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Sex differences and variability in phonological sensitivity among primary school children

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Abstract

Sex differences in phonological sensitivity and awareness were assessed using well-established linguistic measures in translation in a two-year longitudinal study on a sample of 136 children during their first two years at school. Girls obtained significantly higher means on a number of measures of phonological sensitivity but not on tests of ability (Coloured Progressive Matrices) (Cohen's *d* with Hedges adjustment for sample size = .18). The results suggest that girls possess superior phonological skills on entry to school at age 5 years, are better able to utilise their literacy learning experiences to bring them to bear on phonological awareness tasks, and have a lower variance ratio than boys do. There is some support in this study for the notion that girls have somewhat better developed phonological loop memory skills than boys do.

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Introduction

Many contemporary researchers posit the view that there are no differences or only small differences between the sexes in terms of ability. Halpern (2000) clearly states that "sex differences have not been found in general intelligence" (p. 218). This view is shared by other researchers like Brody (1992), Jensen (1998), Lubinski (2000) and Mackintosh (1998). It is therefore established that there are no notable sex differences in general verbal ability, arithmetic, abstract reasoning, spatial visualisation and memory span (Feingold, 1988, 1992). On the other hand, males score higher than females on tests of general knowledge, mechanical reasoning and mental rotations while females score higher than males on tests of language use (Caplan, Crawford, Hyde & Richardson, 1997; Halpern, 2000; Jacklin, 1989; Kimura, 1999; Linn & Hyde, 1989; Linn & Petersen, 1985, Lynn & Irwing, 2004). Even so, these differences have been decreasing over these last generations and it is only in later adolescence that they are marked to any degree (Feingold, 1988). One possibility is that sex differences in verbal learning are minimal or nonexistent during elementary school years, emerging only after puberty when hormonal and psychosocial influences increase (Kramer, Delis, Kaplan, O'Donnell & Prifitera, 1997). If sex differences were present in young children, it would be important to determine if the differences between boys and girls remain constant or if they fluctuate as a function of age or environmental factors.

Measures of phonological sensitivity are widely held to be good predictors of later literacy (Bryant, MacLean, Bradley & Crossland, 1990; Ellis, 1990). Phonological sensitivity can be considered to constitute a hierarchy of skills (Adams, 1990; Stanovich, 1992). Higher levels of phonological sensitivity require more explicit analysis of smaller sized phonological units (e.g., phonemes), and more primitive levels of phonological sensitivity require shallower levels of analysis of larger sound units (e.g., syllables). If one were to adhere to this view, phoneme segmentation, phoneme counting, and phoneme reversal tasks represent the higher levels of sensitivity, whereas rhyming or syllable segmentation tasks represent levels that are more primitive. Sensitivity to phonemes is often assumed to have special status in the relation between phonological sensitivity and reading both because it is at this

ISSN 1726-9725

level that graphemes correspond to speech sounds in reading and because individual phonemes do not have a separable physical reality (Lonigan, Burgess, Anthony & Barker, 1998). It is only later when phonological awareness is applied directly to reading and spelling that phonemes start having a separate psychological reality.

Sex differences in phonological awareness

There is a burgeoning literature on various aspects of sex differences in children's early literacy but little that is specifically about phonological awareness. Numerous studies support the view that generally, young girls possess higher literacy skills than boys (Coley, 2001; Gambell & Hunter, 1999; Lummis & Stevenson, 1990; Phillips, Norris, Osmond, & Maynard, 2002; Soderman, Chhikara, & Kuo, 1999) but this is by no means supported universally. For example, Davies & Brember (1999) suggest that gender differences occur only among higher-achieving students. Given the general lack of consensus about the issue and the fact that differences found are often limited to specific aspects of ability or achievement that may be circumscribed by issues such as sample size, social class, age or even the methodology used in the study, it is not surprising that the topic retains a degree of interest among researchers.

Ready, LoGerfo, Burkam & Lee (2005) provide some inkling as to the possible differences in phonological skills found between boys and girls at an early age. Their study investigated gender differences in a large sample of kindergarten children (8,701 boys and 8,182 girls) and found that girls came to school with an early advantage. Their findings suggest that not only did girls in their sample enter kindergarten with somewhat better developed literacy skills but they also learned slightly more than boys did over the kindergarten year. They attributed these differences to generally more positive behaviours. Part of their study specifically included a basic literacy skills assessment that measured print familiarity, letter recognition, beginning and ending sounds, rhyming sounds and word recognition. All measures are reported to have had high reliabilities. They report that on average, girls entered kindergarten with better-developed literacy skills. There was a difference in the autumn literacy skills assessment that suggested a 0.14 SD (.14 effect size) female advantage at kindergarten entry. Just six months later during the

ISSN 1726-9725

spring literacy assessments, the female advantage widened to 0.19 SD (.19 effect size) with girls having improved their literacy skills faster than boys did. These gender differences are indeed small even if they widen somewhat over the kindergarten year (from 0.14 to 0.19 SD), but they exist nevertheless. Investigating small changes in small differences may be seen as an academic exercise but one cannot ignore the sample size of over 16,000 data sets and the possibility of these small gender differences growing incrementally into larger gender differences over time, by age 16 years.

