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Indicators of Late Emerging Reading-Accuracy Difficulties in Australian Schools

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Abstract: Late-emerging reading-accuracy difficulties are those found present in older students not showing reading-accuracy difficulties when tested in earlier years (Leach, Scarborough and Rescorla, 2003). This paper discusses the constructs of reading-accuracy and late-emerging reading-accuracy difficulties. It then discusses data from a cross-sectional study of Australian readers from Years 1 to 8, which suggests a likelihood of late-emerging reading-accuracy difficulties being present in Australian readers. Results showed a steady increase in the proportion of low achievers ($SS < 90$), and a higher number of boys than girls being low achievers. The results provide evidence for the importance of reading-accuracy screening of students in primary and middle school years, and for reading instruction at all year levels to be focussed where needed on reading accuracy.

Introduction

The strong relationship of early reading accuracy to later reading and academic success is well established (National Research Council, 1998; Torgesen, 2002). It is built through reading accuracy, along with language comprehension, being foundational sub-skills of effective reading comprehension and authentic reading. Gough and Tunmer's (1986) *Simple View* or Component Model can be used to represent this relationship:

Reading Comprehension = Reading Accuracy x Language Comprehension.

Reading accuracy is the recognition or pronunciation of the spoken words corresponding to written words. In effect, reading the words creates the spoken message to which the reader applies language comprehension skills. It is phonological recoding (Galletly, 2004), a broad category that includes both phonemic recoding (recoding of letter sounds) and recoding of larger phonological units, including whole words, syllables, rimes, and orthographic units. English has a complex orthography compared to transparent (highly-regular) orthography nations (Galletly & Knight, 2004; Seymour, Aro & Erskine, 2003). Consequently, Anglophone nations have higher incidences of children with reading difficulties (Landerl & Wimmer, 2000; Landerl, Wimmer, & Frith, 1997). The discussion in this paper focuses on reading-accuracy development of Anglophone children.

In older readers with high levels of reading accuracy skills, language comprehension has a much stronger relationship with reading comprehension than does reading accuracy (Hoover & Gough, 1990; Yovanoff, Duesbery, Alonxo & Tindal, 2005). This, however, is not the case for students with low level reading-accuracy skills. For them, the relationship of reading accuracy to reading comprehension, independent reading, and success in literacy remains strong and unequivocal (Knight & Galletly, 2006; Yovanoff et al., 2005). At all ages, reading accuracy is a

gateway skill separating those students who succeed in literacy, from those who struggle (Catone & Brady, 2005; Knight & Galletly, 2006). Reading-accuracy difficulties are strongly related to difficulties not just in reading comprehension and independent reading, but also spelling, writing, vocabulary and language skills (Adams, 1990; Chard, Simmons, & Kameenui, 1998; Stanovich, 1986). The divide starts small and widens dramatically, due to vast differences in exposure to text and concepts – the Matthew Effect (Stanovich, 1986).

The proportion of Anglophone students requiring reading-accuracy instruction reduces dramatically across the grade levels, but there are indicators that numbers remain high, even in middle and high school (Leach, Scarborough, & Rescorla, 2003; Yovanoff et al., 2005). Leach et al. (2003) studied late-emerging weak reading-comprehenders: children in Grades 4 to 5 who had shown satisfactory reading skills in Grades 1 to 3, but significantly weak reading-comprehension in Grades 4 to 5. These authors report that the basis of the students' weak reading comprehension was evenly spread across the sample, with 35% having reading-accuracy weakness, 32% having language weakness, and 32% having both reading-accuracy and language weakness.

Other studies also indicate the presence of a large spread of reading-accuracy achievement in later-years grades. In their study of students from Grades 4-8, Yovanoff et al. (2005) reported high standard deviations for each grade's reading-accuracy mean, and a negligible change in standard deviation between grade levels. This high variability of scores suggests a wide spread of scores from high reading achievers to weak readers.

Because English is a complex orthography, it would seem plausible that there are also high levels of reading-accuracy weakness in Australian readers. This is indicated by the Program for International Student Assessment (PISA; 2000) finding that Australia had the largest achievement difference of all OECD nations between students who never read for enjoyment and those who did so for an hour or more each day (PISA, 2007), and by the polarised reading results Australia has achieved in all three PISA rounds (in 2000, 2003, 2006), with many high achievers, but also many low achievers (Knight & Galletly, 2006; PISA, 2007).

