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Effects of Outpatient Treatment of Dyslexia

Victor H. P. van Daal and Pieter Reitsma

Abstract

The effects of a Dutch intervention program for dyslexia are reported. The program was individually tailored, depending on the style of reading, the phase of the learning process, and the intermediate results of the treatment. Two groups of participants were involved: (a) a group of children with pure dyslexia ($n = 109$) and (b) a group that had reading problems but also suffered from cognitive deficits or psychiatric symptoms ($n = 29$). Scores of reading single words and text at intake and after the intervention were analyzed to assess the efficacy of the intervention program. Furthermore, the effects of pre-intervention variables such as intelligence, reported speech, and language problems and of intervention variables such as the initial level of performance and the duration of the treatment were examined. Both groups benefitted from the intervention, but the children with pure dyslexia profited most. Neither of the groups could catch up the reading deficit. Intelligence and reported speech and language problems did not affect the treatment outcomes. Individual differences in treatment outcome were related to the absolute level of word reading and age at intake. In the group with comorbidity, the intervention program was more successful in relatively younger children. Within this group, the cognitive deficits and types of psychiatric problems were not related to the treatment.

The term developmental dyslexia is usually applied to children who do not attain a level of reading and spelling proficiency, despite their sometimes high other cognitive abilities. Furthermore, educational opportunities, sociocultural environments, or perceptual deficits cannot explain these reading and spelling deficits. Research has established that this deficit is primarily phonological in nature (Stanovich & Siegel, 1994). Current research is aimed at finding out what exactly the phonological deficits are (e.g., Elbro, 1996). Independent of the possible causes of dyslexia, the question of how to remedy dyslexia has been studied. Methods for treating dyslexia have been available for a long time (Gittelman, 1983), but as yet it is unclear whether it is possible to remedy serious reading and spelling problems. Treatment methods may well be efficacious for only a proportion of children with dyslexia, whereas other children remain resistant to treatment. Furthermore, it is unclear which characteristics dis-

tinguish people who are resistant to treatment from those who benefit from treatment. Therefore, research on the effects of remediation programs for dyslexia is badly needed. This study contributes to this area of research.

In a general review on the efficacy of interventions in the field of learning disabilities (LD), Spreen (1988) drew the following conclusions:

1. Learning disabilities persist into adulthood.
2. The persistence is positively related to the severity of the disability.
3. Specific interventions are not related to the outcomes.
4. Sociodemographic factors do explain the outcomes of treatment to some extent.
5. The intellectual level of the individual children with LD accounts for variations in the outcomes.
6. Children for whom neuropsychological deficits are assessed tend to have lower outcome levels.

7. Children with pervasive language disorders also have poorer outcomes.

Although these conclusions cover a wide range of learning disabilities, it remains to be established whether they also apply to the specific domain of dyslexia and its treatment.

Research on the effects of attempts to remedy reading and spelling problems is relatively scarce. One reason may be that many methodological pitfalls must be avoided in assessing the value of treatment programs. Evaluation research in the LD field typically suffers from inadequate methods. According to Fletcher, Foorman, Francis, Shaywitz, and Shaywitz (1994), intervention results in the field of dyslexia may be unreplicable because of (a) variations in the identification procedures of children with dyslexia; (b) temporal instability of the assessment and identification variables; (c) heterogeneity within the samples of dyslexic children, who also might have been pre-selected; (d) the absence of appropriate

control groups; (e) faulty designs for the measurement of change; and (f) variations in the operationalization of the outcome measures.

