Psychology: the Journal of the Hellenic Psychological Society

Vol 11, No 2 (2004)

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doi: 10.12681/psy_hps.24002

ΨΥΧΟΛΟΓΙΑ, 2004, 11 (2) ◆ 242-254 PSYCHOLOGY, 2004, 11 (2) ◆ 242-254

Phonological processing in poor readers

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ABSTRACT This study was designed to evaluate, firstly, the validity of the discrepancy definition of dyslexia and, secondly, the validity of the phonological deficit versus lag models of reading disability. Phonemic awareness (phoneme deletion and phoneme tapping) and phonological decoding (pseudo-word reading) were examined in 48 children classified into three groups representing a) poor readers with reading-verbal ability discrepancy, b) poor readers without reading-verbal ability discrepancy, and c) younger normal readers (as decoding-level matched controls). The results indicated a qualitative similarity in the phonological processing profiles of poor readers independent of verbal ability level, thus providing no support for the validity of the reading-verbal ability discrepancy classifications of reading disability. Furthermore, support for the phonological deficit hypothesis as a means of accounting for the phonological problems of both discrepant and non-discrepant poor readers was apparent. Theoretical and educational implications of the findings are discussed.

Key words: Reading disability, Classifications of reading disability, Dyslexia, Phonological processing.

Introduction

This study was designed to address two major issues in reading research: firstly, the validity of the discrepancy definition and classification of reading disability and, secondly, the validity of the phonological deficit versus the developmental lag model of reading failure.

Despite the lack of a consensual model of reading disability classification, apparent in research for almost thirty years, and the long dispute over the classification criteria for developmental dyslexia, it has been common in research and educational practice to identify a child as reading disabled or dyslexic on the basis of a discrepancy between observed and expected reading achievement (relative to intelligence test scores). The degree of this discrepancy has been long assumed to be meaningful and has formed the critical criterion for the definition and diagnosis of *developmental dyslexia*, a term reserved for those children exhibiting inadequate for their chronological age reading ability, accompanied by average or above average intelligence (Vellutino, 1979). This discrepancy-based definition of dyslexia has long constituted the basis for the formation of the educational policy over the remedial teaching of dyslexic readers mainly in

Acknowledgements: We are grateful to an anonymous referee for useful suggestions and feedback. We also wish to thank all the children who participated in the study and their teachers, as well as the Educational Authorities of Scotland for giving permission for the study to be conducted within the schools of the Stirling area.

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the US, whereas in Northern Europe such considerations have been outlawed.

Implicit in the use of the discrepancy definition is the assumption that the deficient reading development of poor readers of below average intelligence is explicable in terms of their low IQ levels, whereas the reading failure of average intelligence poor readers is truly unexpected. The notion of «unexpectedness», implying a reading failure despite sufficient intelligence for mastering reading skills, has been the source of much confusion in the reading literature. Furthermore, the remedial potential as well as the patterns of cognitive functioning displayed by poor readers of differing IQ levels have been assumed to be distinctive, in the absence of empirical support (Stanovich, 1994; Stanovich & Siegel, 1994). On the basis of these unproven and non-empirically evaluated theoretical assumptions, differential theoretical and educational treatment of poor readers of differing IQ levels has dominated both research and educational settings.

The discrepancy hypothesis traces its roots in the epidemiological work of Rutter and his associates, who, using regression procedures, distinguished two reading-impaired subgroups (according to the presence or absence of discrepancy between reading attainment and IQ), namely a *specific reading retarded* and a *general reading backward* group (Rutter, Tizard, & Whitmore, 1970; Rutter & Yule, 1973; Rutter & Yule, 1975). Rutter & Yule's (1975) conceptual foundation of specific reading retardation as a distinct entity was based on their finding that, relative to the group of poor readers with general reading backwardness, the group of poor readers with specific reading retardation included more male than female members and had a worse reading prognosis, despite their higher IQ scores. This two-group hypothesis advanced by Rutter & Yule (1975), and the subsequent dominance of the discrepancy assumption, has contributed to the restriction of later investigations to the study of poor (dyslexic) readers defined with strict psychometric criteria.

