Educational Psychology, Vol. 22, No. 4, 2002

Carfax Publishing
Taylor & Francis Group

Do Differences in Phonological Processing Performance Predict Gains Made by Older Low-progress Readers Following Intensive Literacy Intervention?

SIMMONE POGORZELSKI & KEVIN WHELDALL, *Macquarie University*
Special Education Centre, Macquarie University, Sydney, Australia

ABSTRACT *The research study examined the gains in single word recognition and oral reading fluency made by a group of low-progress readers following an intensive, systematic skills based reading programme (MULTILIT). Performance on the Phonological Assessment Battery (PhAB) was used to identify 'dyslexic' students (with poor phonological awareness) from 'garden-variety' low-progress readers. It was hypothesised that the identified group of 'dyslexic' students (N = 16) would make smaller gains in reading outcomes compared to the group of 'garden-variety' low-progress readers (N = 6). The results did not support the hypothesis since both groups of low-progress readers made substantial gains on both reading measures. Moreover, PhAB sub test scores did not predict size of gains. The results provide evidence for the usefulness of intensive literacy remediation to increase the reading gains of disabled readers despite their status (dyslexic or garden-variety) as a low-progress reader and lend support to those researchers who advocate a non-categorical approach to addressing reading disability. There is tentative evidence to suggest that the inclusion of a short phonological awareness training component for nine students may have impacted favourably on the reading outcomes of the 'dyslexic' group of low-progress readers.*

Contrary to the long held, but now largely discredited, belief that failure to learn to read is primarily a visual perceptual problem, recent research has identified it as mainly a language based problem; more specifically a phonological processing problem (Gottardo, Siegel & Stanovich, 1997; Hulme & Snowling, 1992; Share, 1995; Shankweiler, Lundquist, Dreyer & Dickinson, 1996; Stanovich, 1988, 1991, 1994; Torgesen & Wagner, 1998). The recognition by researchers and specialist reading

ISSN 0144-3410 print; ISSN 1469-046X online/02/040413-15 © 2002 Taylor & Francis Ltd
DOI: 10.1080/0144341022000003105

teachers alike, that it is the underlying phonological processing deficits of reading disabled students that causes reading failure, has influenced both the diagnosis and remediation of what has commonly been termed 'dyslexia'. Where previously the diagnosis of 'dyslexia' has been determined by the use of an IQ-reading discrepancy-defined model, recent support for a positive definition of dyslexia based on phonological deficits has arisen (Elbro, Nielsen, & Petersen, 1994; Siegel, 1999). This has been supported by the compelling evidence over the past two decades which has unequivocally shown that it is the presence of phonological processing deficits that leads to the failure to grasp the alphabetic principle, and consequently to develop automatic and fluent reading (Ball & Blachman, 1988, 1991; Bradley & Bryant, 1983; Stanovich, 1991, 1994; Share, 1995).

Disabled readers present with a range of phonological processing difficulties which include delayed speech acquisition and rate, rapid automatic naming deficits and word finding difficulties, and poor phonological recoding in short term memory which is evidenced in tasks such as non-word and digit repetition (Ball, 1996; Frith, 1995; Gallagher, 1995; Hulme & Snowling, 1992; Torgesen & Wagner, 1998). Phonological awareness is another phonological processing skill that is critically related to reading (Adams, 1990; Ball, 1996; Frith, 1995; Gottardo *et al.*, 1997; Torgesen & Wagner, 1998; Torgesen, Wagner, & Rashotte, 1997; Waterman & Lewandowski, 1993). The reading disability literature is replete with terminology to describe phonological awareness, but it is best understood as a metalinguistic skill which facilitates the reader's ability to realise that words are made up of smaller component sounds (phonemes) (Ball, 1996). Stanovich (1986, p. 362) refers to it as having 'conscious access to the phonemic level of the speech stream and some ability to cognitively manipulate representations at this level'.

Phonological awareness is thought to be a developmental skill (Stanovich, 1992; Torgesen & Wagner, 1998) where, at the shallowest level, rhyme and alliteration are evidence of emerging awareness. At a deeper level, which requires the knowledge of an alphabetic code, readers are able to segment phoneme by phoneme and manipulate words and phonemes within words (Adams, 1990; Ball, 1996; Torgesen & Wagner, 1998; Share, 1995; Stanovich, 1992, 1994). The ability to manipulate phonemes (phonemic awareness) requires some level of analysis and a conscious awareness of the units of sounds in words (Fawcett & Nicolson, 1995; Stanovich, 1994). Readers who demonstrate phonemic awareness (e.g., 'say cat without the /c/' or 'change the /o/ in hot to /a/') have more likely progressed further in their phonological awareness skills than younger or disabled readers (Ball, 1996; Fawcett & Nicolson, 1995; Stanovich, 1994). According to Share (1995) it is the 'explicit' awareness of phonemes that is crucially related to early reading success. In fact, it is phonemic awareness along with letter-sound knowledge (phonics instruction) that has been shown to be the best predictor of early reading success (Adams, 1990; Report of the National Reading Panel, 2000).

Integral to the development of competent and efficient reading is what Share (1995) has termed the phonological recoding process, the ability to convert a string of letters to a matching sequence of sounds (Munro, 1998). This process implies a self-teaching mechanism 'enabling the learner to acquire the detailed orthographic representations necessary for rapid, autonomous, visual word recognition' (Share, 1995, p. 152). This self-teaching process is predicated on the assumption that as children begin the process of learning to read, they will access some high frequency words visually or orthographically. But the successful decoding of novel or unfamiliar words will be dependent on the beginning reader's ability to use phonologically based or 'generative' strategies

which are reliant upon the knowledge of letter to sound correspondences and phonemic awareness. Through the repeated exposure of words that require the use of generative strategies the reader will eventually access these words automatically in the same way they access high frequency words.