Nevertheless, some recent studies have used appropriate designs. Lovett and her colleagues (Lovett, Ransby, & Barron, 1988; Lovett, Ransby, Hardwick, Johns, & Donaldson, 1989) compared a decoding skills program, an oral and written language program, and a third condition, which controlled for treatment time and individual attention. The results showed that deficits associated with dyslexia were amenable to treatment, that greater improvement resulted from the two treatment programs, and that the decoding skills program produced the most transfer. A further experiment (Lovett, Warren-Chaplin, Ransby, & Borden, 1990) compared a word training program using the whole-word method with a program that trained constituent grapheme-phoneme correspondences. Both word training programs showed significant gains in accuracy and speed of word recognition, but not in reading untrained materials. Most notably, the children did not profit differentially from letter-sound over whole-word training. Our late colleague Jan Kappers reported on the effects of outpatient treatment in 80 children with dyslexia (Kappers, 1997). Treatment was individually tailored, depending on the style of reading, the phase of the learning-to-read process, and the intermediate results of the treatment. Effects on reading performance, measured after preclinical (home training), clinical, and post-clinical intervention periods, were analyzed through multiple time-series and multilevel analyses. Treatment appeared to have robust effects. Comparing the group with the largest rate of gain to the group with the lowest rate of gain showed that there was no relation between intelligence and the rate of gain in the training. The groups did not differ on the duration of the treatment. The only difference found was that relatively older children with initially higher absolute levels of read-

ing skill benefitted most from the treatment program. Scanlon and Vellutino (1996, 1997) showed that at-risk children in kindergarten could be helped with programs that concentrated on phoneme awareness and reading and writing activities. Children who were resistant to the intervention showed different cognitive abilities, having, for instance, less general world knowledge and a poorer word and sentence memory.

Thus, it is not yet clear what treatment programs or components are most efficacious, because similar outcomes have been achieved with different treatments (e.g., Lovett et al., 1990). Moreover, it is not obvious what exactly works, as programs are often multicomponential and the effects of individual components have not been examined in isolation (e.g., Kappers, 1997). Furthermore, it is not clear whether there are aptitude-treatment interactions. For example, some studies show interactions with intelligence (e.g., Scanlon & Vellutino, 1997), whereas in others no effects of intellectual ability are found (e.g., Kappers, 1997). Finally, there is no agreement on the outcome variables to be measured. Should one, for example, take into account the initial level of performance, or the absolute level attained after treatment (training is successful if participants attain some specified minimum level of literacy), or the duration of the treatment (treatment is less efficient if it takes a long time)? It does not seem informative to report that a treatment was statistically significant, as this only means that, given a specified reliability level, the results were not completely at random. Instead, one would like to express the magnitude of the obtained effect as *strong*, *medium*, or *weak* (Cohen, 1988). Therefore, statements about the obtained effect sizes are necessary.

In this study, we analyzed the results of a treatment program in 138 children who were referred to the outpatient clinic of the Paedologisch Instituut (see Kappers, 1997). Another

aim was to see whether the treatment program also worked in children with different characteristics—that is, whether children with complex learning problems or behavioral problems also profited from this particular treatment. This group of children was designated the comorbidity group. Analyses were conducted to relate the established progress during treatment to pretreatment variables such as intelligence and specific language and speech problems. We attempted to control for the possible pitfalls that Fletcher et al. (1994) warned against as follows. The outpatient clinic to which the children in this study were referred is part of a child psychiatric center. Only dyslexic children who had received professional help but had made no progress were accepted for treatment in this clinic. They were also assumed to be at risk for developmental psychopathological problems as a consequence of their persistent reading problems (Spren, 1989). Thus, our sample consisted of severe cases of dyslexia. The selection criteria for inclusion were as follows. All subjects lagged at least 2 years behind same-age peers in single-word reading or text reading. Children with uncorrected vision problems, hearing loss, acquired neurological disorders, or a primary language other than Dutch were excluded from the study.

The problems that coincided with the reading problems in the comorbidity group were also very serious. Some children in this group had a relatively typical full-scale IQ (> 90) but showed a strong discrepancy between the verbal and performance abilities. Other children in the comorbidity group could be diagnosed with serious emotional and behavior problems according to psychiatric criteria. Because all cases studied were very severe cases of dyslexia, for which previous interventions had not worked out, one can assume that the behavior under study—poor reading and, in the comorbidity group, emotional and intellectual problems—is quite stable over time.