Accordingly, the majority of investigations conducted during the past two decades have examined intensively the phonological processing patterns of poor readers with reading-IQ discrepancy (i.e., dyslexic readers). These investigations have concluded that disabled readers defined with psychometric criteria display remarkable deficits in various aspects of phonological processing, including phonemic awareness, verbal working memory (Gathercole & Baddeley, 1990) and pseudo-word reading (see Rack, Snowling, & Olson [1992] for a review of the pseudo-word reading deficit in dyslexia). However, since poor readers without reading-IQ discrepancy were not included in the samples as controls, no indication was provided as to whether poor readers of this category suffer equivalent phonological deficiencies.

Only recently have a series of converging studies that evaluated the validity of the reading-IQ discrepancy assumption been reported. These studies employed a *garden-variety control design* (terminology developed by Gough & Tunmer, 1986) to address the question whether the cognitive and reading performance profiles of poor readers with and without discrepancy are qualitatively similar or dissimilar. Such designs compare the performance –on a variety of cognitive and reading measures– of poor readers with reading-IQ discrepancy (i.e., discrepant poor readers, or dyslexics) with that of poor readers without discrepancy (garden-variety poor readers). However, these studies, described in reviews by Stanovich (1991) and Siegel (1992), have provided equivocal findings, partly due to methodological issues related to different definitions of discrepancy or to variability in measures of observed and expected reading achievement. Thus, some studies yielded results providing support for a qualitative difference in the cognitive and reading profiles of the two poor reader groups (Rutter & Yule, 1975; Silva, McGee, & Williams, 1985), whereas others provided evidence of a qualitative similarity between the two poor reader groups in cognitive, reading, spelling and phonological processing measures (Taylor, Satz, & Friel, 1979; Johnston, Rugg, & Scott, 1987; Fredman & Stevenson, 1988; Siegel, 1988, 1989, 1992; Felton & Wood, 1992; Stanovich & Siegel, 1994). Consistent with this growing body of literature that fails to support the hypothesised distinction between dyslexic and garden-variety poor readers is also the more recent finding of Francis, Shaywitz, Stuebing, Shaywitz & Fletcher (1996) that the developmental course of reading skills in children with reading disability is independent of their IQ level.

The issue of whether poor readers with and without reading-IQ discrepancy exhibit similar or dissimilar reading-related cognitive profiles is directly relevant to the formation of two distinct hypotheses of reading disability, namely the phonological deficit and the developmental lag hypothesis. The *phonological deficit hypothesis* assumes that reading failure is due to a specific deficit in the phonological component of language. In contrast, the *developmental lag hypothesis* assumes that the rate of the development of the cognitive processes related to reading is slower for poor readers, who are lagging behind their peers on these skills as well as on reading achievement (however, they eventually «catch up» to their peers, according to a strong version of the lag hypothesis).

The issue of phonological deficit versus developmental lag has been traditionally approached in terms of a *reading-level match design*, which compares cognitive development between older poor readers and younger normal readers matched with the poor readers on reading ability. This type of design, although having some interpretive weaknesses, can be of great utility, as it eliminates differences in reading ability between the groups compared (Bryant & Goswami, 1986). More recently, however, a new regression-based analytic strategy for comparing the cognitive profiles of poor readers and normal readers has been proposed by Stanovich & Siegel (1994), who argue that this logic eliminates some of the methodological weaknesses of the reading-level match design.