At the current time in Australia there is minimal research data on reading accuracy achievement and development (de Lemos, 2001a; Galletly & Knight, 2006; Knight & Galletly, 2006; Galletly, 2008). There are indicators that teachers are keen to improve reading and actively seek out professional development in this area (Kilgallon, Maloney, & Lock, 2008; Education Qld, 2000). Further, there has been minimal curriculum input on reading-accuracy development, instruction, and difficulties (de Lemos, 2001b, 2002; Galletly, 2002), which creates a challenge of how best to optimise Australian teacher expertise with reading-accuracy (De Lemos 2001b, 2002; Lyon 2003).

The study reported here is preliminary research investigating the prevalence of reading-accuracy difficulties and indicators of late-emerging reading-accuracy difficulties in a sample of Australian readers. It uses the Test of Word Reading Efficiency (TOWRE; Torgesen, Wagner & Rashotte, 1999), which is established as a rigorous measure and used extensively in large-scale reading research studies (e.g., Byrne et al., 2006; Harlaar, Spinath, Dale, & Plomin, 2005).

Methodology

The current cross-sectional investigation explored the reading-accuracy levels of a cohort of students in Years 1 to 8 in one Australian region. A total sample of 1205 students from up to 5 schools (see Table 1) participated in the study. The study firstly established the proportions of low achieving students, i.e., those likely to be in need of reading-accuracy instruction in each year level. It then investigated changes in the proportions of Low, Average and High reading-accuracy achievers from Years 1 to 8. The data for this investigation was gathered as part of a

multifaceted reading-accuracy study, aspects of which have been discussed elsewhere (Galletly & Knight, 2006).

The students' reading-accuracy skills were tested on the *Test of Word Reading Efficiency* (TOWRE; Torgesen et al., 1999), which measures the number of words correctly read in a 45second time period. Both of the TOWRE's two subtests were used:

- *Sight Word Efficiency* (SWE) which assesses real-word reading. Real words of high frequency are used in this subtest, e.g., *go, dog, river, pretty, strong, famous*.
- *Phonemic Decoding Efficiency* (PDE) which assesses pseudoword reading. Pseudowords, made-up words using standard English orthography, e.g., *mip, stree, framble*, are a proxy for reading of unfamiliar words.

The TOWRE subtests are well established as valid measures of reading accuracy skill and are used widely internationally by school systems and researchers (Torgesen et al., 1999; Galletly, 2008). In schools, they are used to monitor reading-accuracy development and identify students at-risk of low reading progress (Kame'enui, 2002). The TOWRE is quick to administer and makes it a preferred test among experimental researchers, particularly in studies involving testing of very large numbers of children. As an exemplar, TOWRE has been used in a large multinational longitudinal twin research including Australian children, exploring the interrelation of genetics and environment in early literacy development (Byrne et al., 2006; Hawke, Wadsworth, & DeFries, 2005). In several large studies, one or both TOWRE subtests were the only reading-accuracy tests used (Harlaar, et al, 2005). It can be concluded that the TOWRE tests are well established not only as screening tests of reading-accuracy achievement, but also as rigorous efficacious research instruments. The TOWRE was normed on over 1,500 individuals ranging in age from 6- 24 years old residing in 30 states of the USA. The average alternate forms reliability coefficients all exceed .90. The test-retest coefficients range from .83 to .96, suggesting that there is minimal error in the test.

Procedure

Students were administered the TOWRE using the test's standardised instructions. Testing was conducted within a 21 day period at each school, using the test's standardised administration procedures and instructions. The testers were teachers trained in the use of the tests. Testing was conducted at different time points in the school year by different schools, with all testing for each year level at each school conducted within a 3 week period. Sample characteristics including subject and data-sets numbers for each year level are shown in Table 1.

