were less developed were poorer at reading and spelling.

The findings further indicated that this sample of students with specific learning difficulties had particular deficits in the area of auditory sequential memory skills. For these students, age was not significantly related to auditory sequential memory skills. However, there was a significant relationship between visual sequential memory (symbolic) and age. This suggests that auditory sequential memory did not improve with age for this sample of students but visual sequential memory (symbolic) did. Another interesting finding in the present study, which again indicates that children with reading disabilities have difficulty processing information in an auditory-verbal format, is the fact that almost a third of the sample attended a speech and language therapist. This professional was the most frequently attended professional outside of school.

The results of the present study also suggest that students with specific learning disability have difficulty integrating auditory and visual memory skills. The results noted that there were no significant relationships between Visual Sequential Memory skills and Auditory Sequential Memory skills. Visual Sequential Memory (P) and VSM(S) were not significantly related to ASM, though they were highly correlated with each other, i.e. higher scores on VSM(P) were significantly related to higher scores on VSM(S).

A large proportion of the children in the present study, 43.5%, had a history of family literacy difficulties. Most of this information was anecdotal information obtained from the parents themselves, who reported that they had also experienced literacy difficulties at school.

The results of the present study noted that higher Full Scale IQ scores were related to higher scores on reading. When IQ was examined further it was noted that it was the Verbal IQ scores that appeared to be causing this effect, higher Verbal IQ scores were significantly related to higher scores on reading. No significant relationship was noted between Performance IQ and reading ability. Higher Verbal IQ scores were related to higher scores on spelling. There were no significant relationships noted between either Performance IQ or Full Scale IQ and spelling. Therefore Verbal IQ appears to have a mediating effect on both reading and spelling ability.

EDUCATIONAL IMPLICATIONS

The finding that deficits in auditory memory skills are related to deficits in reading and spelling abilities is consistent with the recurring research findings that individuals who have a reading disability have difficulty recalling sequences of letters and numbers when presented in an auditory-verbal format (Shapiro et al.,

1990). Studies have in fact also indicated that memory skills, particularly auditory sequential memory skills, are predictive of further reading ability (Grogan, 1995). Research findings suggest that the development of auditory-verbal short-term memory skills appear to be an important prerequisite for the development of reading spelling abilities.

In Ireland in 1999, a revised Primary School Curriculum was launched which emphasises the importance of the development of oral language at a junior infant level and de-emphasises the introduction of formal reading at this stage. Time spent developing oral language in the classroom at junior infant level or indeed in the preschool setting would provide the time and opportunities to implement programmes designed specifically to develop auditory sequential memory skills and verbal short-term memory skills in general. It is likely that these programmes would be particularly beneficial for children "at risk" of developing future literacy difficulties. For example, simple activities could be firstly introduced and these could gradually become more advanced. Activities such tapping or clapping out a rhythm in imitation could be firstly introduced. These could be followed by activities requiring a child to repeat or remember a series of words and numbers called in sequence, and finally activities requiring a child to remember sentences, riddles, jokes, poems, rhymes, songs and stories could be used. Asking a child to follow instructions in a number of parts could be used as a classroom based activity. This could also be carried out during times such as when physical education is taking place or during playtime. Instructions involving a number of parts could be given such as "raise your hands, clap them and then turn around."

The results of the present study also suggest that students with specific literacy disabilities have difficulty integrating auditory and visual memory skills. This finding is consistent with previous research such as Gupta & Garg's (1996) study, which noted that children with reading disabilities have difficulty integrating visual and phonological information. The results of the present study also tend to suggest that visual memory skills may be an area of strength for children with specific literacy disabilities. Activities designed to integrate auditory and visual memory skills may help to ensure the development of reading and spelling skills, particularly for those at risk of developing literacy difficulties. For example activities requiring a child to listen to letter sounds, words, etc. while he/she is looking at them. At the more basic level these activities could include exercises such as playing a series of environmental sounds on a tape and having the child point to the object or picture of the object that makes the sound. The number of sounds the child must hear before responding could be gradually increased. These activities could be followed by activities such as requiring the child to circle the letter or word on a worksheet he/she has heard and finally requiring the child to circle the correct sequence of letters or words heard.

The results of the present study suggest that children with specific literacy difficulties tend to have a history of speech and language difficulties. Children with verbal difficulties may often rely on their visual/spatial abilities which may be an area of relative strength for them. They may perform well on non-verbal tasks involving activities such as jigsaw assembly, constructing designs with blocks, Lego etc. Employing these activities and adding a verbal component to them might be a useful strategy to develop verbal skills and prevent future literacy difficulties.

For example, the objects in the jigsaw being made or the colour pattern in the block design could be discussed. The child could also follow instructions given in sequence when completing these activities.