For the assessment of the reading of single words and text, age-norm-referenced tests were used, so that the reading performance could be assessed in a reliable and valid way. Of course, any group of children with learning disorders, especially with comorbidity, is heterogeneous. This should not preclude the search for factors that might influence the outcomes of intervention programs. In this study we concentrated on the effect of preintervention variables, such as intelligence and reported speech and language problems, and intervention variables, such as the initial level of performance and the duration of the treatment. The variations in the outcomes were analyzed by means of regression analysis.

Instead of using controls without disabilities, who are rarely available in intervention studies, we used norm-referenced scores to examine the outcomes of the intervention. In this study, we combined the outcome measure with the measurement of change by ensuring that both were based on norm-referenced scores. These norm-referenced scores are standardized scores with a mean of 10 and a standard deviation of 3, representing a participant's relative position in the norm group. A significant change would be an increase or decrease of 3 points or more. Furthermore, we reported effect sizes of the treatment. In the regression analyses, effect sizes were expressed as proportions of explained variance.

The general hypothesis tested in this study was whether severe dyslexia is amenable to treatment. Other hypotheses included the effects of the underlying (verbal) deficits on treatment efficacy. There is increasing evidence that at least some children with dyslexia suffer from a variety of oral language deficits (Tallal, Allard, Miller, & Curtiss, 1997). In this study, we were interested in four aspects of language and speech. First, there may be evidence of *early problems with phonology*. One would expect that phonological skills such as rhyming exert an influ-

ence on the efficacy of the treatment. If phonological skills form the core deficit in reading disability (Stanovich, 1988), the treatment effects would be related to the severity of the phonological skills impairment. The more serious the dyslexia, the more the phonological deficits would be present and the less amenable the dyslexia would be to treatment. However, when children grow older, the influence of phonological skill on reading might disappear, because such skills have by that time been trained very frequently and intensively. In this study we have assumed that severe problems with phonology would be mentioned by the parents of the children when they were asked whether there had been (or still were) problems with tasks such as rhyming and remembering songs.

The second aspect of interest was the *quality of the phonological representation*, which is thought to be poor if children speak unintelligibly. The quality of phonological representations in kindergarten-age children can be assessed by means of an ingenious procedure introduced by Elbro (1996). The child is shown a puppet with apparent speech difficulties. For example, the puppet pronounces *crocodile* as *codi*. The child is then requested to teach the puppet the correct pronunciation. The child has been told that the puppet is also hard of hearing, so that anything said to the puppet has to be pronounced very carefully and loudly. From the responses of the child, it can be computed how accurate and how distinct the phonological representations are. In this study, the children's parents were asked whether the child spoke more unintelligibly than its peers or the other children in the family, on the assumption that such speech problems reflected the quality of the phonological representations.

A third aspect related to speech problems is *stuttering*. Stuttering may be an indicator for deficits with articulation and naming. McBride and Manis (1996) found that naming difficulty was a separate contributor to poor reading, independent of phono-

logical skill. Stuttering can easily be detected by the parents of the child; therefore, questions about this aspect were included in the intake interview. We expected that children with a history of speech problems (speaking unintelligibly and stuttering) would benefit less from the treatment than children without such problems.

The fourth aspect of interest involved *linguistic competence*. Obviously, this is measured to a large extent with verbal IQ tests. Furthermore, we questioned the parents about word finding, remembering word meanings, and problems in constructing proper sentences. These problems were all held to be contraindications for success of the intervention.

Another question involved the influence of preintervention variables. Some studies have found that the level of intellectual functioning affects the efficacy of the treatment (Scanlon & Vellutino, 1997; Spreen, 1988), whereas others have argued that intelligence should not even be included in the definition of dyslexia (Stanovich, 1991). Kappers (1997) found that intelligence may not be important for the success of the treatment either at a general level (verbal IQ, performance IQ) or at the subtest level.

Method

Research Questions

We set out to examine whether the clinical intervention described in a subsequent section created higher levels of reading performance, both in the reading of single words and in the reading of text. We also analyzed whether students with comorbidity achieved lower levels of reading. Two groups participated in this study (a) a group of children with pure dyslexia, and (b) a group of children with reading problems who also showed cognitive deficits or psychiatric symptoms. A final research question concerned the factors that might influence the efficacy of the treatment program. To

provide an answer to this question, both groups were examined on various pretreatment and intervention variables.