Year level	No. of schools	No. of subjects	Female (%)	Male (%)	Age range at test-point	No. of midyear data-sets	No. of endyear data-sets	Total data-sets
Yr 1	4	133	39.1	60.9	6.31±0.34	109	133	242
Yr 2	5	169	49.7	50.3	7.32±0.42	133	169	302
Yr 3	5	187	42.2	57.8	8.44±0.42	152	187	339
Yr 4	1	49	51.0	49.0	9.56±0.41	49	0	49
Yr 5	2	179	49.2	50.8	10.39±0.37	116	63	179
Yr 6	2	146	46.1	53.9	11.50±0.44	70	76	146
Yr 7	2	105	47.3	52.7	12.61±0.38	50	55	105
Yr 8	1	237	49.1	50.9	12.79±0.44	118	119	237
Totals		1205	45.8	54.2	---	797	802	1599

Table 1: Sample characteristics including subjects and data-sets per year level

Many subjects in Years 1 to 3 were tested at both mid-year and end-year test-points. It was considered appropriate for the purposes of this investigation to include as separate student data-sets the mid-year and end-year data-sets for those students with more than three months between the two test-points. As a result, there are more data-sets than subjects for these year levels (see Table 1). In Years 4 to 7, students were tested at a single test-point with some schools testing at mid-year, and others at end-year. In Year 8, two cohorts from consecutive school years were included.

The research design incorporated multiple schools and year levels as a means to control for school effects, e.g., instructional characteristics of a particular school or teacher (Knight & Galletly, 2006). It was considered that there was strong likelihood of school effects in the Year 4 data due to it being from a single school, so the Year 4 data was omitted from the data analyses. While Year 8 data came from a single school, there was little likelihood of it showing school effects, as Year 8 is the first year of secondary school, and the Year 8 students had come from multiple feeder primary schools. School effects were also likely in considering mid-year and end-year test-points in Years 5 to 7 as only one school was tested at each test-point (See Table 1). As preliminary analysis of the data indicated no significant differences in means and standard deviations between test-points for these years, the data was combined resulting in 2 schools for each of these year levels. The final sample comprised 1550 data-sets, with at least 100 data-sets per year level for Year levels from Year 1 to 3, and Year 5 to 8.

Results

Mean achievement across years

For the purposes of these studies, SWE and PDE results were expressed as raw scores and standard scores (SS) and also as achievement levels developed from TOWRE scores, using the authors' recommended ranges to denote Low (SS: <90), Average (SS: 90-110), and High (SS>110) achievers. As shown in Figure 1, the year level means for reading ages and standard scores are all in the average range, with standard-score means all between 96 and 107 and student reading ages for PDE and SWE tests approximately equivalent to students' chronological ages. The profile of standard-score means shows a decline in achievement levels is evident from Year 3 on, though all standard-score means are above 95 and well within the average range.

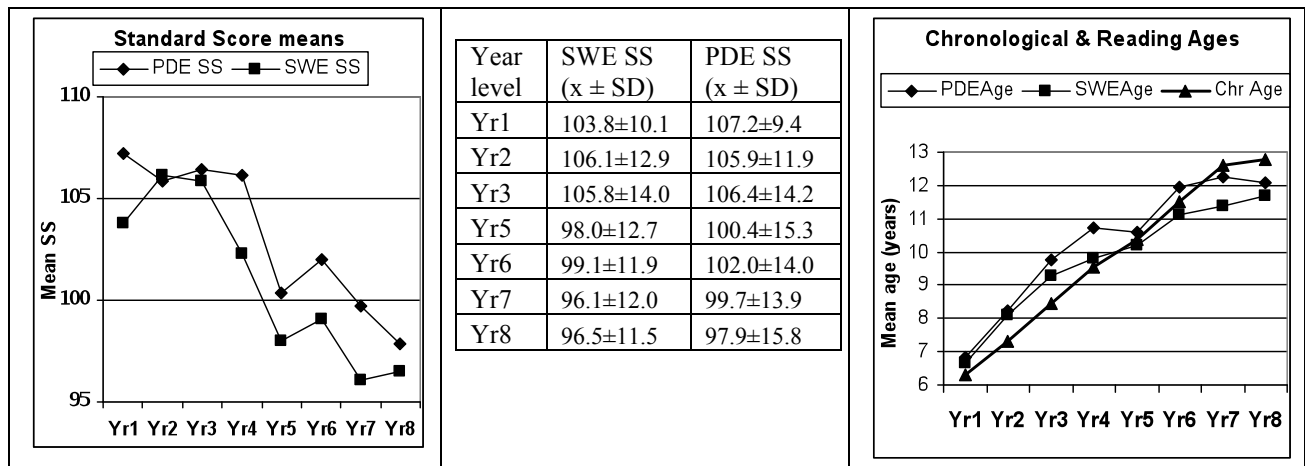


Figure 1: Distribution from Year 1-8 of (a) SWE & PDE SS, and (b) Chronological and reading ages