Earlier intervention strategies such as those described above would be beneficial for all children, particularly for children who may be "at risk" of developing future literacy difficulties. Consistent with previous research, the results of the present study suggest that children with specific literacy difficulties often have a history of literacy difficulties in their families. It might be useful when obtaining early school and medical records for children to include a standard question asking if there is a history of literacy difficulties in the family. These children could then be specifically targeted when designing early intervention strategies to develop auditory memory skills and verbal skills in general. Extra activities could be arranged outside of school for these children (e.g., speech and drama groups, visit to libraries, homework clubs, etc.) to develop their language skills and increase their exposure to reading material.

It is important to review any intervention strategies put in place at a young age and assess a child's response to them. Similarly, it is important to develop a process of assessment, intervention and re-assessment as a child progresses through school in order to tailor intervention strategies to suit a child's needs and stage of development. For example in later primary school years it may be more beneficial for the child, both academically and personally, to focus on their strengths when teaching literacy skills. For the students in the present sample, whose mean age was 12 years, visual memory skills appeared to be an area of strength.

Studies have generally tended to look at the relationship between Full Scale IQ and reading/spelling ability. The results of the present study suggest that Verbal IQ may be the more important component in the development of reading and spelling ability. Further studies might benefit from investigating the relationship between Verbal IQ and reading/spelling ability and the relationship between Verbal IQ and factors which have been shown to be related to reading skills, for example, memory skills, phonological awareness, etc. Studies examining the predictive relationship between Verbal IQ and reading skills are required. Recent research has suggested that Full Scale IQ is not predictive of reading progress (Klassen, 2001).

This paper is dedicated to the memory of the late Irene Leahy, senior psychologist, COPE Foundation.

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Table (i) Description of the present sample (based on full sample N=69)

Variable	Age	FS IQ	Perf IQ	Verbal IQ	Length in FT Remedial (in years)	School Absences
Mean	12.09	88.53	89.98	89.95	1.47	25.5 days
SD	1.62	11.94	15.97	9.93	1.05	
N	68	64	64	65	68	65

Table (ii) Scores on Aston Index, Reading and Spelling (N=69)

Subtest	ASM	VSM(S)	VSM(P)	R.A.(yrs)	S.A.(yrs)
Mean	5.33	6.75	6.95	8.04	7.38
SD	1.11	1.67	1.66	1.14	1.19
N	67	67	67	66	68

Table (iii): Correlations between Aston Index scores, Reading and Spelling

Test Scores		**VSM(P) Raw score**	**ASM Raw score**	**VSM(S) Raw score**
R.A. Young-Group	Pearson Correlation	.216	.372**	.393**
	Sig (2-tailed)	.084	.002	.001
	N	65	65	65
S.A. Schonnell	Pearson Correlation	.120	.404**	.266*
	Sig (2-tailed)	.335	.001	.029
	N	67	67	

* = p< .05 ** = p< .01

Table (iv): Correlations between Age and Memory Skills

Age (at May 31)	**VSM (P)**	**VSM(S)**	**ASM**
Age	. 327**	.340**	.196
Pearson	.007	.005	.112
Correlation	n=67	n=67	n=67
Sig (2-tailed)			

** p < .01

Table (v) : Memory skills intercorrelated

	VSM (P)	**VSM(S)**	**ASM**

VSM(P)	1.000	.589**	.202
Pearson Correlation		.00	.101
Sig (2-tailed)	n=67	n=67	n=67
VSM(S)	.589**	1.000	.127
Pearson Correlation	.00		.305
Sig (2-tailed)	n=67	n=67	n=67
ASM	.202	.127	1.000
PearsonCorrelation	.101	.305	
Sig (2-tailed)	n=67	n=67	n=67

** = p < .01

Table (vi): Number of students who received outside professional input (as recorded in school files)

Input from Professionals	**Yes**	**%**	**None**	**%**
Speech & Language Therapist	21	(30.4%)	48	(69.6%)
Audiologist	6	(8.7%)	63	(91.3%)
ENT specialist	9	(13%)	60	(87%)
Paediatrician Input	9	(13%)	60	(87%)
Ophthalmologist	9	(13%)	59	(85.5%)

Table (vii): Number of students with a history of family literacy difficulties (as noted from school files)

	Yes	**%**	**No**	**%**
History of family disability	30	43.5%	39	56.5%

Table (viii): Correlations between IQ and Reading and Spelling

Test Scores		Verbal IQ	Performance IQ	Full scale IQ	SA
R.A.	Pearson Correlation	.351**	.206*	.349	.880
Young-	Sig (2-tailed)	.005	.107	.005	.000
Group	N	63	62	62	66
S.A.	Pearson Correlation	.274*	.023		
Schonell	Sig (2-tailed)	.027	.856		
	N	65	64		

* = p < .05 ** = p < .01