Several studies have employed a reading-level match design to address the validity of the two hypotheses of reading disability, providing equivocal support for either the phonological deficit hypothesis (Bradley & Bryant, 1978; Snowling, 1980, 1981; Baddeley, Ellis, Miles, & Lewis, 1982; Kochnower, Richardson, & Di Benedetto, 1983; Holligan & Johnston, 1988; Olson, Wise, Conners, Rack, & Fulker, 1989) or the developmental lag hypothesis (Beech & Harding, 1984; Treiman & Hirsh-Pasek, 1985; Szeszulski & Manis, 1987; Vellutino & Scanlon, 1987) [see also Rack et al. (1992) for a review].

Moreover, Stanovich (1988, 1993) has proposed the *phonological-core variable-difference (PCVD) model* as a framework for conceptualising the phonological problems of poor readers of differing IQ levels. Within the PCVD model, the assumption of specificity inherent in the definition of developmental dyslexia holds. That is, the basis of the dyslexic performance pattern is a vertical faculty, a specific deficit in the phonological language domain, providing support for the phonological deficit hypothesis. Indeed, the finding of dyslexic readers' deficits in various aspects of phonological processing is well established, and the evidence of a causal linkage between phonological processing ability and reading skill is growing (Wagner & Torgesen, 1987). On the other hand, poor readers without reading-IQ discrepancy (i.e., the garden-variety poor readers) share the phonological problems of dyslexic readers, their deficits being extended into a variety of domains, providing support for the developmental lag hypothesis.

In view of the aforementioned theoretical and methodological considerations, the present study was designed to compare the phonological processing performance of poor readers with and without reading-verbal ability discrepancy, while at the same time considering an analogous comparison between poor readers as a group and decoding-level controls.

Two experimental designs were employed to attain the two-fold purpose of the study:

(a) A *garden variety control design* evaluating the validity of the reading-verbal ability discrepancy assumption. In the context of this design, the phonological processing profiles of poor readers with and without reading-verbal ability discrepancy matched (group matching) on word recognition ability were compared. Therefore, the issue addressed was whether poor readers with reading-verbal ability discrepancy (from now on referred to as *discrepant poor readers*) and poor readers without reading-verbal ability discrepancy (from now on referred to as *non-discrepant poor readers*) display qualitatively similar or dissimilar phonological processing profiles in tasks of phonemic awareness and phonological decoding.

(b) A *decoding-level control design* [matching groups on word recognition ability, as Stanovich, Nathan & Zolman (1988) suggest] evaluating the validity of the phonological deficit versus the developmental lag hypothesis. Within the framework of this design, the phonological processing patterns of the two poor reader groups were compared to those displayed by younger normal readers of average verbal ability matched (group matching) with the poor readers on the basis of word recognition ability. Thus, the issue addressed was whether the phonological deficits of discrepant and non-discrepant poor readers fit the phonological deficit or the developmental lag hypothesis.

Method

Sample

The sample consisted of 48 Primary School children (35 male and 13 female) drawn from 5 schools serving a suburban middle-class area, with the exception of 1 school serving an area characterised by social deprivation and lower socio-economic status. All participants were native English speakers and were being educated in English. Children with sensory deficits, neurological or behavioural problems and English as a second language were excluded from the sample. Two groups of poor readers, one group of average verbal ability (mean age: 10 years 2 months) and one group of below average verbal ability (mean age: 10 years 3 months), as well as a group of decoding-level controls (mean age: 8 years 2 months) participated in the study. Poor readers were designated as discrepant and non-discrepant and decoding-level controls were selected on the basis of their scores on the British Ability Scales (BAS) Word Reading Test (Elliott, Murray, & Pearson, 1979) and on the British Picture Vocabulary Scale (BPVS) (Dunn, Dunn, & Whetton, 1982). Specifically, children of Primary 5 and 6[1] age could qualify for the initial pool of poor readers and children of Primary 3 and 4[2] age could qualify for the pool of decoding-level controls as follows:

1. Discrepant poor readers: 21 children with a BPVS standardised score of at least 85 (one standard deviation unit below the mean) and with a BAS word reading age at least 15 months behind chronological age.