Gender Effects

A trend of girls achieving higher than boys was evident in the data, with mean SS for all year-levels being higher for girls than boys. Significant differences for gender were explored in year-levels with low likelihood of school effects (Years 1, 2, 3, and 8). T-test analyses showed significant gender differences for SWE standard scores in Years 1, 2, and 8 ($p < 0.05$), and differences although not significant, indicating a trend for PDE standard scores in Years 2 and 8 ($p < 0.1$).

Differences between mid- and end-year standard scores.

Differences between mid-year and end-year data-sets for each year level were analysed using T-test analyses. No significant mid-to-end year differences in standard scores across test-points were found for any year-level. As there were no significant differences present, the mid-year and end-year data-sets were combined for subsequent analyses. This resulted in a mean of 221 data-sets per year-level, ranging from 105 data-sets for Year 7 to 339 data-sets for Year 3 (See Table 1).

Different achievement by lower-years and upper-years

In the same manner that Leach et al. (2003) compared the achievement of older and younger cohorts, the current study used T-test analyses to explore differences between year-levels on SWE and PDE standard scores. These analyses showed significant differences ($p < 0.01$) between the standard scores for early-years (Years 1 to 3) and those for later years (Years 4 to 8). The mean and standard deviations for SWE and PDE tests for each year-level are shown in Figure 2.

The early-years standard scores (Years 1-3) were not significantly different to each other but were significantly different to and higher than the standard scores of each year-level in Years 5-8 (SWE $p < 0.01$; PDE $p < 0.05$), with the exception of Year 6 PDE. Similarly, the Year 5-8 standard scores did not differ significantly from each other and, with the exception of Year 6 PDE, were significantly different from and lower than the standard scores of each level in Years 1-3.

It can be seen in Figure 1, above, that

- For SWE, the mean standard scores for Years 1 to 3 were all equal to or above 103.8, while those for Years 5 to 8 were lower, being equal to or below 99.1.
- For PDE, the mean standard scores for Years 1 to 3 were all equal to or above 105.9, while those for Years 5 to 8 were lower, with the mean for Year 6 being 102.4, and those for Years 5, 7 and 8 being equal to or below 100.4.

Distribution of Low, Average, and High achievers

Student scores on the PDE and SWE tests were assigned to categories using the TOWRE's standard score ranges (Low: SS < 90 ; Average: SS 90-110; High: SS > 110). Analysis using one-way ANOVA showed significant differences between low, middle and high groups at every year-level for both SWE and PDE standard scores ($p < 0.001$). The percentage of year-level cohorts in each category are shown in Figure 2.