Participants

Altogether, 138 children with reading problems, who were admitted to the treatment program of the outpatient clinic and terminated the program before the beginning of 1998, took part in this study. No selection of participants was made once the children were admitted to treatment. Thus, the sample includes participants who had terminated the program because they no longer received reimbursement from the General Exceptional Medical Expenses Act, which allows for 90 treatment sessions of 50 minutes each. The sample also includes children who had terminated treatment because they had made up their reading skill deficit or because they did not profit at all from the treatment. Group 1 (pure dyslexia) consisted of 109 children, Group 2 (comorbidity) of 29 children.

Reading Tests

Reading performance was measured using standardized tests. Single word reading was assessed using a 1-minute reading test (OMT; Brus & Voeten, 1973), and text reading was assessed by means of text cards (AVI; Van den Berg & Te Linteloo, 1977) and other comparable tests. OMT scores reflect the number of words correctly read within 1 minute. The AVI score indicates a level of text reading (0–12) representing the mastery of a text within a given time and at a certain level of accuracy. In both measures, speed and accuracy are thus measured. Comprehension measures were not taken.

Other Assessments

Intelligence was assessed using the Dutch version of the Wechsler Intelligence Scale for Children–Revised (WISC-RN, Van Haasen et al., 1985). Problems with language and speech,

classified according to (a) phonology, (b) speech intelligibility, (c) speech fluency, (d) word finding, and (e) sentence construction were assessed in an interview with the parents of the children. Prior to the interview, parents had completed an anamnestic questionnaire with questions in these areas. Depending on the version of the questionnaire, there were two or three questions for each different aspect of language and speech problems. The anamnestic questionnaire contained items such as, "Did your child have more problems than other children in . . . remembering songs." In the intake interview, parents were requested to expand on any of the problems they had indicated. The interviewer then scored either *certainly severe problems* or *certainly no severe problems*. For the present analysis, the information was reduced to the five aforementioned dichotomy scales.

Behavioral problems reported in the questionnaire or by the children's teacher were further examined by requesting the child's parent or teacher to complete the CBCL (Achenbach, 1991; Verhulst, Van der Ende, & Koot, 1996). In case of severe problems the child was referred to a child psychiatrist who made a diagnosis according to the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV; American Psychiatric Association, 1994). Within the comorbidity group, the following four subgroups were found: (a) a group of children with a strong discrepancy between verbal and nonverbal IQ; (b) a group of children who suffered from depressions; (c) a group of aggressive children; and (d) a group of children with pervasive developmental disorders.

Design and Procedures

At intake, the IQ, the actual reading level, and the reading strategy of the children were assessed. In children who belonged to the comorbidity group, the CBCL was administered, and an interview was conducted by the child psychiatrist, if appropriate.

Clinical treatment sessions were individual, each approximately 50 minutes in duration, usually on a weekly basis. The treatments were carried out by a staff of child neuropsychologists and special educators, with occasional assistance from university psychology students. Although each child had his or her own therapist, every child met other therapists on a number of occasions due to holidays, illness, changing time schedules, and so forth. The treatment periods of the study participants varied from at least half a year to a maximum of 26 months. Measures of reading performance on both word and text reading were taken after approximately every eight clinical treatments. Only measures taken at intake and after termination of the treatment were analyzed.

Treatment Method

The treatment methods were based on Bakker's Balance model (Bakker, 1979; see, for an extensive description, Kappers, 1997), and on sound educational principles that are generally acknowledged as important for the remediation of children with LD, including structured practice, many repetitions, and motivation techniques. In practice, however, the treatment method had many options to accommodate individual needs.