According to Share (1995), disabled readers fail to develop sufficiently a self-teaching mechanism for beginning reading. This failure has been attributed to a phonological processing deficit, which limits the disabled reader's ability to learn the letter to sound correspondences and phonemic awareness skills needed to apply the alphabetic principle to help decode unfamiliar words (Ball, 1996; Bruck, 1992, 1993; Greenberg, Ehri & Perin, 1997; Hulme & Snowling, 1992; Pratt & Brady, 1988; Shankweiler *et al.*, 1996; Stanovich, 1991; Stuart & Masterson, 1992; Torgesen *et al.*, 1997; Yap & Van Der Leij, 1993). In fact, disabled readers are more likely to rely on restrictive and limiting visual memory strategies, rather than generative decoding strategies, to compensate for their weak phonological skills (Hulme & Snowling, 1992; Share, 1995; Stanovich, 1994).

There is a general consensus in the field of reading research that there exists a reciprocal relationship between reading and phonological awareness in which the latter is a 'necessary but not sufficient condition for learning to read' (Ball & Blachman, 1991; Ball, 1996, p. 83; Bruck, 1993; McGuinness, McGuinness, & Donohue, 1995, p. 830; Share, 1995). According to Ball (1996, p. 82) there exists a relationship, which shifts from a causal one at the beginning reading stages to one of 'mutual facilitation' as children begin to make use of superior decoding strategies. The evidence to suggest that there exists a causal relationship between phonological awareness and reading has been found in a number of studies where training in phonological awareness has been shown to impact favourably on reading and spelling (Bradley & Bryant, 1983; Ball & Blachman, 1988, 1991; Hatcher, Hulme & Ellis, 1994). Research in this area has led to the conclusion that the most effective approach to beginning reading instruction is to combine training in phonological awareness skills with explicit instruction in letter-sound relations (Hatcher *et al.*, 1994).

Stanovich (1988, 1991) has proposed a Phonological Core Variable Difference Model (PCVDM) to explain how deficits in phonological processes are causally related to reading disability. According to the PCVDM (Stanovich, 1988) there are two distinct types of poor readers that exist along a continuous gradient of intelligence and reading ability. The premise of this model is that the variability in the cognitive processes determines the categorisation of the reader. 'Dyslexic' readers are characterised by a relatively high IQ, compared with their reading ability, but with word identification problems that are primarily caused by phonological processing difficulties (Stanovich, 1988, 1991). In contrast, the more delayed 'garden-variety' reader has a lower or more typical IQ and exhibits difficulties in the areas of language, comprehension and vocabulary in addition to the phonological processing deficit displayed by the 'dyslexic' reader (1991, p. 13). Stanovich (1991) argued that it is the degree of severity of these processing differences that distinguishes the two types of poor readers and that the 'dyslexic' reader will be more resistant to intervention, a view which he subsequently modified, however (Stanovich, 1991; 2000).

The difficulty of distinguishing between older 'dyslexic' readers and 'garden-variety' readers is complicated by the behavioural characteristics with which older readers might present (Ball, 1996, Frith, 1995). Both types of readers may have phonological processing deficits but the research suggests that the 'true' dyslexic reader has a greater and more specific deficit to begin with and that this is likely to endure (Frith, 1995; Stanovich, 1998). Variations in poor readers, beyond that which can be described as

'dyslexia', could be attributed to a range of environmental causes. According to some researchers (Ball, 1996; Frith, 1995; Siegel, 1999) it is only by excluding those children who have had limited educational opportunities, due to ineffective instructional methods or extended absences from school, that a positive definition of dyslexia can be determined.

According to Torgesen *et al.* (1997), there exists a small percentage (3% to 5%) of the reading population who are severely 'reading disabled' and for whom even intensive intervention fails to help. The notion that phonological processing deficits are specific and enduring for the 'dyslexic' reader is crucial to the concept of reading disability. The phonological core deficit model, that weak performance in phonological skills does not reflect a developmental delay but rather a core deficit, has been supported by studies that show that phonological awareness and non-word decoding deficits persist in older students (Bruck, 1992, 1993; Elbro *et al.*, 1994; Fawcett & Nicolson, 1995; Gottardo *et al.*, 1997; Pratt & Brady, 1988; Shankweiler *et al.*, 1996).

Despite the consistent research that shows that phonological awareness difficulties persist in older readers, there is evidence that when older low-progress readers receive appropriate and effective instruction they are able to make significant gains in reading outcomes (Hempenstall, 1999; Wheldall & Beaman, 2000). According to Share (1995), older readers are able to benefit from instruction in the self-teaching mechanism that facilitates generative strategies in word decoding in much the same way as beginning readers.

A successful example of applying best practice methods to older low- progress readers is the MULTILIT (Making Up Lost Time in Literacy) programme (Wheldall & Beaman, 2000). The MULTILIT programme is predicated on a non-categorical approach to reading disability and the researchers of the programme contend that given effective instruction, all students, despite their categorisation, have the potential to learn (Wheldall, 1994; Wheldall & Beaman, 2000; Wheldall & Carter, 1996). Students in the MULTILIT programme (Years 3–6, i.e. 4 to 7 years of schooling) have demonstrated gains of 15 months in reading accuracy and 13.5 months in reading comprehension, over two terms (approximately 20 weeks) of full time instruction. Furthermore, follow up studies at 6 and 12 months have demonstrated retention of these significant gains. Wheldall & Beaman (2000) make the important point that in order for these gains to be maintained in severely *reading disabled* students, long-term support may be required.