2. Non-discrepant poor readers: 13 children with a BPVS standardised score of below 85 and with a BAS word reading age at least 15 months behind chronological age.

3. Decoding-level controls: 14 younger normal readers with a BPVS standardised score of at least 85, whose word reading age on the BAS (as a group) matched that of the two poor reader groups.

The mean chronological ages, BAS word

1. These stages of schooling in Scotland correspond to Grades 4 and 5 respectively in the US.
2. These stages of schooling in Scotland correspond to Grades 2 and 3 respectively in the US.

reading ages and BPVS age equivalent scores of all three groups are presented in Table 1.

Materials

a) Phonemic Awareness Tasks

A phoneme deletion and a phoneme tapping task were used. These tasks measure *analysis*, a sophisticated aspect of phonemic awareness referring to the ability to produce isolated phonemes from words. The phoneme deletion task shows high correlations with other phonemic awareness tasks and with measures of phonological decoding (Lenchner, Gerber, & Routh, 1990). The phoneme tapping task was employed on the grounds that it does not require a verbal response and allows for detection of spelling strategies (Perfetti, Beck, Bell, & Hughes, 1987). Furthermore, neither phoneme deletion nor tapping involve a serious memory load, as only one word per trial is dealt with.

The phoneme deletion task used was adopted from Bruce (1964) and administered according to Bruce's procedure. This task employed thirty words (twenty-six monosyllables, three disyllables and one trisyllable). The position of the deletion on these words varied; for ten of the words the suggested deletion was at the beginning of the word, for ten around the middle and for ten at the end of the word. Children were required to repeat each word without the designated sound (e.g., «OLD» for «COLD»), and correct deletion produced both the sound and the correct spelling of the residual word. The phoneme tapping task was a slightly modified version of the tapping task developed by Liberman, Shankweiler, Fischer & Carter (1974) and was administered following the suggested procedure, but the original forty two items list was modified to include only thirty items (ten one-segment, ten two-segment and ten three-segment items). Under the guise of a «tapping game», children were required to repeat a word or a sound and to indicate, by tapping a pencil on the table, the number of sounds in the stimulus items.

Both phonemic awareness tasks were presented auditorily to all of the children and required an oral response. Several practice items

Table 1
Means and standard deviations for chronological age, BAS word reading age and BPVS age equivalent scores for the three groups

	Chronological age		BAS word reading age		BPVS age equivalent scores	
Group	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
DPR (*N* = 21)	10y2m	6.55	7y9m	7.90	9y9m	18.27
NDPR (*N* = 13)	10y3m	7.72	7y9m	8.98	7y3m	8.10
DL (*N* = 14)	8y2m	7.75	8y3m	8.98	7y11m	10.62

Notes: 1. DPR = discrepant poor readers; NDPR = non-discrepant poor readers; DL = decoding-level controls.
2. Standard deviations for chronological age, BAS word reading age and BPVS age equivalent scores are expressed in months.

with corrective feedback were presented before the experimental trials. During the experimental trials only general encouragement was provided, with no feedback on the correctness of responses. Correct response data were recorded on a scoresheet, with a score of 1 for each correct response.

b) *Phonological Decoding Task*

Phonological decoding was assessed by means of a pseudo-word reading accuracy measure consisting of fifteen monosyllabic and fifteen polysyllabic pseudo-words adopted from Kochnower et al. (1983) and from Olson et al. (1989). These pseudo-word reading measures were selected for three reasons:

i. their discriminating power had been established;
ii. they included polysyllabic, phonologically complex pseudo-words, which precluded the possibility of the more advanced readers being restricted by the test ceiling;
iii. the pseudo-words adopted from Olson et al. (1989) were not visually similar to real English words, thus eliminating the possibility of pseudo-word reading by analogy with real words.