The treatment always covered three levels of practice: letters, words, and text. The aim of practice with letters was to increase the fluency of letter identification as a building block for the further advancement of word recognition skills. The most frequently used method to enhance letter naming consisted of a manual flashcard training. Letters and bigraphs were briefly presented on cards by the therapist and the child had to name the letter(s) by sound. The therapist marked misreadings and rated the speed of naming in a qualitative way. Misreadings were given another try. Flashcards were usually practiced four times at the beginning of the treatment session. Occasionally, letters that were

hard to learn for an individual were presented three or more times in a run. Other examples of practice at the letter level are letter dictation and word analysis.

Practice at the word level was carried out to boost the identification of single words. Depending on the goals set for the individual child, combinations of the presentation, type, arrangement, and way of processing of the materials were varied. For example, for some children we used plastic letters that were fastened to the grooves of a planning board, which were out of sight and had to be processed with either the left or the right hand. Materials used were either real words or pseudowords, which could be presented in isolation or in word lists (e.g., word families).

Words also could be flashed by means of an especially designed computer program, which controlled whether the words were presented to the left, right, or both visual half-fields. Presentation times were shortened as soon as a predetermined level of mastery was attained. The instructions for the child were varied (naming, matching, letter detection, etc.). The therapist always marked how many errors the child made and at what pace the child proceeded.

The final part of each session was devoted to reading text. Several options were available: tactile reading versus "normal" reading, normal text, cloze text versus scrambled text (each letter written in a different font), and ways of providing feedback (depending on whether the goal was to read fast, to read accurately, or to read for meaning).

Treatment Variations

In the comorbidity group, various problems occurred together with the reading problems. Apart from the treatment for reading, additional treatment was implemented depending on the type of problem.

For example, for children with a low self-concept, we tried to give the child insight into his or her actual performance and the way in which he or she thought about it. The therapist showed understanding for failures and, together with the child, worked out more realistic aims. Small steps in reading practice had to be taken, and each step was accompanied by positive feedback. We also taught how to attribute a success to "working hard" instead of thinking "I had a good day" or "I was lucky."

Problems with motivation were handled according to principles of behavioral learning theory (Dickerson & Creedon, 1981; Kanfer & Scheff, 1988; Prochaska & Diclemente, 1984). This therapy is aimed at increasing the child's insight into his or her learning problem, to prepare him or her for a change by having him or her acknowledge his or her problem, and at the same time increasing his or her feelings of competence so that he or she believes in a change for the better.

The most prevalent cognitive problems encountered within the comorbidity group included language and speech problems such as poor auditory memory and specific cognitive deficits (low scores on some IQ subtests). The last cluster of problems was formed by psychiatric symptoms, which were classified as (a) depressions, (b) aggressive behavior, and (c) pervasive disorders.

Results

Participants' Characteristics

Table 1 presents the participants' characteristics at intake. Formal reading instruction starts in the Netherlands at the average age of 6 years 5 months.

TABLE 1
Participants' Characteristics at Intake

Variable	Group 1 Pure dyslexia			Group 2 Comorbidity			<i>F</i>	<i>df</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	range	<i>M</i>	<i>SD</i>	range			
Age (months)	123	17	88–180	120	18	84–162	< 1	1, 132	
Reading instruction received at school (months)	38	13	17–68	36	15	9–65	< 1	1, 132	
Single word reading (wrds/min)	31.06	13.03	7–65	18.33	9.37	4–38	20.51	1, 132	< .001
Text reading (levels 0–12)	3.66	2.29	0–9	1.67	1.58	0–6	16.47	1, 132	< .001
Full scale IQ	102.67	10.72	85–140	91.21	9.32	79–116	22.94	1, 117	< .001
Verbal IQ	99.19	11.70	79–137	88.91	9.96	67–106	15.05	1, 116	< .001
Performance IQ	106.48	11.90	85–141	94.22	11.31	73–122	20.00	1, 116	< .001

Note. Group 1 *n* = 109; Group 2 *n* = 29.