Doctoroff, Greer & Arnold (2006) also report on the relationship between social behaviour and emergent literacy. In their study, subtests from the Developmental Skills Checklist (DSC; CTB, 1990) were combined with other measures of expressive and receptive language skills to create an emergent literacy measure. What is of particular interest is that this composite measure comprised, along with the above measures, tests of phonological awareness and print awareness. These included measures of letter recognition (assessed by children's ability to name upper- and lower-case letters), auditory skills (assessed by children's ability to identify same versus different sounds), word and sentence segmentation skills, rhyme skills and knowledge of print (knowledge about structure and format of words, differentiating print from pictures and numbers and the identification of components of writing). On a composite measure, albeit adulterated somewhat by other measures for expressive and receptive language, girls outperformed boys once again. In the article by Doctoroff et al. (2006), scores are expressed as z scores but when converted to standard scores, girls obtained 101 scores and boys 98 scores in this emergent literacy measure. The computed effect size expressed in terms of Cohen's *d* was .24, similar to the effect size reported by Ready et al. (2005) but this was probably somewhat inflated due to the inclusion of the receptive and expressive language measures.

Before moving on to the research questions posited by this present article and describing the methodology used, one must make mention of some other concepts relevant to this study. One such concept is the phonological loop. Most of the measures administered in this study and indeed in most studies of phonological

ISSN 1726-9725

awareness relied to a greater or lesser degree on auditory memory. The phonological loop consists of a short-term store that is reported to be in place at around age 3 years, one that retains verbal material in terms of its phonological characteristics but also one that is subject to rapid decay (Baddeley, Gathercole & Papagno, 1998; Ford & Silber, 1994; Gathercole & Adams, 1993; Gathercole & Pickering, 1999). Although Vallar & Baddeley (1984) posit the view that the decay of representations in the memory store can be counteracted by serial subvocal rehearsal, this strategic rehearsal process does not emerge typically until about 7 years of age (Gathercole & Hitch, 1993). This means that any phonological assessment of children under age 6 is likely to tap this phonological loop directly. Ardilla & Roselli (1994) and Gathercole & Pickering (2000) report some minor sex differences for central executive mediated items but none for phonological loop mediated memory items in their batteries of measures. Kramer et al. (1997) document some semantic mediated sex differences in recall. This is suggestive of possible underlying cognitive mechanisms for those sex differences reflecting greater overall learning efficiency on the part of the girls.

The last issue to be discussed with reference to sex differences concerns variability. Feingold (1992) makes the case that while there are differences between the sexes on various cognitive measures, males are more variable than females in IQ. He concludes that "cognitive sex differences in central tendency must be considered in concert with sex differences in variability to understand how effect sizes vary with level of performance" (p. 79).

The present study

The present study was designed to examine whether the superiority of the girls in reading and writing at age 9 years (Martinelli & Lynn, 2005) can be traced to their performance on measures of phonological awareness, in spite of girls in the same sample having no particularly higher cognitive skills than boys do. It is also attempting to consider the possibility that measures of phonological sensitivity that have been causally linked to later literacy (Bus & van Ijzendoom, 1999; Lundberg, Frost, & Petersen, 1988; Schneider & Ennemoser, 2000) also show a sex bias. Girls

ISSN 1726-9725

may be better equipped to achieve successful literacy than boys are and boys may show a higher variance ratio than girls.

This study posits the following research questions;

(a) Do girls show superior performance over males on measures of phonological sensitivity and awareness?

(b) Do females in the participating sample progress better than boys on the acquisition of these causal skills over a two-year period between first entry to school at age 5 years and the end of their first formal year at school at age 7 years?

(c) In view of the fact that performance on most of these measures of literacy also depends on the phonological loop described by Gathercole & Pickering (2000), are girls superior to boys on those measures that tax this phonological loop heavily?

(d) Is male variability higher than female variability on any of the abilities and skills assessed?