Other researchers report the development and implementation of remediation programmes based on phonological awareness training. A Phonological Awareness Training (PAT) programme developed by Wilson (see Wilson & Frederickson, 1995) which focuses on specifically teaching rime analogies, was administered over a 20 week instructional period to 24 students (mean age 9.5 years). A comparison group of 24 students was used to test the hypothesis that students with reading difficulties who received PAT training in addition to remedial reading instruction would make better progress than those children who did not receive such training. In addition it was expected that those children who received the PAT programme would be more likely to have improved phonological skills, as measured by the Phonological Assessment Battery (cited in Wilson & Frederickson, 1995). The results indicated an increased ability by the PAT trained group to read by analogy using rimes. In addition the PAT trained group showed significantly greater gains in both reading and spelling than the comparison group. Although the results indicated that the group trained with PAT showed increased gains on curriculum based test of words read correctly, they found no

significant differences between the PAT trained group and the control group on a timed measure of words read correctly or non-word reading (Wilson & Frederickson, 1995). A further finding was that although the PAT trained group had highly significant improvements in scores on the phonological skills of Spoonerisms and Rhyme Fluency, they did not find significant improvements on the other phonological skills, which included alliteration, rhyme, digit and picture naming speed, alliteration fluency and semantic fluency.

According to the research gathered in a meta-analysis conducted by the National Reading Panel in the United States (Report of the National Reading Panel, 2000), older readers who receive instruction in phonemic awareness have improved reading outcomes when training is paired with letter-sound correspondences. Support for explicit instruction in phonemic awareness has also been found in the research of Lovett, Borden, De Luca, Lacerenza, Benson and Brackstone (1994). The researchers carried out intensive reading intervention using a modified version of a Direct Instruction programme (PHAB/DI), which trained students in phonological segmentation and blending with concurrent letter-sound correspondence training. A second treatment approach taught metacognitive decoding strategies from a programme called Word Identification Strategy Training (WIST). The programmes were administered to reading disabled students with a mean age of 9.6 years. Results showed increased gains in word identification and word attack skills for both groups of disabled readers. Whilst the WIST group were found to have greater generalisation to multisyllabic words and exception words, the PHAB/DI group was found to have increased gains in the phonological domain with evidence of transfer effects to unknown unin-structed real words, standardised measures of reading achievement and non-word reading. The researchers concluded that with appropriate intervention and training of letter-to-sound correspondences, segmentation analysis and sound blending, the core phonological reading deficit in older dyslexics could be improved upon. This is consistent with research on training programmes with younger disabled readers (Hatcher *et al.*, 1994).

It is clear from the research, then, that in order for older low-progress readers to make meaningful gains in reading, effective instruction in the alphabetic code, and possibly also in phonological awareness, is required (Hempenstall, 1999, Share, 1995). Recent research supports the hypothesis that a deficit in phonological processing skills is a critical variable in the reading disability of older readers.

It is commonly believed that the dyslexic's decoding problem will be more difficult to remediate than the garden-variety reader's problem, due to the specificity of the dyslexic's core phonological processing deficit (Frith, 1995). Taking the specificity hypothesis into account and considering the research to date, it would be expected that *true dyslexics* would typically make significantly lower gains in reading compared to a group of 'garden-variety' readers after undergoing intensive remedial instruction. The present study aims to test this hypothesis that students who have a severe *reading disability* (dyslexia) will be less responsive to an intensive remedial reading programme than 'garden-variety' poor readers. The independent variable for this study is status as a low-progress reader (dyslexic or garden-variety) as determined by performance on a test of phonological processing skills, in this case the Phonological Assessment Battery (PhAB) (Frederickson, Frith & Reason, 1997). The dependent variable will be the gains made on reading measures (reading outcomes) following a period of one school term (approximately 10 weeks) of intensive reading intervention. The results of this study will bear on the PhAB's usefulness in predicting reading outcomes and hence

impact on the type of intervention programmes for different types of poor readers in so far as it might indicate which students require additional training in phonological awareness.

Method

Participants

The sample of low-progress readers comprised 22 students (14 boys and 8 girls) attending the Schoolwise Programme delivered at the Exodus Foundation Tutorial Centre in Ashfield, New South Wales. The mean age of the participants was 11 years and 9 months (141 months: standard deviation 8.76 months) with 16 students in Year 6 and 6 in Year 7.

Students were selected into the programme on the basis of meeting specific criteria. They were required to be at least two years behind in reading accuracy, socially disadvantaged and at serious risk of disaffection from school. The mean reading age for the group for reading accuracy as measured by the Neale Analysis of Reading (Neale, 1999) was 91.55 months (7 years: 6 months) and 91.14 months (7 years: 5 months) for reading comprehension. The sample was thus, on average, 4 years behind for both reading accuracy and comprehension compared with their chronological age.

Measures

On programme entry, the participants were given a battery of standardised tests, administered over five days by trained research assistants. The standardised tests included a phonological processing battery, measures of reading accuracy and comprehension, single word recognition, oral reading fluency and spelling. For the purposes of this study, follow up data after one term (10 weeks of instruction) were only available for the measures of single word recognition and oral reading fluency (The Burt Word Reading Test and the WARP measures respectively—see below).

Phonological Assessment Battery (PhAB). Phonological processing was measured using the Phonological Assessment Battery (PhAB) (Frederickson *et al.*, 1997). The PhAB is designed to assess phonological processing and includes: four phonological awareness tests of alliteration, rhyme, spoonerism and non-word reading; two phonological production speed tests of naming speed in pictures and digits; two phonological fluency tests of alliteration and rhyme; and a test of semantic fluency.