By the end of the first grade (10 months later), the average child reads 23 words per minute in the OMT. Before we analyzed whether the groups obtained different results after treatment, possible differences at intake were analyzed. The groups differed in the levels of reading performance at intake; the comorbidity group (Group 2) read significantly less single words per minute and read text at a lower level of difficulty than the dyslexic group (Group 1). Thus, the reading problems were more serious in the comorbidity group. With respect to intelligence scores, Group 1 scored nearly 10 IQ points higher than Group 2. Thus, comorbidity problems are partly reflected in the intelligence measures. No differences by age and amount of reading instruction received were found.

Generally, although no norms exist, the incidence rate of the various speech-language problems seemed to be relatively high. Except for rhyming, they occurred equally often in both groups. It is noteworthy that problems with rhyming occurred more often in the comorbidity group. Thus, Group 2 seems to have a more severe deficit related to reading (phonological skill). The incidence of speech-language problems is reported in Table 2.

Intercorrelations between the scales were relatively low, except for word finding and sentence construction ($r = .61$), from which it can be inferred that the scales covered different areas of speech-language problems. The measures of the various aspects of speech-language problems can be considered reliable (Cronbach's $\alpha = .72$), especially when taking into account the small number of items in the scale.

Efficacy of Treatment

To evaluate the effects of the treatment program, the results of reading single words and text passages were analyzed by means of an analysis of variance. The scores at intake and after treatment formed the within-subjects factor, and the duration of the treatment was used as a covariate, as there

were small differences between and within the groups with respect to this variable.

Mean scores for single word reading and text reading are presented in Table 3. In single word reading there was overall improvement, $F(1, 131) = 268.06$, $p < .001$. Both groups progressed significantly. The interaction of the improvement with groups was significant, $F(1, 131) = 4.62$, $p = .033$. Group 1 started at a higher level than Group 2 and eventually reached a higher level of word reading. Duration of treatment was not a significant covariate, $F(1, 130) < 1$. In text reading there was overall improvement, $F(1, 131) = 303.57$, $p < .001$. Both groups progressed significantly. The interaction of the improvement with groups was significant, $F(1, 131) = 9.21$, $p < .003$. Duration of treatment was not a significant covariate in this analy-

sis, $F(1, 130) < 1$. Effect sizes for treatment ($\eta^2 = .67$ for word reading and $\eta^2 = .70$ for text reading, respectively) were relatively large (Cohen, 1988).

The correlations between scores at the pretest and the posttest were substantial, .83 for word reading and .78 for text reading, respectively. The reading of single words correlated .91 with text reading at the pretest, and .93 at the posttest. The correlations within the groups showed a similar pattern. These figures may indicate that, in the measurement of reading performance, a high level of reliability was achieved. However, it is evident that the individual differences were stable over time.

For the single-word reading test, norms are available for the population of Dutch school children (Van den Bos, Lutje Spelberg, Scheepstra, & De Vries, 1994). On this measure, the pure

TABLE 2
Incidence Rate of Speech-Language Problems

Problems with	Group 1 Pure dyslexia	Group 2 Comorbidity	χ^2 ($df = 1$)
Rhyming	.30	.54	4.96 ($p = .03$)
Intelligible speech	.21	.29	0.73 ($p = .39$)
Fluency (Stuttering)	.18	.25	0.55 ($p = .46$)
Word finding	.40	.50	0.74 ($p = .39$)
Sentence construction	.27	.42	1.87 ($p = .17$)

Note. Group 1 $n = 109$; Group 2 $n = 24$.

TABLE 3
Results on Single Word and Text Reading Before and After Treatment

Variable	Group 1 Pure dyslexia	Group 2 Comorbidity
Duration of treatment (months)	14.62	15.50
Single word reading ^a		
At intake	31.06	18.33
After treatment	51.30	33.87
Text reading ^b		
At intake	3.66	1.67
After treatment	7.81	4.58

^aNumber of words per minute. ^bDifficulty level attained.

dyslexics progressed from 2.47 to 4.83 and the comorbidity group from 1.58 to 2.20 (with a mean of 10 points and a standard deviation of 3 points). An analysis of covariance produced similar levels of significance and effect sizes as the previous analyses. Thus, there was progress in both groups, although real significant progress was only approached by the group of students with pure dyslexia.