Method

Participants

This study followed a group of 136 Maltese nursery aged children through nursery into the first year of primary school. Sample attrition over the two years was minimal. The children in this study attended seven schools that were chosen on the basis of the schools having obtained an average score on the primary schools' rankings, which are based on the annual results of national tests taken by children in Years 4, 5 and 6 (ages 8, 9 and 10 years). The children were all born in the first three months of the year. They all came from socio-economic classes 3 to 7 of the Office for National Statistics' Socio-economic Classification (2004). All children born in that period were invited to participate in the study through a letter to their parents after permission to do so was sought from the Education Division, Malta (as it was known then). No parents objected to the study but in those cases where it was found that children were being stressed by the procedure due to their unfamiliarity with the assessor, the assessment was stopped. In fact, out of a possible 167 pupils, 136 (81%)

ISSN 1726-9725

started to participate in the study. Another three children stopped before all the measures could be administered in the second year. Table 1 shows the number and average age of the participants during the various stages of the study and the bracketed figures indicate the standard deviation of the participants' age at the different times of testing.

Table 1: Average age of participants at each stage in the study

Testing	Boys	Girls	Total	Mean age in months
Kindergarten cycle 1	71	65	136	**56.4 (.66)**
Kindergarten cycle 2	71	65	136	**62.0 (.66)**
Year 1 cycle 1	70	64	134	**68.3 (.90)**
Year 1 cycle 2	**69**	**64**	**133**	**74.4 (.90)**

Measures

The ages of four and five years are developmentally important ages to observe and investigate children's phonological development. Four year-olds are an important group to investigate as the age range 4 to 6 years covers the period prior to the onset of literacy to the beginning of formal literacy. It is highly unlikely that children would be in possession of any formal reading skills at age 4 years but towards the end of Year 1 (in the Maltese context), most would be expected to master the basics of simple word reading even if they would not have attained fluency.

A battery of tests for phonological sensitivity in Maltese was administered during the first year of the study. This was administered in two stages with the more difficult measures being administered in the second part of the school year. In the second year, this procedure was repeated all over again. Other measures that were meant to act as control variables in this study were also administered and these included measures of intelligence, language ability and short-term verbal and visual memory. Measures for short-term memory were administered twice but those for intelligence and language

ISSN 1726-9725

ability only once. This design controlled for the effect of age on performance, as participants' chronological age range on any measure was never more than three months.

Measures of phonological sensitivity

Concerning phonological sensitivity, children were assessed on a number of tasks. These included measures of implicit and explicit sensitivity to phonemes. Within implicit phonological sensitivity, children were assessed for awareness of rhyme and alliteration. Within explicit phonological sensitivity, children were assessed along a scale that constituted three broad levels of explicit phonological detection. These comprised awareness and identification of phonemes in words, segmentation of short words into phonemes and longer words into syllables and finally the manipulation of phonemes. The use of pseudo words in some of the measures was used to help children concentrate better on constituent sounds of words, rather than on meaning (McNeil & Stone, 1965). All phonological awareness tests were administered in Maltese.

All measures were modelled on other measures used in the established literature and were administered in close conformity with the prescribed procedures. The provenance of the tests is detailed in table 2 below. Only the original studies are being listed in a bid to keep the list short and avoid the confusion of names and procedures that developed after these measures were modified in subsequent studies.

Table 2: Test provenance

Phonological sensitivity / awareness measures	Featured in or published
Rhyme and Alliteration Oddity tests	Bradley (1990)
Combined Phoneme Oddity tests	Cataldo & Ellis (1988)
Syllable Counting test (tapping)	Mann & Liberman (1984)
Syllable Counting test (counters)	Elkonin (1973)
Letter-Sound Knowledge	Reason & Boote, 1986
Original Rhyme test	Ellis (1990)
Phoneme Segmentation test	Ellis (1990)

ISSN 1726-9725

Phoneme Deletion test	Bryant, MacLean, Bradley & Crossland (1990)
Phoneme Isolation test	Wallach & Wallach (1976)
Phoneme Reversal test	Lundberg, Olofsson & Wall (1980)
Measures peripheral to this study	
Intelligence	*Coloured Progressive Matrices* (Raven, 1956)
Expressive language	*British Picture Vocabulary Scale* (Dunn, Dunn, Whetton, & Pintilie, 1982)
Receptive language	*Sentence Comprehension Test-Revised* (Wheldall, Mittler & Hobsbaum, 1987)
Concepts about print	*Sand - concepts about print test* (Clay, 1972)
Auditory memory - Sentence-Repetition test	Share, Jorm, Maclean, & Matthews (1984)
Visual memory - Object span test	Katz, Shankweiler & Liberman (1981)

Control measures

A number of measures of intelligence, language (expressive and receptive language and sentence comprehension), concepts about print, and verbal and visual short-term memory were administered as control measures in order to be able to compare the sexes on constructs other than those of phonological sensitivity. The two measures for short-term verbal and visual memory were administered twice over the two-year period, as was the concepts-about- print test but this was administered twice in one year, at the beginning and end of Year 1 as the test was deemed too difficult to administer in the Kindergarten year. The majority of the tests for phonological sensitivity possessed good internal consistency in the region of .7 to .8 and this level of consistency was

ISSN 1726-9725

eminently comparable to the internal consistency figures quoted for the original measures when these figures were reported.