The internal consistency of all sub tests on the PhAB is reported to be high with a cronbach co-efficient alpha of 0.8. In support of the criterion related validity of the PhAB, Frederickson *et al.* (1997) report that the correlations between the PhAB sub-tests and the Neale Analysis of Reading Ability (1988) components were all significant ($p < 0.01$) and positive, ranging from 0.3 to 0.72, not including Fluency (semantic) Test which, they argue, 'is not intended as a test of phonological ability' (p. 87). There were significant ($p < 0.05$) moderate to high intercorrelations between the sub-tests indicating that all the sub-tests are tapping into underlying phonological processing skills. This coupled with the increases in mean performance scores with age for each test is taken to be indicative of construct validity.

According to the authors of the PhAB, the absence of any highlighted scores on the PhAB profile sheet indicates that phonological difficulties would be unlikely to be the reason for any reading disability (Frederickson *et al.*, 1997). In contrast, students who

have three or more highlighted scores are considered to have a severe phonological processing deficit (p. 59). Highlighted scores are standardised scores that fall one standard deviation (15) below the mean (100), that is, scores below 85.

The alliteration test. In this test the student is required to isolate the initial sounds in single syllable words. Identification of two words out of three as beginning with the same sound (e.g. ship, *fat, fox*) is required for a correct response.

The naming speed tests. Two forms of the Naming Speed Test are provided: The Picture Name Test and The Digit Naming Test. Students are required to say out loud the visual array of either pictures (table, door, ball, hat and box) or numbers (1–9) in sequence as quickly as possible. This test is designed to 'assess speed of phonological production, involving retrieval of phonological coding at the whole word level' (Frederickson *et al.*, 1997, p. 1).

The rhyme test. In this test students are required to listen to three orally presented single syllable words (e.g. made, hide, fade) and to identify the rhyme.

The spoonerisms test. There are two parts to this test. In the easier first part the student is required to replace the first sound of a word with a new sound (e.g. 'cot' with a /g/makes 'got'). The test increases in difficulty by asking the student to exchange the initial sounds of two words (e.g. 'sad cat' makes 'cad sat'). A time limit of three minutes is imposed. The Spoonerisms test is designed to assess a student's ability to segment single syllable words and then synthesise (blend) the segments to provide new words or word combinations.

The fluency tests. There are three parts to these tests, which assess 'retrieval of phonological information from long term memory' (Frederickson *et al.*, 1997, p. 1). Within a time limit of 30 seconds the students are required to generate a list of words for animals (semantic category), words beginning with /m/ (fluency/alliteration) and words rhyming with 'bat' (fluency/rhyme). The semantic test is administered to provide comparison data.

The non-word reading test. The presentation of non-words or pseudowords allows for the assessment of the ability to translate an orthographic code into a phonological code. This test 'taps the phonological processing involved in reading non-words' (Frederickson *et al.*, 1997, p. 2). It allows for the discrimination between readers who use compensatory visual strategies to identify words and those who draw on their phonological processing skills and knowledge of letter-sound correspondences. It requires generative decoding strategies.

The Neale Analysis of Reading—3rd Edition (Neale, 1999). This test is used to provide information regarding a student's ability in reading accuracy and reading comprehension (Neale, 1999). Six text passages of increasing difficulty are presented to the student. The student reads orally to an examiner and errors on each passage are recorded and used to determine an accuracy age. Following the oral reading of each story the student is required to answer verbally a series of questions. The number of correctly recalled responses determines a student's reading comprehension age.

The Neale Analysis yields high levels of internal consistency for accuracy and comprehension with correlations ranging from 0.71 to 0.96 (Neale, 1999). A good relationship was found between the Neale Analysis and the Schonell Graded Word Reading Tests with Pearson product moment correlations ranging between 0.76 and 0.98 indicating good criterion-related validity.

Burt Word Reading Test (Gilmore, Croft & Reid, 1981). This test is a measure of single word recognition skills. Students are required to read a series of words presented on a test card in order of difficulty. They are instructed to read as many words as possible and stopped when ten consecutive errors are reached. The student is then given the opportunity to look over the remaining words to see if they recognise any further words.

The Burt Word Reading Test has high test-retest reliability (>0.95) and high internal consistency (>0.96). Significant and positive correlations (range = 0.90–0.98) between the Burt Word Readng Test and the Schonell Graded Word Reading Test and the Oral Word Reading Test indicate that the test has high criterion validity and is measuring similar abilities being tapped by other word recognition tests (Gilmore *et al.*, 1981). A caution is warranted as Wheldall and Beaman (2000) report that in some cases the Burt Word Reading Test has a tendency to overestimate reading age by 4 to 5 months.

South Australian Spelling Test (Westwood, 1999). This test was used to determine spelling age. It can be used with children in the age range 6 years to 15.5 years and can be individually or group administered. The test reports good internal reliability with a test-retest reliability coefficient of 0.96 (Westwood, 1999).

Wheldall Assessment of Reading Passages (Wheldall, 1996). The WARP is a curriculum-based measure of oral reading fluency (Wheldall & Beaman, 2000). Students are required to read three 200-word text passages each for one minute and words read correctly per minute (WPM) rate is recorded. The reading passages have been shown to have high internal consistency, inter-correlations exceeding 0.95 (Wheldall & Beaman, 2000, p. 74). The passages have also been shown to be highly correlated with the Neale Analysis of Reading accuracy measure (0.84–0.87) indicating good criterion-related validity (Madelaine & Wheldall, 1998).