Probably because of the heterogeneity of the comorbidity problems, no relations could be found between comorbidity problems and treatment outcomes. Interactions between progress on word and text reading and the presence or absence of a psychiatric disorder were nonsignificant, $F(1, 21) < 1$. The interactions for the three different groups with psychiatric disorders were nonsignificant as well, $F(2, 11) = 1.31, p = .309$.

Factors That Influenced Treatment Efficacy

In the previous section, the average results for both groups were presented but, as indicated by the standard deviations reported in Table 1, the groups appeared to be rather heterogeneous. Whereas some children seemed to profit considerably, others remained at the same level of reading ability or even deteriorated. Is it possible to account for these individual differences in terms of age at intake, intelligence, reported speech-language problems, and duration of the treatment? Who was resistant to treatment, and who was not?

We used the standardized gain in the reading of simple words to search for factors that might influence the efficacy of the treatment program. Correlations within and across groups were computed between the standardized gains and the following factors: initial word-reading level, intake age, treatment duration, IQ (VIQ and PIQ), and speech-language variables. Then, regression analyses were conducted. The correlation coefficients within

and across groups are presented in Table 4. To obtain reliable independent variables for the regression analyses, the speech-language variables were subsumed under one summed variable, whereas for intelligence the full scale measure was used. (Correlations between verbal subscales of the WISC-RN and treatment outcomes were low and insignificant in both groups.) Similar analyses were performed on the gains in word reading, expressed as differences between the number of words read at pretest and the number of words read at posttest. These analyses yielded similar results. Nineteen percent of the total variance within the group of students with pure dyslexia could be explained. The more words that were read at intake, the larger the progress that was made, $t = 3.49, p < .001$. The longer the duration of the treatment, the more efficacious the treatment, $t = 3.43, p < .001$. In the comorbidity group, 32% of the variance could be explained. The only significant variable that accounted for this was the age at intake; for children with comorbidity, help with reading was more efficacious at a younger age, $t = -2.40, p = .027$.

Discussion

This study examined the effects of a treatment program for dyslexia in two groups of children, one with pure dyslexia and one group with additional problems. The performance on word reading and text reading before and after the treatment was analyzed. Both groups improved significantly in the absolute numbers of single words read in a minute and in the absolute level of difficulty attained in text reading. Standardized gains—a measure that reflects the relative position within the age-norm group—were found to be marginal, however. This finding indicates that, although there was considerable progress in absolute scores, the reading deficit was not made up by most of the children. The group of children with pure dyslexia appeared to improve significantly more than the group with comorbidity in both word and text reading.

The effects of preintervention variables such as intelligence and reported speech-language difficulties on the outcomes were also examined. Only a small part of the outcome variance in word reading could be explained, most

TABLE 4
Predictors (Correlation Coefficients) for Standardized Gain in Word Reading

Variable	Group 1 Pure dyslexia		Group 2 Comorbidity		Both groups combined	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
Number of single words read at intake	.30	.001	.09		.36	< .001
Age at intake	.20	.03	-.42	.04	.14	
Duration of treatment	.22	.02	.29		.20	.02
VIQ	.07		.13		.17	
PIQ	.01		-.24		.11	
Rhyming	.15		-.13		.05	
Speaking intelligibly	-.07		.11		-.07	
Stuttering	.02		.09		.01	
Word finding	.00		-.21		-.04	
Sentence construction	.00		-.26		-.06	

Note. *p* values are shown when significant at 5%. VIQ = Verbal IQ; PIQ = performance IQ.

of which was accounted for by the number of single words read at intake, the duration of the treatment (in the group with pure dyslexia), and age at intake (in the group with comorbidity). IQ and reported speech-language problems did not affect the outcome.