Results

The initial results are shown in Table 3.1 through to 3.4. This gives the means and standard deviations for boys' and girls' performance on each of the tests administered over the two Kindergarten cycles and the two Year 1 cycles. This is followed by *d* values (the differences between the means divided by the pooled standard deviations – Cohen's *d* based on sample size using Hedges adjustment through ESG 2.3 (Devilly, 2004)) for the differences between the mean scores of the boys and girls. The last column on the right gives the t-values for the statistical significance (one tailed) of the differences between the boys' and girls' performance. The Bonferroni-adjustment to maintain overall alpha < .05 for control of Type I error for all pairwise comparisons as described in Green & Salkind (2005) was applied to all values of statistical significance reducing the number of prima facie significant findings. In calculating the values of t, Levene's test for equality of variance was run and showed that the variances were not significantly different for most of the tests; the assumption of equality of variances was justified in most cases. When this was not justified, the adjusted t value was registered.

The first research question concerned the possible female superiority in performance on measures of phonological sensitivity and awareness. Invariably, girls obtained higher mean scores on all the tests, even if they performed statistically significantly better than boys on fewer measures after correction for Type I errors. On some tests, the *d* value indicated that the difference was close to half a standard deviation and on these measures, girls did statistically significantly better than boys. This was particularly true of measures of phonological sensitivity administered in the second year of the study. Girls seem to have significantly better phonological skills that are causally associated with literacy development. Girls' sentence comprehension skills, as assessed by the *Sentence Comprehension Test (Revised)* (Wheldall et al., 1987) were superior to boys' skills on the same construct. Of note is the fact that the difference between the boys and girls on the *Coloured Progressive Matrices* (Raven,

ISSN 1726-9725

1956) were not statistically significant although girls obtained a slightly higher mean. In other non-phonological measures like the memory tasks (Object Span and Sentence Repetition tasks), girls' higher mean scores were not statistically significant in the first year of the study for both measures and continued being non-significant in the second year of the study. Likewise, there were no significant differences registered for the *British Picture Vocabulary Scale* (Dunn et al., 1982) in the first year of the study (this being the only time it was administered).

Table 3.1: Sex differences on phonological sensitivity tests (Kindergarten year)

School Year	Phonemic Sensitivity Tests	Sex	N	Mean	SD	*d*	T 1 tailed
Kindergarten cycle 1	Final Rhyme Oddity-Real	Boys	71	0.54	1.14	.51	3.00**
Age		Girls	65	1.20	1.44		
56.4 (.66)	Final Rhyme Oddity-Pseudo	Boys	71	0.41	0.95	.46	2.72ns
		Girls	65	0.95	1.34		
	Medial Rhyme Oddity-Real	Boys	71	0.42	1.04	.37	2.13ns
		Girls	65	0.91	1.55		
	Medial Rhyme Oddity-Pseudo	Boys	71	0.30	0.85	.37	2.13ns
		Girls	65	0.68	1.19		
	Alliteration Oddity-Real	Boys	71	1.37	2.37	.40	2.32ns
		Girls	65	2.46	3.06		
	Alliteration Oddity-Pseudo	Boys	71	0.82	1.76	.38	2.18ns
		Girls	65	1.62	2.42		
	Combined Phoneme Oddity Initial-Real	Boys	71	0.37	0.80	.42	2.46ns
		Girls	65	0.80	1.20		
	Combined Phoneme Oddity Initial-Pseudo	Boys	71	0.27	0.84	.34	2.00ns
		Girls	65	0.60	1.07		
	Combined Phoneme Oddity Final-Real	Boys	71	0.17	0.59	.36	2.05ns
		Girls	65	0.45	0.94		
	Combined Phoneme Oddity Final-Pseudo	Boys	71	0.11	0.46	.41	2.31ns
		Girls	65	0.42	0.95		
	Combined Phoneme Oddity Medial-Real	Boys	71	0.14	0.59	.16	0.90ns
		Girls	65	0.25	0.77		
	Combined Phoneme Oddity Medial-Pseudo	Boys	71	0.14	0.54	.07	0.44 ns
		Girls	65	0.18	0.61		
	Phoneme Isolation-Initial	Boys	71	1.24	1.69	.26	1.52 ns
		Girls	65	1.71	1.89		
	Phoneme Isolation-Medial	Boys	71	0.28	1.03	.36	2.09ns
		Girls	65	0.74	1.46		
	Phoneme Isolation-Final	Boys	71	0.42	1.06	.32	1.84ns
		Girls	65	0.83	1.47		
	Memory Span Tests						
	Sentence Repetition test	Boys	71	4.97	1.31	.20	1.18ns
		Girls	65	5.22	1.08		
	Object Span test	Boys	71	7.66	1.93	.12	0.70ns
		Girls	65	7.89	1.87		