Intervention

The Schoolwise Programme at the Exodus Tutorial Centre comprises intensive MULTILIT literacy instruction (Wheldall & Beaman, 2000) during morning sessions from 9.00am to 1.00pm, five mornings per week. Students received two hours of independent work; one half hour group spelling lesson; group reading, comprehension and language lessons, for about an hour; and serial reading. In addition to this, students received individual reading instruction for one half hour each day. The Schoolwise Programme is a version of the MULTILIT intervention, both developed by Wheldall and his colleagues at Macquarie University Special Education Centre, Sydney (Wheldall & Beaman, 2000), featuring the MULTILIT Reading Tutor programme. This programme teaches phonic word attack skills, sight words and reinforced reading using Pause, Prompt and Praise (see Wheldall & Beaman, 2000 for a fuller discussion of the programme).

TABLE I. Descriptive statistics (means and standard deviations) for standardised reading and spelling measures, and oral reading fluency at initial testing for the whole sample

Literacy variable	*n*	Mean literacy levels (SD)
Neale Accuracy (months)	22	91.55 (7.62)
Neale Comprehension (months)	22	91.14 (10.52)
WARP (wpm)	22	69.86 (23.02)
SA Spelling (months)	22	97.95 (11.22)
Burt (months)	22	99.14 (14.54)

Test of Auditory Analysis Skills (TAAS) (Rosner, 1975, 1993). As part of the intensive literacy intervention programme, 12 of the 22 students (based on the outcomes of placement testing on the TAAS) received one to one training in a programme to develop auditory analysis skills (TAAS) (Rosner, 1975, 1993). The main goal of TAAS is to teach students how to discriminate between and manipulate phonemes. The programme teaches a range of phonological awareness skills beginning with finding missing syllables in words (e.g. 'Is the word "to" hidden in the word "tomorrow" '?). More difficult tasks require the student to delete (e.g. 'Say "make". Now say it again but don't say the "k" sound') and manipulate ('Say "sad". Now say it again but instead of "s" say "m") single sounds from a sequence. Students move through progressively more difficult levels once they have mastered the current level. The programme promotes listening skills and was administered for up to five minutes each day.

Results

Literacy and Phonological Processing Measures

Means and standard deviations for all literacy measures and sub tests of the PhAB for the total sample of 22 older low-progress (dyslexic and garden-variety) readers are shown in Tables I and II.

As already noted, standardised scores on the PhAB have a mean of 100 and a standard deviation of 15 (Frederickson *et al.*, 1997, p. 58). Of the 22 students partici-

TABLE II. Means (and standard deviations) of the raw and standardised scores on the PhAB sub-tests for the whole sample

Phonological Variable	*n*	Mean Phonological Raw Score February (SD)	Mean Phonological Standardised Score February (SD)
Alliteration	22	8.727 (0.985)	86.64 (7.95)
Rhyme	22	12.18 (5.24)	82.18 (12.50)
Spoonerisms	22	12.00 (5.67)	88.09 (8.13)
Non-word reading	22	8.955 (3.632)	87.00 (6.82)
Naming speed pictures	22	97.00 (29.01)	87.86 (16.09)
Naming speed digits	22	57.91 (14.00)	87.91 (10.96)
Fluency alliteration	22	12.227 (3.085)	94.59 (9.60)
Fluency rhyme	22	7.864 (3.167)	94.14 (10.14)
Fluency semantic	22	21.09 (6.27)	89.23 (16.20)

TABLE III. Means (and standard deviations) of word recognition and oral reading fluency at initial testing and at follow-up, and resultant gains for the whole sample

Literacy variable	*n*	Reading level February (SD)	Retest April (SD)	Gain (SD)	Effect sizes
Burt (months)	22	99.14 (14.54)	112.18 (18.76)	13.05 (8.74)	0.90
WARP (wpm)	22	69.86 (23.02)	100.86 (23.69)	31.00 (10.17)	1.34

pating in this study, 16 were found to have marked phonological difficulties; that is, 16 students were found to have three or more standardised sub test scores that were below 85.

Reading Outcomes for the Whole Sample

Results of the pre-test and post-test means and the gains made for the whole sample following one term of MULTILIT Schoolwise intervention are shown in Table III. The 22 students in the Schoolwise sample as a whole made highly significant gains with good effect sizes for both reading measures. On average, students made mean gains of 13 months on single word recognition as measured by the Burt ($t = 7.00$. $p < 0.01$), and increased the number of words read correctly per minute by 31 words on the WARP ($t = 14.29$. $p < 0.01$), in just one term (ten weeks) of instruction, mornings only.

The main aim of this study was to determine whether students who have a severe reading disability (dyslexia), as defined by the PhAB, would be less responsive to an intensive remedial reading programme than 'garden-variety' poor readers. Table IV shows the mean reading gains for readers who were low in phonological processing skills (Low P), (as previously defined) and for readers who were (relatively) high in phonological processing skills (High P). There were no significant differences in gains between the two groups. The results show that, following intensive literacy intervention, low-progress readers with significant phonological problems made very similar gains to the readers without marked deficits. More importantly, the differences in gains made between the two groups were not consistent across the two dependent variables and, in any case, yielded low effect sizes, indicating that PhAB categorisation was not effective in predicting which readers would make the greater gains in reading after receiving intensive remedial instruction. The simple *t*-test analysis of gains reported in Table IV was confirmed by a subsequent analysis of covariance but it should be noted that the sample sizes were small.