Children were presented with thirty white index cards (5X3 cm), each containing a pseudo-word printed in «schoolbook» font. They were instructed to read aloud the nonsense words at their own pace. The pseudo-words were visually presented in a randomised order obtained by shuffling the cards prior to presentation. No feedback on correctness of responses was provided.

The phonemic awareness and the phonological decoding tasks are reported in the Appendix.

c) *Reading and Proxy Verbal Ability Measures*

The British Ability Scales (BAS) Word Reading Test-short form, Test B (Elliott et al., 1979), a standardised reading test examining context-free single-word recognition skill, was used as a criterion and matching variable. The British Picture Vocabulary Scale (BPVS) short form (Dunn et al., 1982) was employed as a proxy measure of verbal ability. This measure of receptive vocabulary for Standard English traces its roots to the Peabody Picture Vocabulary Test (Dunn, 1965), which has been found to correlate highly (r = .66) with WISC (Wechsler, 1949) Verbal IQ (Sattler, 1974). Moreover, the PPVT (Dunn, 1965) and the PPVT-R (Dunn & Dunn, 1981) have been employed, along with other matching variables, in several other investigations (Taylor et al., 1979; Siegel, 1988, 1992; Felton & Wood, 1992; Stanovich & Siegel, 1994).

Procedure

The experiment was conducted within a one-month period, during the last month of the school year. Children were tested individually in a single session, with no time limits, in a small quiet room in their own school. The length of time required for the completion of the tasks ranged from 30 to 50 minutes, depending on children's speed of response. The BPVS-short form was administered first and the BAS Word Reading Test-short form was administered last in all of the cases. A counterbalancing sequence of task administration was employed for the three experimental tasks, to control for potential facilitating or inhibiting effects of one task on performance on the other tasks.

Results

Mean BPVS age equivalent scores are presented in Table 1. A one-way ANOVA conducted on the BPVS standard scores revealed a significant difference between groups, $F(2, 45) = 33.50$, $p < .001$, which was further investigated using planned orthogonal comparisons. The subsequent analysis revealed the predicted difference between discrepant and non-discrepant poor readers (t = 7.36, df = 45, p < .001) and between non-discrepant poor readers and controls (t = -7.11, df = 45, p < .001), with no significant difference between discrepant poor readers and controls (t = -.41, df = 45, ns). Given the significant difference between groups in BPVS standard scores, Pearson product-moment correlations between BAS word reading ages and BPVS standard scores were computed for each of the three groups to determine whether an analysis of covariance, using BPVS as a covariate, would be required. As these correlations failed to reach significance (p > .10), word reading age appears to be independent of BPVS for all of the groups in the present sample.

The mean performance of discrepant poor readers, non-discrepant poor readers and decoding-level controls on all three experimental tasks is shown in Table 2 and depicted graphically in Figure 1.

Three separate one-way randomised ANOVAs, one for each experimental task, were carried out upon the complete data, since the differing characteristics and cognitive demands of the three experimental tasks would pose problems as far as the interpretation of possible between-task differences or interactions involving the «task» variable is concerned.

The ANOVAs conducted on phoneme deletion and phoneme tapping revealed no significant between-group differences for either phoneme deletion, $F(2, 45)$ = 1.08, ns, or phoneme tapping, $F(2, 45)$ = 1.93, ns. Therefore, discrepant poor readers' performance on phoneme deletion and phoneme tapping was not shown to differ significantly from the performance of non-discrepant poor readers, and the two poor reader groups appeared to perform at a level similar to that of decoding-level controls on both measures.