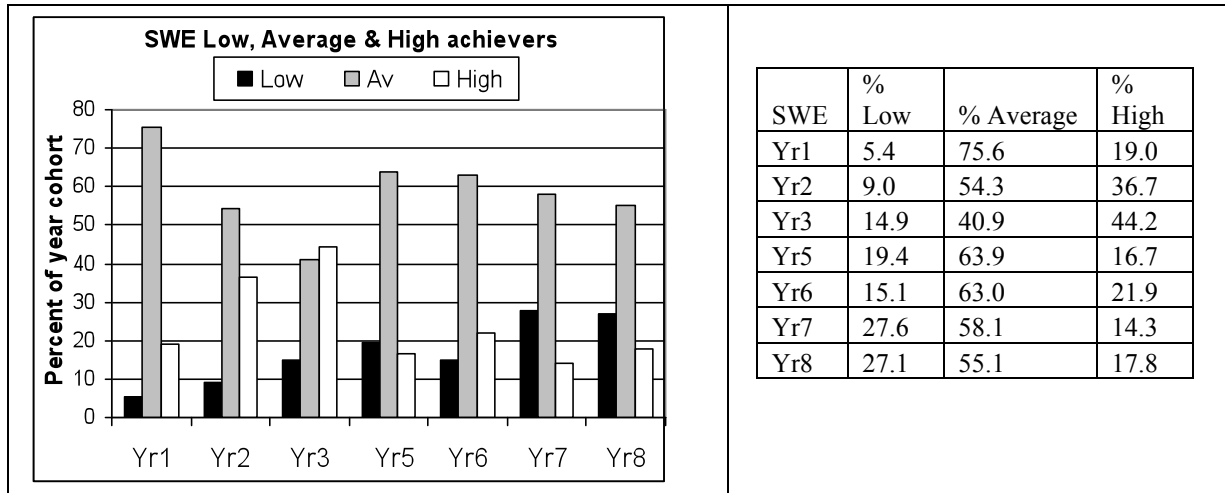


Figure 2: Proportion of year-level cohorts in low, average and high achievement categories

It can be seen in Figure 2 that

- Large proportions of the Year 1 to 8 students show healthy reading-accuracy levels.
- A steady increase in the proportion of Low achievers is evident across years for both SWE and PDE, with the percentage of low achievers ranging from less than 10% by Year 2 to 27% (SWE) and 34% (PDE) in Year 8.

Analysis using one-way ANOVA showed significant differences between low, middle and high groups at every year-level for both SWE and PDE standard scores ($p < 0.001$).

Trends within Low achievement

To be conservative in exploring trends in the increase of proportions of Low achievers, it was decided to exclude Year 1 data from the comparisons. It was considered that the very small percentage of Low achievers in Year 1 may be an artefact, due to high standard scores being given for raw scores of 0 and 1 for students aged 6yrs 0-11mths (Torgesen et al, 1999). The remaining year-levels were then grouped into three double-year groups (Years 2-3, Years 5-6, Years 7-8). The proportion of Low achievers in the three double-year groups is reported in Figure 3, first without considering gender, then showing the proportion of low-achieving boys and girls in each year-group.

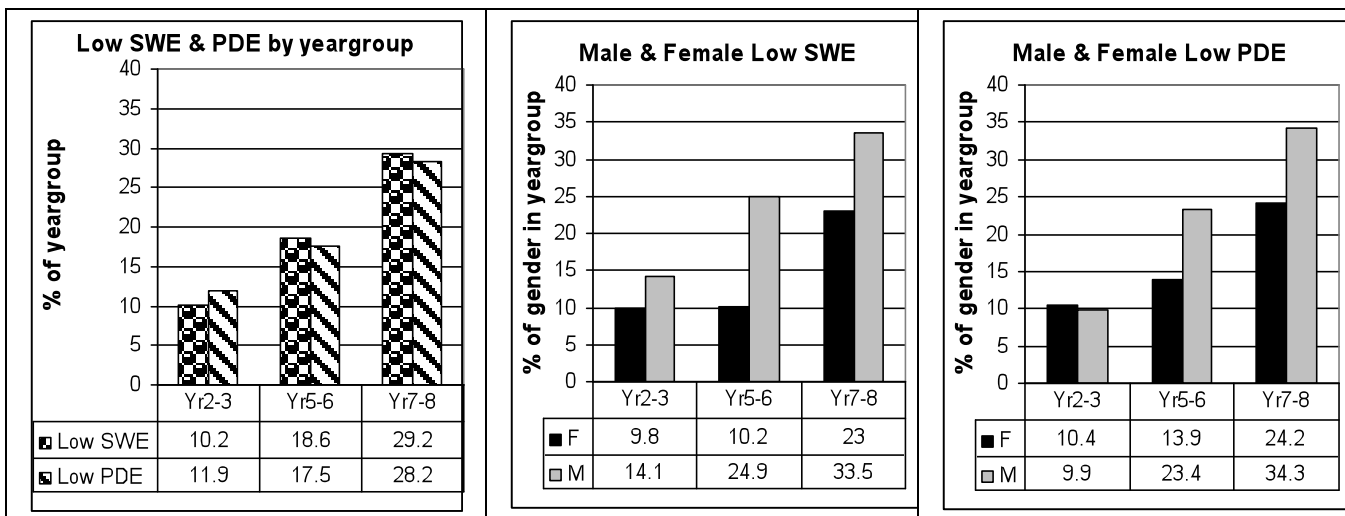


Figure 3: Percentages of low achievers across year levels

Two trends are evident in Figure 3. Firstly, the number of Low achievers increases across the school years from approximately 10% in early years to almost 30% in later years. Secondly, there are markedly more boys than girls being Low achievers in all year-groups, except for PDE in Years 2-3. This is in strong contrast to the ratios of boys to girls for whole year-levels of the sample (See Table.1).