Further exploratory analyses of the correlations between sub test scores, the number of highlighted sub tests and scores on reading measures were undertaken to determine whether any of the sub test scores could independently predict reading gain. No

TABLE IV. Mean differences between low and high PhAB groups for gains in word recognition and oral reading fluency

Literacy variable	Mean gains for Low P($n = 16$)	Mean gains for High P ($n = 6$)	*t*	*P*	ES
Burt (months)	12.50 (8.10)	14.50 (10.97)	0.47	> 0.05	0.23
WARP (wpm)	31.87 (11.46)	28.67 (5.65)	1.63	> 0.05	.31

TABLE V. Correlations between gains on Burt and the WARP and the PhAB sub-test scores for the whole sample

Variable	Burt	WARP
Allit	−0.065	−0.081
Rhyme	0.128	−0.168
Spoon	0.133	−0.420*
Non-W	0.192	−0.175
Name P	0.028	0.000
Name D	0.091	−0.019
Fl Allit	0.102	−0.525*
Fl Rh	−0.069	−0.154
Fl S	0.133	−0.268

*$P < 0.05$.
Abbreviations: Allit, alliteration; Rhyme, rhyme; Spoon, Spoonerisms; Non-W, non-word reading; Name P, picture naming speed; Name D, digit naming speed; Fl-All, alliteration fluency; Fl Rh, rhyme fluency; Fl S, fluency semantics.

relationship was found between the size of gains made and the number of 'highlighted' PhAB sub tests. Table V shows the correlations between gains on Burt reading age, oral reading fluency and PhAB sub tests. Analysis of the individual sub tests as predictors of gains in word recognition and oral reading fluency indicated that only spoonerisms and fluency alliteration were moderately correlated ($p < 0.05$) with gains in WARP reading fluency but *negatively* (see Table V) i.e. a higher initial score on these sub tests indicates a *lower* level of gain in reading fluency.

Phonological Awareness Training

In the current study, as part of the intensive literacy programme, 12 students (based on the results of teacher placement testing) received auditory analysis training (TAAS) (Rosner, 1975, 1993) for up to five minutes each day. Three of the six High P students and nine of the 16 Low P students received this training (i.e. about half of each group). The results showed that students who received TAAS training achieved better gains on the reading measures compared to the group who did not receive TAAS training. For Burt Word Recognition, the 12 students who received TAAS gained 14.83 months (SD 7.52) compared with 10.9 months (SD 9.98) for the group who did not receive TAAS. Similarly for WARP reading fluency, the TAAS group gained 33.92 words per minute (SD 9.45) compared with 27.50 words per minute (SD 10.36) for the non-TAAS group.

To examine this more clearly, the six students with higher PhAB scores were excluded and the scores for the 16 low PhAB students were analysed. This analysis revealed differences in mean gains between Low P groups who did receive TAAS training and those who had no training. The Low P group ($N = 9$) who received TAAS training made an average gain of 15 months on the Burt and increased oral reading rate by an average of 35 words per minute. The Low P group who did not receive training in TAAS ($N = 7$) made an average gain of 8 months on the Burt and increased oral reading rate by an average of 27 words per minute. Details of the initial,

TABLE VI. Means (and standard deviations) for Low P students on initial testing, follow-up and the resultant gains

Literacy variable	TAAS	*n*	Pre-test (February)	Retest (April)	Gains	*t* (*P*)	ES
Burt	No	7	94.43 (6.13)	103.29 (9.67)	8.86 (6.20)	1.68	0.80
(months)	Yes	9	94.78 (7.66)	110.11 (14.37)	15.33 (8.57)	$P > 0.05$	
WARP	No	7	57.43 (21.85)	85.00 (22.71)	27.57 (12.35)	1.02	0.67
(wpm)	Yes	9	69.33 (24.25)	104.56 (25.70)	35.22 (10.15)	$P > 0.05$	

follow-up and resultant gains on the Burt and WARP for these students are shown in Table VI. Although no significant differences were found between groups, large effect sizes were evident.

To summarise, the key finding of this study is that the PhAB does not effectively predict student gains in reading. The inclusion of phonological awareness training (TAAS) in the literacy intervention for this sample of students may have influenced the results. The results of the group differences between Low P students who received TAAS training and those who received no training suggest a trend in favour of the Low P with TAAS group. This group achieved greater gains on both dependent variables, the Burt and the WARP, but note that this was not a true experimental manipulation since allocation to treatment group was not random.

Discussion

The primary aim of this study was to examine whether the status of a low-progress reader as being either a true 'dyslexic' or 'garden-variety' low progress reader, as determined by the PhAB, would predict reading gains after receiving one term of intensive remedial reading instruction. Results of the study do not support the hypothesis that students with marked phonological processing deficits, as determined by the PhAB, make less significant gains in reading outcomes compared to students without apparent deficits. In fact it was found that the intervention programme (MULTILIT) (Wheldall & Beaman, 2000) was effective in achieving substantial and significant gains in single word recognition and oral reading fluency for both groups.

The results of the present study suggest that older low-progress readers who present with marked phonological processing difficulties are still able to make rapid gains in reading if they receive effective intensive intervention based on 'best-practice' methods such as the methods employed in the MULTILIT programme (Wheldall & Beaman, 2000). The MULTILIT programme incorporates much of the effective instructional design and programming principles for 'effective reading instruction' as described by Foorman and Torgesen (2001, p. 203), for example. Furthermore, the gains made by the Schoolwise sample also support the contention by Share (1995) that older readers should receive instruction that promotes the 'self-teaching mechanism' which leads to the development of generative decoding strategies.

A subsidiary finding was that reading performance might have been influenced by the provision of auditory analysis training (TAAS). Note, however, that TAAS was only provided for up to five minute of instruction per day. It should be emphasised that the proportion of students receiving TAAS was almost equal (about half) for both Low P and High P groups. In other words, the possible effect of TAAS was systematically controlled and hence the results are not confounded by the TAAS factor.