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Table 3.2 Sex differences on phonological sensitivity tests (Kindergarten year)

School Year	Phonemic Sensitivity Tests	Sex	N	Mean	SD	*d*	T 1 tailed
Kindergarten cycle 2	Phoneme Segmentation	Boys	71	0.38	1.28	.24	1.42ns
Age		Girls	65	0.74	1.63		
62.0 (.66)	Syllable Counting-Tapping	Boys	71	7.44	3.26	.22	1.27ns
		Girls	65	8.09	2.73		
	Syllable Counting-Elkonin	Boys	71	6.14	3.57	.29	1.67ns
		Girls	65	7.11	3.15		
	Phoneme Deletion-Initial	Boys	71	0.13	0.90	.13	0.86ns
		Girls	65	0.25	0.92		
	Phoneme Deletion-Final	Boys	71	0.14	0.52	.31	1.77ns
		Girls	65	0.38	1.00		
	Letter-Sound Knowledge	Boys	71	3.04	3.93	.43	2.50ns
		Girls	65	4.80	4.28		
	Original Rhyme	Boys	71	0.35	0.83	.02	0.13ns
		Girls	65	0.37	0.65		
	Phoneme Reversal	Boys	71	0.01	0.12	.11	0.66ns
		Girls	65	0.03	0.17		
	Language Tests						
	British Picture Vocabulary Test	Boys	71	31.93	10.12	.05	0.32ns
		Girls	65	32.49	10.41		
	Sentence Comprehension Test	Boys	71	27.30	5.16	.50	2.92**
		Girls	65	29.66	4.19		
	Ability Test						
	Ravens Coloured Progressive Matrices	Boys	71	14.01	3.73	.18	0.89ns
		Girls	65	14.52	2.89		

Table 3.3: Sex differences on phonological sensitivity tests (Year 1)

School Year	Phonemic Sensitivity Tests	Sex	N	Mean	SD	*d*	T 1 tailed
Year 1 cycle 1	Final Rhyme Oddity-Real	Boys	70	1.60	1.47	.48	2.76ns
Age		Girls	64	2.30	1.46		
68.3 (.90)	Final Rhyme Oddity-Pseudo	Boys	70	1.34	1.33	.56	3.26***
		Girls	64	2.13	1.45		
	Medial Rhyme Oddity-Real	Boys	70	1.36	1.56	.59	3.45***
		Girls	64	2.27	1.48		
	Medial Rhyme Oddity-Pseudo	Boys	70	1.19	1.42	.54	3.14***
		Girls	64	2.00	1.58		
	Alliteration Oddity-Real	Boys	70	4.26	3.12	.69	3.99***
		Girls	64	6.28	2.68		
	Alliteration Oddity-Pseudo	Boys	70	3.53	3.00	.57	3.32***
		Girls	64	5.16	2.64		
	Combined Phoneme Oddity Initial-Real	Boys	70	1.66	1.53	.47	2.73ns
		Girls	64	2.44	1.77		
	Combined Phoneme Oddity Initial-Pseudo	Boys	70	1.40	1.50	.51	2.98***
		Girls	64	2.20	1.63		
	Combined Phoneme Oddity Final-Real	Boys	70	1.36	1.42	.38	2.23ns
		Girls	64	1.89	1.37		
	Combined Phoneme Oddity Final-Pseudo	Boys	70	1.31	1.45	.41	2.38ns
		Girls	64	1.92	1.51		

ISSN 1726-9725

	Combined Phoneme Oddity Medial-Real	Boys	70	1.20	1.24	.33	1.90ns
		Girls	64	1.63	1.35		
	Combined Phoneme Oddity Medial-Pseudo	Boys	70	1.13	1.34	.24	1.41ns
		Girls	64	1.45	1.32		
	Phoneme Isolation-Initial	Boys	70	3.26	1.90	.51	3.01***
		Girls	64	4.13	1.42		
	Phoneme Isolation-Medial	Boys	70	1.84	1.88	.46	2.66ns
		Girls	64	2.72	1.93		
	Phoneme Isolation-Final	Boys	70	2.00	1.74	.32	1.88ns
		Girls	64	2.59	1.92		
	Knowledge About Print Test						
	Sand	Boys	70	7.16	3.28	.43	2.48ns
		Girls	64	8.47	2.79		
	Memory Span Tests						
	Sentence Repetition test	Boys	70	5.99	0.99	.19	1.08ns
		Girls	64	6.17	1.02		
	Object Span test	Boys	70	8.44	1.80	.35	2.04ns
		Girls	64	9.05	1.62		