The children with comorbidity profited less from the intervention, and the type of additional disorder was not related to the outcome of the intervention. It would be worthwhile to examine whether these children's progress in reading depends on the amelioration of their other problems or whether improvement in reading is relatively independent of the other problems, because within this group no correlation was found between IQ—the variable that differentiated this group from the others—and the standardized gain in word reading. Similar results with respect to intelligence were found for the other group; moreover, no effect of intelligence on treatment outcomes was found across groups. This is not in line with the findings of Scanlon and Vellutino (1996, 1997) with much younger children. Kappers (1997) compared extreme groups—that is, those who profited most with those who were resistant—on all subtests and subscales of the WISC and did not find any differences. Thus, the argument of Stanovich (1988) can be extended to treatment: Dyslexia is not related to intelligence, and the effects of treatment are not influenced by intelligence. Moreover, the role of intelligence in the treatment of dyslexia might be different from that in the treatment of other learning disabilities (Spreen, 1989).

Reported speech-language difficulties did not affect the efficacy of the treatment. Provided that the operationalization of the respective concepts is appropriate, this finding would provide support for the position that dyslexia, although it could be a manifestation of a general verbal deficit, is a rather isolated problem. However, assessment of speech and language problems at intake with the

help of standardized test instruments should converge with the types of assessments that were carried out in this study. Self-report data usually correlate significantly with psychometric testing (e.g., Finucci, Whitestone, Isaacs & Childs, 1984; Schulte-Körne, Deinell, & Remschmidt, 1997). However, only longitudinal studies examining speech and language development in depth may advance insights in how they are related to the incidence of dyslexia and the differential response to various treatments.

Some of the results of Kappers' (1997) study could be replicated: The absolute level of word reading at intake was a predictor of the success of the treatment. The more words a child can read, the more words he or she will learn during treatment. Age at intake, which Kappers (1997) also found to be of importance for the success of the treatment—that is, the older the child, the more gains—was found to be important in the pure dyslexia group, but not in the comorbidity group. Thus, for pure dyslexic children the treatment used here could be more efficacious at a relatively older age, when a certain level of reading has been mastered. For the comorbidity group, help with reading may work better when children are younger and additional problems do not yet interfere with learning.

In this study, on average 60 hours of treatment were given to children with severe reading problems. Nevertheless, rather moderate effects were obtained, at least with respect to the norm-referenced scores. A number of explanations are warranted. First, the treatment may not have been efficacious in the sense that all children caught up their deficit, although the treatment certainly helped them to attain a higher absolute level of reading. Second, the participants may have been very hard to teach. A third reason may have been that the treatment did not fit the type of participant. Because different groups were defined in this study, it is likely that, both within and across the groups, the

participants differed in relevant but untested variables, which might explain why there were individual differences in response to the reading treatment. Although the treatment on average looked ineffective, it actually worked well for some participants but not for others. This highlights the importance of understanding differences in response to treatment. One way to examine the individual differences in response to treatment is to experimentally manipulate the content and the procedures of practice. Some children may need much drill and practice, along with encouragement to repeatedly process many words, whereas others, for instance, may need multisensorial treatments. For practical reasons, it is probably best to set up multiple case designs, in which some participants do not yet receive treatment but serve as controls.

Apparently, none of the children with severe dyslexia in the present study developed a self-teaching mechanism (Share, 1995), as typically developing children do. One of the challenges for future research would be to examine whether we can create learning situations for children with severe dyslexia in which they become motivated to spend time on reading exercises either in an explicit or an implicit way; one must not forget that these children have a history of reading failure, which often leads to loss of motivation. On the other hand, genetic predispositions might well set limits to what can be achieved in children with severe dyslexia with respect to the development of phonological skills and orthographic skills (e.g., Olson, Wise, Connors, Rack & Fulker, 1989). In the general population, some 40% of the reading performance can be influenced by the environment, (i.e., treatment), but in children with severe problems, the possibilities for change could be far more restricted.

Although many early intervention studies have shown that it is possible to reduce the number of children at risk for reading and spelling disabilities, the studies that are devoted to

the treatment of children who had not benefitted from such interventions and were at a later age diagnosed with dyslexia remain scarce. The challenge for future research remains to investigate whether and how intensive remedial treatment can significantly improve the reading ability of persons with severe dyslexia.

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AUTHORS' NOTE

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