Discussion

The current study is preliminary research hence it is necessary to be cautious in generalising from its findings. Limitations of the research include it being cross-sectional rather than longitudinal; conducted in a single region within one state using volunteer schools; the TOWRE's norms being developed from U.S. rather than Australian readers; and no data gathered on the reading-instruction practices of the cohort schools, given reading accuracy achievement is likely to be impacted by instructional practices.

The study was conducted as preliminary research using available resources, focussed on locating indicators of the need for further detailed research. It is considered that the findings of the study need to be further investigated using longitudinal and cross-sectional research designs; multiple regions and states; multiple measures of reading-accuracy and other literacy skills; and gathering information on reading-accuracy instruction received (e.g., time spent reading books, extent of focussed instruction of different types). For the purposes of this study it is considered that while there are needs to establish definitive Australian norms for the TOWRE tests (Knight & Galletly, 2006), the TOWRE is sufficiently established as a rigorous screening test to be used for the purposes of this study. It is acceptable for the TOWRE means to have been used to delineate students as Low, Average and High achievers.

There are four major findings of this research to be discussed. Firstly, a large majority of readers at all year levels show healthy reading-accuracy levels as measured by the TOWRE. Secondly, the reading-accuracy achievement, expressed as standard scores, of early-years readers (Years 1 to 3) is significantly higher than that of readers in later-years (Years 5 to 8). Thirdly, there are indications of late-emerging reading-accuracy difficulties, given that the proportion of students with Low ($SS < 90$) reading-accuracy achievement increases from Year 1 to Year 8. Finally, there are indications that more boys than girls are low achievers.

Healthy readers

For all year levels, mean reading ages and standard scores were in the average range, and the vast majority of students achieved as at least Average readers. Even in Year 8, which had the largest low achiever group, two thirds of students achieved in the TOWRE's Average and High achiever categories. The proportions of readers in Average and High achievement categories ranged from over 90% (Years 1 and 2) to at least 66% (Years 7 and 8). If the TOWRE achievement categories represent satisfactory achievement, there is much that is successful about current Australian reading and reading-accuracy instruction. It is important, of course, to note that average achievement does not necessarily reflect satisfactory progress, e.g., with findings that 40% of American students are not reading at adequate levels in Grade 4 (Alexander & Lyon, 2004), it may be the case that Average achievement on the TOWRE indicates representative but not necessarily satisfactory achievement.

Compared to the USA normative sample, the reading-accuracy achievement of Years 1 to 3 in the cohort schools is very healthy. As shown in Figures 1 and 2, an increasing proportion of High achievers is evident from Year 1 to Year 3, and, while the proportion of Low achievers does increase from Years 1-3, it is still below 10% in Year 2 for both SWE and PDE, and increases only to 14.9% (SWE) and 12.0% (PDE) in Year 3. In light of the minimal data available on reading-accuracy achievement in different Australian states (de Lemos, 2001a), there would seem value in investigating the extent to which this pattern of early-years strength in reading-accuracy is present in other regions and states.

Late-emerging reading-accuracy difficulties.

The proportion of Low achievers increases markedly from Year 5 in the current study (no Year 4 data was included in the study's analyses), and almost one quarter of girls and one third of boys show Low achievement in Year 8. This finding suggests the need for further research to monitor reading-accuracy development of other students.

The results of this study are similar to the findings of Leach et al's (2003) study of late-emerging reading-accuracy difficulties in American readers, given that their sample of Low achieving Year 4 to 5 students displayed late-emerging difficulties after Year 3. The trend for an increase in the proportion of Low achievers from Year 1 to Year 8 in this study suggests that later-emerging reading-accuracy difficulties may also be occurring in Australian schools across later years of primary school. This finding has implications for reading-accuracy instruction across the grades. At the current time, it is common for reading-accuracy instruction to be prioritised in early years of primary school, but not in upper primary years and high school (Catone & Brady, 2005; Watson & Boman, 2005).