Table 3.4: Sex differences on phonological sensitivity tests (Year 1)

School Year	Phonemic Sensitivity Tests	Sex	N	Mean	SD	*d*	T 1 tailed
Year 1 cycle 2	Phoneme Segmentation	Boys	69	3.48	1.84	.32	1.84ns
Age		Girls	64	4.03	1.62		
74.4 (.90)	Syllable Counting-Tapping	Boys	69	9.07	2.07	.08	.48ns
		Girls	64	9.22	1.33		
	Syllable Counting-Elkonin	Boys	69	8.74	2.49	.07	.31ns
		Girls	64	8.90	1.79		
	Phoneme Deletion-Initial	Boys	69	1.74	1.90	.09	.51ns
		Girls	64	1.91	1.89		
	Phoneme Deletion-Final	Boys	69	2.10	1.93	.38	2.22ns
		Girls	64	2.84	1.92		
	Letter-Sound Knowledge	Boys	69	11.61	1.34	.15	.87ns
		Girls	64	11.80	1.14		
	Original Rhyme	Boys	69	1.72	1.48	.47	2.75**
		Girls	64	2.50	1.76		
	Phoneme Reversal	Boys	69	0.70	1.51	.33	1.89ns
		Girls	64	1.27	1.94		
	Knowledge About Print Test						
	Sand	Boys	69	11.61	1.34	.13	1.21ns
		Girls	64	11.80	1.14		

The second research question considered the accelerated progress in phonological awareness tasks of the girls over the boys during the two years of the study. On the

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phonological sensitivity tasks, girls generally gained on boys with more significantly superior performance in the second year than in the first year. Therefore, for example, in the first year, girls performed non-significantly better on all measures of phonological sensitivity except on the Final Rhyme Oddity (Real) test. In the second year, they outdid boys by reaching significant superiority on seven phonological sensitivity tasks as shown in table 3.1 and 3.3. There seems to be a clear pattern here with girls not only doing better than boys by the second year of the study, but also doing significantly better on a number of phonological sensitivity tasks. Table 4 shows that girls outperformed boys on all measures of phonological awareness over the two years of the study with Cohen's *d* difference increasing over the two years with the exception of the Final Rhyme Oddity-Real word task, both of the Syllable Counting tasks, the Phoneme Deletion-initial and the Letter-Sound Knowledge tasks.

With reference to the third research question involving the difference in tasks taxing the phonological loop, there was little direct evidence to support the notion that girls showed superiority on such tasks as assessed by the sentence repetition measure that constituted part of the battery of measures administered.

Table 4: Comparison of girls' performance over boys' performance using the ds value on measures of phonological sensitivity by year and comparison of the magnitude of this value between the two sexes over the two years

Phonological Sensitivity Tests		Kindergarten Year		Year 1		Kindergarten Year	Year 1	
	Sex	N	Mean	N	Mean	Boys /Girls KG *d*	Boys /Girls Year 1 *d*	Difference in *d* between Year 1 and KG
Final Rhyme Oddity-Real	Boys	71	0.54	70	1.60	.51	.48	-0.03
	Girls	65	1.20	64	2.30			
Final Rhyme Oddity-Pseudo	Boys	71	0.41	70	1.34	.46	.56	0.1
	Girls	65	0.95	64	2.13			
Medial Rhyme Oddity-Real	Boys	71	0.42	70	1.36	.37	.59	0.22
	Girls	65	0.91	64	2.27			
Medial Rhyme Oddity-Pseudo	Boys	71	0.30	70	1.19	.37	.54	0.17
	Girls	65	0.68	64	2.00			
Alliteration Oddity-Real	Boys	71	1.37	70	4.26	.40	.69	0.29
	Girls	65	2.46	64	6.28			
Alliteration Oddity-Pseudo	Boys	71	0.82	70	3.53	.38	.57	0.19
	Girls	65	1.62	64	5.16			
Combined Phoneme Oddity Initial-Real	Boys	71	0.37	70	1.66	.42	.47	0.05
	Girls	65	0.80	64	2.44			
Combined	Boys	71	0.27	70	1.40	.34	.51	0.17