Secondary analysis found that the group that were found to be low in phonological processing skills but who received auditory analysis training (TAAS) made larger gains in both single word recognition and oral reading fluency than a group of low phonological processing students who did not receive such training. Although these gains were not significant, the large effect sizes suggest that training in TAAS may have had a favourable impact on word recognition and oral reading fluency. Moreover, it is likely that all the students who received training in TAAS benefited from training in both phonological awareness and explicit instruction in letter to sound correspondences. It is likely that the benefits of such training are similar to those achieved by younger beginning readers with phonological awareness problems (Hatcher *et al.*, 1994). The tentative results of the current study are also consistent with the research by Lovett *et al.* (1994) and suggest that those readers who present with phonological difficulties may benefit from effective reading intervention that includes a phonological awareness component.

The results of the current study suggest that students with 'dyslexia', at least as determined by their performance on the PhAB, can acquire competency in reading, and that knowledge of the alphabetic principle can be induced, as part of intensive remedial instruction. In addition, the evidence suggests that reading gains can be made despite the possibility that phonological awareness deficits may persist (Bruck, 1992; 1993; Elbro *et al.*, 1994; Fawcett & Nicolson, 1995; Felton *et al.*, 1991; Gottardo *et al.*, 1997, Shankweiler *et al.*, 1996). The results of this study, although contrary to the stated hypothesis, are encouraging in that they highlight the fact that the key to treating reading disability lies in the effectiveness of the instruction received rather than the categorisation of reader type.

The limitations of this study, in addition to relatively small sample size, were that the phonological awareness training received by the Low P group was not experimentally manipulated in that the students were not randomly allocated to training and control groups, but rather selected through placement testing on the TAAS. Further research should include the random allocation of students to groups before training in phonological awareness is conducted. This would allow for a more systematic examination of the processes involved in reading remediation and assist in determining how much impact direct and explicit phonological awareness training has on the reading gains made by older disabled readers. Further research examining the persistence of phonological processing deficits in this sample may assist in clarifying the issue of whether or not effective remedial instruction can address the core phonological deficit of 'dyslexic' readers in addition to achieving positive reading outcomes.

This paper reports the findings of the study based on the progress of a sample of older low-progress readers on two dependent variables after one term of intensive literacy instruction. The aim is to follow-up the students after a further term of instruction at which point the students will be re-assessed on all five of the original literacy measures, and the PhAB, administered at the beginning of the research project. This will allow not only comparisons of progress on more literacy measures following extended intensive literacy intervention but also an examination of current performance on the PhAB following intervention.

Correspondence: Professor Kevin Wheldall, Director, Macquarie University Special Education Centre, Macquarie University, Sydney, NSW 2109, Australia (e-mail: kevin.wheldall@mq.edu.au).

REFERENCES

Adams, M. J. (1990). *Beginning to read. Thinking and learning about print.* Cambridge, MA: The MIT Press.

Ball, E. W. (1996). Phonological awareness and learning disabilities: Using research to inform our practice. *Advances in Learning and Behavioural Disabilities*, *10*(A), 77–100.

Ball, E. W., & Blachman, B. A. (1988). Phoneme segmentation training: Effect onreading readiness. *Annals of Dyslexia*, *38*, 209–225.

Ball, E. W., & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Reading Research Quarterly*, *26*, 49–66.

Bradley, L., & Bryant, P. E. (1983). Categorising sounds and learning to read. A causal connection. *Nature*, *301*, 419–421.

Bruck, M. (1992). Persistence of dyslexics' phonological awareness deficits. *Developmental Psychology*, *28*, 874–886.

Bruck, M. (1993). Word recognition and component phonological processing skills of adults with childhood dyslexia. *Developmental Review*, *13*, 258–268.

Elbro, C., Nielsen, I., & Petersen, D.K. (1994). Dyslexia in adults: Evidence for deficits in non-word reading and in the phonological representation of lexical items. *Annals of Dyslexia*, *44*, 205–226.

Fawcett, A., & Nicolson, R. L. (1995). Persistence of phonological awareness deficits in older children with dyslexia. *Reading & Writing: An Interdisciplinary Journal*, *7*, 361–376.

Felton, R. H., Naylor, C. E., & Wood, F. B. (1991). Neuropsychological profile of adult dyslexics. *Brain & Language*, *39*, 485–497.

Frederickson, N., Frith, U., & Reason, R. (1997). *Phonological assessment battery: Manual and test materials.* Windsor, UK: NFER-NELSON Publishing Company Ltd.

Frith, U. (1995). Dyslexia: can we have a shared theoretical framework? *Educational and Child Psychology*, *12*, 6–17.

Gallagher, A. (1995). The development of a phonological assessment battery: research background. *Educational and Child Psychology*, *12*, 18–24.

Gilmore, A., Croft, C., & Reid, N. (1981). *Burt word reading test: New Zealand revision.* Wellington, NZ: New Zealand Council for Educational Research.

Gottardo, A., Siegel, L. S., & Stanovich, K. E. (1997). The assessment of adults with reading disabilities: What can we learn from experimental tasks? *Journal of Research in Reading*, *20*, 42–54.

Greenberg, D., Ehri, L.C., & Perin, D. (1997). Are word-reading processes the same or different in adult literacy students and third-fifth graders matched for reading level? *Journal of Educational Psychology*, *89*, 262–275.

Foorman, B. R., & Torgesen, J. (2001). Critical elements of classroom and small-group instruction promote reading success in all children. *Learning Disabilities Research and Practice*, *16*, 203–212.

Hatcher, P. J., & Hulme, C., & Ellis, A. W. (1994). Ameliorating early reading failure by integrating the teaching of reading and phonological skills: The phonological linkage hypothesis. *Child Development*, *65*, 41–57.