It is important to note that in the Leach et al (2003) study, students' reading difficulties were not just late-identified but also late-emerging, with most having had satisfactory Year 3 reading achievement. It is possible that reading-accuracy difficulties in the later years, both late-emerging and late-identified, could be related to the development of students' orthographic representations in the early years. If reading-accuracy instruction is only included in early years, it will be adequate for early-years reading demands when reading is usually of semantically-familiar short words. This early-years reading-accuracy instruction may well be insufficient for many readers to support them in fluent reading of texts encountered in later years, when many words are multisyllabic and contain less frequent orthographic units. There is a need to research the presence and prevalence of late-emerging reading-accuracy difficulties and the characteristics and impact of early-years and middle-years reading-accuracy instruction on the reading-accuracy difficulties of older readers. There would also seem to be value in teacher-led research to establish optimal reading-accuracy and literacy instruction for students with weak reading-accuracy.

It is of interest that the proportion of readers with Low reading-accuracy achievement in high school readers in the current study (>30%) is similar to the proportion of teenage readers with low reading-comprehension achievement in the PISA 2000 and 2003 international comparisons of readers (PISA, 2007). This indicates the possibility that reading-accuracy difficulties may be a factor in Australia's continuing high proportions of low achievers in the PISA studies. This suggests value in assessing the reading-accuracy levels of Australian readers in future PISA cohorts. Using Gough and Tunmer's Component model (Reading Comprehension = Reading Accuracy x Language Comprehension), there would seem value in concurrently

Boys as Low achievers

More boys were represented in the Low achiever category in all year levels from Year 2 for real word reading, and from Year 5 for non-word reading. In addition, the proportion of boys increased across the upper-school years (See Figure 3), with relatively equal proportions of Low male and female readers in Years 2-3, but 17% more boys than girls being Low achievers in Years 7-8. This finding suggests the need for gender to be included as a variable in future studies of reading-accuracy development and instruction.

Conclusion

Reading accuracy is a pivotal skill supporting development of reading comprehension, literacy and academic learning (Adams, 1990; Chard, Simmons, & Kameenui, 1998). In contrast to transparent orthography nations where reading-accuracy develops rapidly to ceiling levels (Landerl & Wimmer, 2000; Landerl, Wimmer, & Frith, 1997), reading-accuracy development in Anglophone nations is a slow process taking many years for most readers to reach ceiling level (Torgesen et al., 1999; Galletly & Knight, 2004). Reading-accuracy instruction is important at least until readers reach a level of confident independent reading and are able to improve their reading skills through engaging in extensive independent reading (de Lemos, 2001b, 2002; Galletly, 2002, 2004; Galletly & Knight, 2004). Consequently, weak readers with weak reading-accuracy skills will need effective reading-accuracy instruction, irrespective of what year-level they are in.

This preliminary research study explored data on the reading-accuracy achievement of Australian students in Years 1 to 8 for evidence of late-emerging reading-accuracy difficulties. While mean achievement at all year-levels was within the average range, exploration of Standard Scores showed the proportion of Low achievers (SS<90) to have increased relatively steadily across Years 1 to 8, suggesting the likelihood that late-emerging reading-accuracy difficulties are present, akin to those found in Leach et al.'s (2003) study of American readers. More boys than girls were low achievers, and the proportion of boys increased across the upper-school years.

The findings suggest a need for further research on reading-accuracy achievement across primary and high school years. There would seem value in screening reading-accuracy achievement across the school years, perhaps in conjunction with national literacy tests; and to conduct longitudinal research to establish data on Australian reading-accuracy achievement, and to explore if and when reading-accuracy difficulties present (Galletly, 2008).

The findings also suggest value in researching current and optimal reading-accuracy instruction for developing readers of all ages. With older weak readers likely to also be reluctant readers, it is likely that, in addition to teaching reading skills, reading-accuracy instruction for older readers will need to be highly engaging (Dalley-Trim, 2007; Strikwerda-Brown, Oliver, Hodgson, Palmer, & Watts, 2008), incorporating use of new technologies (Forlin & Lock, 2006), and using reflective and transformative practices to build self-efficacy and ownership of learning (Jones, 2009).

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