ISSN 1726-9725

Phoneme Oddity Initial-Pseudo	Girls	65	0.60	64	2.20			
Combined Phoneme Oddity Final-Real	Boys	71	0.17	70	1.36	.36	.38	0.02
	Girls	65	0.45	64	1.89			
Combined Phoneme Oddity Final-Pseudo	Boys	71	0.11	70	1.31	.41	.41	0
	Girls	65	0.42	64	1.92			
Combined Phoneme Oddity Medial-Real	Boys	71	0.14	70	1.20	.16	.33	0.17
	Girls	65	0.25	64	1.63			
Combined Phoneme Oddity Medial-Pseudo	Boys	71	0.14	70	1.13	.07	.24	0.17
	Girls	65	0.18	64	1.45			
Phoneme Isolation-Initial	Boys	71	1.24	70	3.26	.26	.51	0.25
	Girls	65	1.71	64	4.13			
Phoneme Isolation-Medial	Boys	71	0.28	70	1.84	.36	.46	0.1
	Girls	65	0.74	64	2.72			
Phoneme Isolation-Final	Boys	71	0.42	70	2.00	.32	.32	0
	Girls	65	0.83	64	2.59			
Phoneme Segmentation	Boys	71	0.38	69	3.48	.24	.32	0.08
	Girls	65	0.74	64	4.03			
Syllable Counting-Tapping	Boys	71	7.44	69	9.07	.22	.08	-0.14
	Girls	65	8.09	64	9.22			
Syllable Counting-Elkonin	Boys	71	6.14	69	8.74	.29	.07	-0.22
	Girls	65	7.11	64	8.9			
Phoneme Deletion-Initial	Boys	71	0.13	69	1.74	.13	.09	-0.04
	Girls	65	0.25	64	1.91			
Phoneme Deletion-Final	Boys	71	0.14	69	2.1	.31	.38	0.07
	Girls	65	0.38	64	2.84			
Letter-Sound Knowledge	Boys	71	3.04	69	11.61	.43	.15	-0.28
	Girls	65	4.8	64	11.8			
Original Rhyme	Boys	71	0.35	69	1.72	.02	.47	0.45
	Girls	65	0.37	64	2.5			
Phoneme Reversal	Boys	71	0.01	69	0.7	.11	.33	0.22
	Girls	65	0.03	64	1.27			

The fourth research question concerned the variance ratio of the boys and the girls. In the first year of the study, the boys in the sample showed more variability on relatively fewer phonological awareness tasks. As shown in table 5, there is a substantial increase in variance ratios (boys' SD^2/girls' SD^2) from one year to the next with only two measures, the Sentence Repetition test and the Original Rhyme test showing less variability in the second year. Initially boys' variability is less than

ISSN 1726-9725

girls' variability. Boys showed higher variability on only five of 25 measures in the first year. However, there is a steady trend of increasing variability with boys showing more variance than girls on 14 of the 25 phonological sensitivity measures administered in the second year of the study. Boys' higher variability is also evident on the Ravens Matrices, the Sentence Comprehension Test (Revised) and Sand – Concepts about Print Test. So generally, in keeping with Feingold's (1992) findings, boys showed substantially more variability in their scores than girls did.

To put the results in perspective, girls generally outperformed boys in all measures of phonological awareness achieving statistically significant higher scores as they progressed from Kindergarten to Year 1 and the difference between them increased over the two years of the study with the effect size increasing for the girls. At the same time as girls were scoring higher than boys on virtually all measures with increasing effect size, boys were developing more variability generally. Thus, over the two years of this study, boys showed more variability than girls did in a good number of the phonological awareness tasks. These differences in variability are shown in table 5 below with boys' higher variance ratios being underlined.

Table 5: Variability estimates

		Year 1 SD	Year 1 Variance ratio	Year 2 SD	Year 2 Variance ratio
Final Rhyme Oddity-Real	Boys	1.14	0.63	1.47	**1.01**
	Girls	1.44		1.46	
Final Rhyme Oddity-Pseudo	Boys	0.95	0.50	1.33	0.84
	Girls	1.34		1.45	
Medial Rhyme Oddity-Real	Boys	1.04	0.45	1.56	**1.11**
	Girls	1.55		1.48	
Medial Rhyme Oddity-Pseudo	Boys	0.85	0.51	1.42	0.81
	Girls	1.19		1.58	
Alliteration Oddity-Real	Boys	2.37	0.60	3.12	**1.36**
	Girls	3.06		2.68	
Alliteration Oddity-Pseudo	Boys	1.76	0.53	3.00	**1.29**