Hempenstall, K. (1999). *Literacy and older children? What focus for instruction?* Feature address presented at the Australian Association of Special Education National Conference, September 1999, Sydney, Australia.

Hulme, C., & Snowling, M. (1992). Phonological deficits in dyslexia: A 'Sound'reappraisal of the verbal deficit hypothesis? In N. Singh, & I. Beale (Eds.), *Learning disabilities: Nature, theory and treatment* (pp. 270–301) New York: Springer Verlag.

Lovett, M. W., Borden, S. L., De Luca, T., Lacerenza, L., Benson, N. J., & Brackstone, D. (1994). Treating the core deficits of developmental dyslexia: Evidence of transfer of learning after phonologically-and-strategy- based reading training programs. *Developmental Psychology*, *30*, 805–822.

Madelaine, A., & Wheldall, K. (1998). Towards a curriculum-based passage reading test for monitoring the progress of low-progress readers using standardised passages: A validity study. *Educational Psychology*, *18*, 471–478.

McGuinness, D., McGuinness, C., & Donohue, J. (1995). Phonological training and the alphabet principle: Evidence for reciprocal causality. *Reading Research Quarterly*, *30*, 830–852.

Munro, J. (1998). *Assessing and teaching phonological knowledge*. Melbourne, Victoria: The Australian Council for Educational Research Limited.

Neale, M. D. (1999). *Neale analysis of reading ability—3rd Edition.* Hawthorn: Australian Council for Educational Research.

Pratt, C., & Brady, S. (1988). Relation of phonological awareness to reading disability in children and adults. *Journal of Educational Psychology*, *80*, 319–323.

Report of the National Reading Panel. (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction*. (Report, National Institute of Child Health and Human Development). Retrieved June, 2000 from the World Wide Web: http://www.nichd.nih.gov/publications/.

Rosner, J. (1975). *Helping children overcome learning difficulties: A step by step guide for parents and teachers.* New York: Walker and Co.

Rosner, J. (1993). *Helping children overcome learning difficulties: A step by step guide for parents and teachers*, (3rd ed.). New York: Walker and Co.

Shankweiler, D., Lundquist, E., Dreyer, L. G., & Dickinson, C. C. (1996). Reading and spelling difficulties in high school students: Causes and consequences. *Reading & Writing, An Interdisciplinary Journal*, *8*, 267– 294.

Share, D. L. (1995). Phonological recoding and self-teaching: Sin qua non of reading acquisition. *Cognition*, *55*, 151–218.

Siegel, L.S. (1999). Learning disabilities: The roads we have travelled and the path to the future. In R. L. Sternberg & L. Spear-Swerling (Eds.), *Perspectives on Learning Disabilities. Biological, Cognitive, Contextual.* (pp. 159–175). Colarado, USA: Westview Press.

Stanovich, K. E. (1986). Mathew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly*, *21*, 360–391.

Stanovich, K. E. (1988). Explaining the differences between the dyslexic and the garden-variety poor reader: The phonological-core-variable-difference model. *Journal of Learning Disabilities: 21*, 590–604.

Stanovich, K. E. (1991). Discrepancy definitions of reading disability: Has intelligence led us astray? *Reading Research Quarterly*, *26*, 7–23.

Stanovich, K. E. (1992). Speculations on the causes and consequences of invdividual differences in early reading acquisition. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading Acquisition*. Hillsdale, New Jersey: Laurence Erlbaum Associates.

Stanovich, K. E. (1994). Romance and reality. *The Reading Teacher*, *47*, 280–291.

Stanovich, K. E. (2000). Progress in understanding reading: Scientific foundations and new frontiers. New York: Guilford Press.

Stuart, M., & Masterson, J. (1992). Patterns of reading and spelling in 10-year-old children related to prereading phonological abilities. *Journal of Experimental Child Psychology*, *54*, 168–187.

Torgesen, J.K., & Wagner, R. K. (1998). Alternative diagnostic approaches for specific developmental reading disabilities. *Learning Disabilities Research & Practice*, *13*, 220–232.

Torgeson, J. K., Wagner, R. K., & Rashotte, C. A. (1997). Prevention and remediation of severe reading disabilities: Keeping the end in mind. *Scientific Studies of Reading*, *1*, 217–234.

Waterman, B., & Lewandowski, L. (1993). Phonologic and semantic processing in reading-disabled and non-disabled males at two age levels. *Journal of Experimental Child Psychology*, *55*, 87–103.

Westwood, P. (1999). *Spelling approaches to teaching and assessment.* Camberwell, VIC: ACER.

Wheldall, K. (1994). Why do contemporary special educators favour a non-categorical approach to teaching? *Special Education Perspectives*, *3*, 45–47.

Wheldall, K. (1996). *The Wheldall assessment of reading passages: Experimental edition.* Sydney, Australia: Macquarie University Special Education Centre.

Wheldall, K., & Beaman, R. (2000). *An evaluation of MULTILIT: 'Making up lost time in literacy'.* Canberra: Commonwealth Department of Education, Training and Youth Affairs.

Wheldall, K., & Carter, M. (1996). Reconstructing behaviour analysis in education: A revised behavioural interactionist perspective for special education. *Educational Psychology*, *16*, 121–140.

Wilson, J., & Frederickson, N. (1995). Phonological awareness training: An evaluation. *Educational and Child Psychology*, *12*, 68–79.

Yap, R., & Van Der Leij, A. (1993). Word processing in dyslexics. An automatic decoding deficit. *Reading and Writing: An Interdisciplinary Journal*, *5*, 261–279.