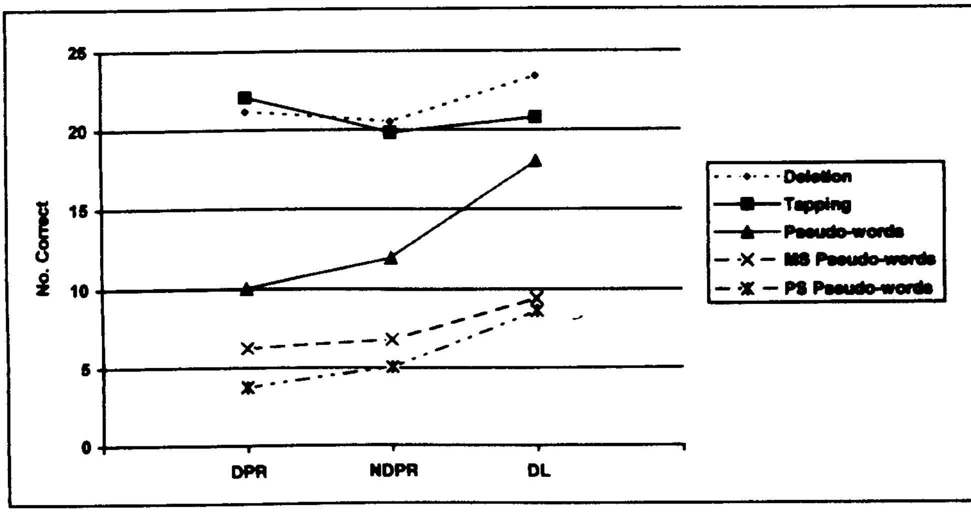
With respect to the pseudo-word reading measure, an ANOVA indicated a significant

Table 2
Means and standard deviations for performance on the phonemic awareness and phonological decoding measures for the three groups

	DPR (N = 21)		NDPR (N = 13)		DL Controls (N = 14)	
Task	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Deletion	21.19	5.54	20.53	4.68	23.42	5.98
Tapping	22.09	2.64	19.84	4.54	20.78	2.88
Pseudo-words	10.04	5.54	11.92	6.00	18.07	4.85
MS Pseudo-words	6.28	2.83	6.84	3.62	9.42	2.37
PS Pseudo-words	3.76	2.84	5.07	3.22	8.64	3.00

Notes: 1. Deletion = phoneme deletion;
Tapping = phoneme tapping;
Pseudo-words = pseudo-word reading;
MS Pseudo-words = monosyllabic pseudo-word reading;
PS Pseudo-words = polysyllabic pseudo-word reading.
2. The maximum test scores are: 30 for phoneme deletion, phoneme tapping and pseudo-word reading;
15 for monosyllabic and polysyllabic pseudo-word reading.

Figure 1
Mean performance of discrepant poor readers, non-discrepant poor readers and decoding-level controls on all phonological measures.



difference between groups, $F(2, 45) = 9.26$, $p < .001$. The significant main effect of group was further analysed using planned orthogonal comparisons. The *t-tests* performed revealed a significant difference in pseudo-word reading between discrepant poor readers and controls ($t = -4.23$, $df = 45$, $p < .001$) and between non-discrepant poor readers and controls ($t = -2.90$, $df = 45$, $p < .01$), with no difference between the two poor reader groups ($t = -.96$, $df = 45$, ns). On the whole, discrepant and non-discrepant poor readers appeared to perform at a significantly lower level than decoding-level controls on pseudo-word reading, with no significant difference between the two poor reader groups.

The impact of the complexity of the pseudo-word reading task on performance was tested by a two-way ANOVA with repeated measures on one factor. There was one between-subjects factor, «group» with three levels (discrepant poor readers, non-discrepant poor readers and decoding-level controls), and one within-subjects factor, «pseudo-word type» with two levels (monosyllabic versus polysyllabic pseudo-words). The main effect of pseudo-word type was significant, $F(1, 45) = 25.11$, $p < .001$, with more correct responses occurring to the monosyllabic pseudo-word reading. There was also a significant main effect of group, $F(2, 45) = 9.26$, $p < .001$, which was further investigated using follow-up planned comparisons. The *t*-tests performed revealed a significant difference between discrepant poor readers and controls ($t = 4.23$, $df = 45$, $p < .001$) and between non-discrepant poor readers and controls ($t = -2.90$, $df = 45$, $p < .01$), with no significant difference between the two poor reader groups ($t = .96$, $df = 45$, ns). Thus, both discrepant and non-discrepant poor readers performed at a poorer level than decoding-level controls. The «group by pseudo-word type» interaction failed to reach conventional levels of significance, $F(2, 45) = 2.42$, $p = .100$, and thus was excluded from further analysis.