ISSN 1726-9725

	Girls	2.42		2.64	
Combined Phoneme Oddity Initial-Real	Boys	0.8	0.44	1.53	0.75
	Girls	1.2		1.77	
Combined Phoneme Oddity Initial-Pseudo	Boys	0.84	0.62	1.5	0.85
	Girls	1.07		1.63	
Combined Phoneme Oddity Final-Real	Boys	0.59	0.39	1.42	**1.07**
	Girls	0.94		1.37	
Combined Phoneme Oddity Final-Pseudo	Boys	0.46	0.23	1.45	0.92
	Girls	0.95		1.51	
Combined Phoneme Oddity Medial-Real	Boys	0.59	0.59	1.24	0.84
	Girls	0.77		1.35	
Combined Phoneme Oddity Medial-Pseudo	Boys	0.54	0.78	1.34	**1.03**
	Girls	0.61		1.32	
Phoneme Isolation-Initial	Boys	1.69	0.80	1.90	**1.79**
	Girls	1.89		1.42	
Phoneme Isolation-Medial	Boys	1.03	0.50	1.88	0.95
	Girls	1.46		1.93	
Phoneme Isolation-Final	Boys	1.06	0.52	1.74	0.82
	Girls	1.47		1.92	
Sentence Repetition test	Boys	1.31	**1.47**	0.99	0.94
	Girls	1.08		1.02	
Object Span test	Boys	1.93	**1.07**	1.80	**1.23**
	Girls	1.87		1.62	
Phoneme Segmentation	Boys	1.28	0.62	1.84	**1.29**
	Girls	1.63		1.62	
Syllable Counting-Tapping	Boys	3.26	**1.43**	2.07	**2.42**
	Girls	2.73		1.33	
Syllable Counting-Elkonin	Boys	3.57	**1.28**	2.49	**1.94**

ISSN 1726-9725

	Girls	3.15		1.79	
Phoneme Deletion-Initial	Boys	0.9	0.96	1.90	**1.01**
	Girls	0.92		1.89	
Phoneme Deletion-Final	Boys	0.52	0.27	1.93	**1.01**
	Girls	1		1.92	
Letter-Sound Knowledge	Boys	3.93	0.84	1.34	**1.38**
	Girls	4.28		1.14	
Original Rhyme	Boys	0.83	**1.63**	1.48	0.71
	Girls	0.65		1.76	
Phoneme Reversal	Boys	0.12	0.50	1.51	0.61
	Girls	0.17		1.94	
British Picture Vocabulary Test	Boys	10.12	0.95		
	Girls	10.41			
Sentence Comprehension Test	Boys	5.16	**1.52**		
	Girls	4.19			
Ravens Coloured Progressive Matrices	Boys	3.73	**1.67**		
	Girls	2.89			
Sand 1	Boys	3.28	**1.38**		
	Girls	2.79			
Sand 2	Boys	1.34	**1.38**		
	Girls	1.14			

Discussion

The results contain some points of interest. It appears that three of the four research questions have been answered clearly. Girls outperformed boys on all measures administered without exception and in spite of the difference not always being statistically significant, they performed better all round. This superior performance appears to be in place at least as early as age 5 years when children in this study

ISSN 1726-9725

entered Kindergarten and increased over the next year. Therefore, girls appeared to be able to make better use of their educational opportunities to develop adequate phonological sensitivity awareness to employ in their reading skills than boys were able to do. Indeed, the female superiority in phonological awareness tasks and in subsequent literacy assessments seems to be independent of their equal footing on the non-verbal Coloured Progressive Matrices measure for cognitive abilities, in line with similar findings reported in Lynn & Irwing (2004). Furthermore, these findings lend support to the Ready et al. (2005) and Doctoroff et al. (2006) studies reporting that girls enter kindergarten with better developed literacy skills if one considers the causal importance of phonological awareness/sensitivity skills to later formal literacy.

In conformity with Feingold's (1992) findings, boys' scores in general seem to possess more variability than those of the girls. In the case of this particular sample, with increasing variability in boys' scores and girls' improving performance over the two years, it appears that boys were generally achieving more scores that were varied. It would appear that with high scores for girls all round but increased variability for boys, the sex differences in phonological awareness were smaller at the right end of the curve of distribution and larger at the left end of the distribution suggesting more variance at the lower end of the scale for boys.

This study suffers from a number of limitations, these being the number of participants in the study, the relative simplicity of the measures used and the brevity of the individual measures. The fact that social classes 1 and 2 were not represented in the sample of participants may be considered to be a limiting factor in terms of the overall applicability and interpretation of the results. Concerning the relative lack of sophistication of the measures used, it is evident that when the measures were administered in the second year of the study, the scores approached normality in terms of distribution of scores around a mean, something not evident in the first year. The issue of test brevity is another methodological consideration. Technically speaking, everything else being equal, longer tests afford better measures of the constructs assessed by virtue of better sampling of the area assessed, but young participants seriously risk being fatigued by measures that are too long, thereby

ISSN 1726-9725

invalidating the assessment. These three issues need to be considered if any of the limitations of this study were to be remedied in any significant way and the study extended to a larger sample with measures that maximise children's performance whilst retaining normality in the score distribution.

In the situation where teachers in the first year of formal schooling set about providing literacy experiences for their children, they have to keep in mind that that once formal exposure to literacy starts, girls are better able than boys to capitalise on the learning experience and maintain a lead over boys generally. Boys, on the other hand, not only achieve somewhat lower scores but show a more varied profile in terms of capitalisation on learning experiences, resulting in an overrepresentation in the lowest quartile of the class.

ISSN 1726-9725

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