Discussion

The first main purpose of this study was to examine the phonemic awareness and phonological decoding patterns of poor readers with and without reading-verbal ability discrepancy, thus addressing the meaningfulness of distinguishing between two distinct subtypes of reading disability. The null results of the garden-variety control design indicated that, irrespective of verbal ability level, poor readers appear to display similar overall levels of accuracy in all three phonological processing measures. This evidence of remarkable similarity between discrepant and non-discrepant poor readers in the phonological processing subskills adds to a growing body of literature that fails to support the hypothesised distinction between the two poor reader groups (Taylor et al., 1979; Johnston et al., 1987; Fredman & Stevenson, 1988; Siegel, 1988, 1989, 1992; Felton & Wood, 1992; Fletcher et al., 1994; Stanovich & Siegel, 1994; Francis et al., 1996). Therefore, no support for the validity of classifying reading disability on the basis of the presence or absence of reading-verbal ability discrepancy was provided, as both definitions yielded poor readers with similar phonological processing profiles.

The second major issue addressed in this study was whether the phonological deficiencies of poor readers with and without reading-verbal ability discrepancy fit the phonological deficit or the developmental lag hypothesis. Both poor reader groups appeared to perform at a lower level than decoding-level controls only on the phonological decoding measure of pseudo-word reading; no difference between the groups in their performance on the two phonemic awareness measures was found.

This mixed set of results yielded by the decoding-level control design can be accounted for in terms of several interpretations. The negative (no difference) result pertinent to the phonemic awareness measures presents certain interpretive problems (Backman, Mamen, & Ferguson, 1984; Jackson & Butterfield, 1989; Stanovich & Siegel, 1994). Thus, it can be interpreted, according to Bryant & Goswami (1986), as supporting either the developmental lag hypothesis of no underlying difference or, alternatively, the compensatory processing notion of a difference disguised by the higher overall developmental level of the two poor reader groups.

On the other hand, the significant difference between the two poor reader groups and their decoding-level controls in the phonological decoding of pseudo-words supports the phonological deficit hypothesis. Interestingly, it could also be suggested that poor readers tend to compensate for their deficient phonological processing by developing orthographic strategies for reading words, thus having some success with word decoding on BAS, although not at an appropriate for their chronological age level. Moreover, the latter finding can be cautiously interpreted as merely an indicator (although not evidence) that deficits in phonological decoding may have something to do with the cause of reading difficulties [see Bryant & Goswami (1986) for a discussion of the strengths and weaknesses of the reading-level match design].

In relation to the phonological performance profiles of discrepant poor readers, the finding that discrepant poor readers performed at a poorer level than decoding-level controls on pseudo-word reading is in line with earlier studies supporting the phonological deficit hypothesis for dyslexic readers (Snowling, 1980, 1981; Baddeley et al., 1982; Kochnower et al., 1983; Holligan & Johnston, 1988; Olson et al., 1989), as well as with the predictions of the PCVD model (Stanovich, 1988, 1993). On the other hand, with respect to the performance profiles of non-discrepant poor readers, the finding of non-discrepant poor readers performing poorer than decoding-level controls on pseudo-word reading provides also support for the phonological deficit hypothesis, but fails to confirm the predictions of the PCVD model (Stanovich, 1988, 1993). However, the latter finding is consistent with a later conjecture of the PCVD model (Stanovich & Siegel, 1994), according to which discrepant and non-discrepant poor readers exhibit clearly a similar phonological core deficit which impairs the word recognition process (see also Fredman & Stevenson, 1988; Felton & Wood, 1992). Therefore, this study provides evidence supporting the phonological deficit hypothesis as a means of accounting for the phonological problems of both discrepant and non-discrepant poor readers.

In view of the present findings, the reading-verbal ability discrepancy assumption underlying the definition and classification of reading disability, according to which poor readers of differing verbal ability levels form distinct reading disability groups requiring different forms of remediation, is questioned. Indeed, the clinical and educational practice of identifying a specific type of reading disability on the grounds of psychometric criteria (measured general ability) and designing a special educational treatment for this type of disability may be invalid, as discrepant and non-discrepant poor readers do not seem to be distinguishable, at least in terms of their phonemic awareness ability and their ability to decode pseudo-words phonologically (see also Ellis, McDougall, & Monk, 1996). It is suggested that assessment and intervention should rather focus on a detailed analysis of those reading-related processes which are deficient in each individual with reading difficulties, a view consistent with Bryant & Bradley (1985).

Furthermore, the emergence of a deficit model accounting for the phonological problems of both discrepant and non-discrepant poor readers has important implications for intervention. Poor readers as a whole were found in this study to exhibit a specific deficit in the phonological language domain, presumably persisting into adolescence, even adulthood. Hence, the early detection of reading inefficiency is deemed as essential for an adequate and effective intervention at an early age, before poor reading becomes persistent.

In conclusion, this study sheds light on the phonological processing profiles of poor readers with and without reading-verbal ability discrepancy and of younger decoding-level controls. Evidence is provided in support of a qualitative similarity between discrepant and non-discrepant poor readers as well as in support of the phonological deficit hypothesis accounting for the phonological problems of both poor reader groups. However, while recent studies have revisited the issue of whether poor and skilled readers may be distinguished in terms of the cognitive processes underlying word recognition and reading comprehension (Swanson & Alexander, 1997), little is as yet known as to whether discrepant and non-discrepant poor readers are distinguishable in respects other than phonological processing ability. Further research into the cognitive processes underlying word recognition may provide valuable insights into our understanding of reading failure and lead to a shared theoretical and therapeutical framework among researchers and practitioners.

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Appendix

Phoneme deletion measure

S-T-AND (SAND), J-AM (AM), FAIR-Y (FAIR), HA-N-D (HAD), STAR-T (STAR), NE-S-T (NET), F-ROCK (ROCK), TEN-T (TEN), LO-S-T (LOT), N-ICE (ICE), STOP (TOP), FAR-M (FAR), MON-K-EY (MONEY), S-PIN (PIN), FOR-K (FOR), C-OLD (OLD), PART-Y (PART), WE-N-T (WET), F-R-OG (FOG), N-EAR (EAR), THIN-K, (THIN), P-LATE (LATE), S-N-AIL (SAIL), B-RING (RING), PIN-K (PIN), LE-F-T (LET), CAR-D (CAR), S-P-OON (SOON), H-ILL (ILL), EVER-Y (EVER).

Phoneme tapping measure

OUT, /ei/, MINE, /e/, COOL, TOY, HIS, / /, BAG, /a /, IS, TOYS, /i/, POUT, AT, MY, CAW, /i/, LAKE, POT, RED, / i/, HE, LAY, /ai/, HEAT, /ae/, COO, ED, /u:/.

Pseudo-word reading measure

TER, ITE, LUT, CALCH, SHUM, STRALE, DOUN, SED, HOAM, JIT, BLESH, VOZE, DRIME, ROUD, FROICE, TEGWOP, POSKET, VOGGER, STALDER, BLIDAY, GRIBBET, FRAMBLE, SHIMPOLK, VLINDERS, LISIT, SUBLISH, ZOWER, LOMPRAIN, EXCRODE, MOTATE.