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Eye movements of dyslexic children when reading in a regular orthography☆

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Abstract

Participants were German dyslexic readers (13-year-olds) who—compared to English dyslexic readers—suffer mainly from slow laborious reading and less from reading errors. The eye movements of eleven dyslexic boys and age-matched controls were recorded during reading of text passages and pseudoword lists. For both text and pseudoword reading, the dyslexic readers exhibited more and much longer fixations, but relatively few regressions. Increased length of words and pseudowords led to a greater increase in number of fixations for dyslexic than normal readers. Comparisons across studies suggest that the present German dyslexic eye movement findings differ from English-based findings by a lower frequency of regressions (presumably due to the higher regularity of German) and from Italian findings by longer fixation duration (presumably due to the greater syllabic complexity of German).

Keywords: Dyslexia; Eye movements; Regular orthography

1. Introduction

The reading difficulties of dyslexic children in more regular orthographies than English differ from those of English dyslexic children. To illustrate, in Landerl, Wimmer, and Frith's (1997) comparative English-German study, 11-year-old dyslexic children were required to read words which were similar in both languages. Words like *character*, *paradise* or *attractive* were difficult for the English dyslexic children. For example, among the responses to *character* were refusals, word guesses such as "chancellor" and "charger" and nonwords such as "tshrakter." Furthermore, to complete a correct reading of such words, the English dyslexic children needed between five and six times longer than the normal readers. In contrast, the German dyslexic counterparts for the almost identical words *Charakter*, *Paradies*, and *attraktiv* showed no refusals and only few errors, which all were close to the correct reading, but similar to English children, they suffered from slow laborious reading. However, the German readers were advantaged in decoding these words by the rather regular grapheme–phoneme relations of German orthography.

The difference between German and English is particularly marked for graphemes representing vowels. To illustrate, the letter *a* is consistently pronounced as /a/ in the German words *Hand*, *Hass*, *Ball*, and *Garten* while the pronunciation is different for each of the English equivalents (for a detailed discussion of spelling-sound regularity of English and German see Ziegler, Perry, & Coltheart, 2000). The inconsistencies of English vowel-grapheme pronunciation are reduced when the consonant letters following the vowel are taken into account. However, even when English-German consistency differences are counted for spelling bodies (vowel plus following consonants) there still is a marked difference of 70 and 84%, respectively (English: Ziegler, Stone, & Jacobs, 1997; German: J. C. Ziegler, personal communication, February 20, 2001). Furthermore, the majority of the inconsistencies of German have to do with vowel length and normally do not result in reading errors.

One would expect that the mentioned differences in dyslexic reading may be reflected in different eye movement patterns. More pointedly, what is sometimes

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described as haphazard eye movements of dyslexic readers due to oculomotor-dysfunctions could be seen as specific for English. A high number of such wrongly directed eye movements are actually reported for English dyslexic readers. For passage reading of dyslexic 11-year-olds, Lefton, Nagle, Johnson, and Fisher (1979) found that 35% of all fixations were followed by regressions, whereas for normal readers 15% of all fixations were followed by regressions. Hyönä and Olson (1995) recorded the eye movements of 14-year-old dyslexic readers during passage reading. For low frequency words, the percentage of regressions (after the eyes have already moved to the next words) was more than 30%. For English, such high numbers of regressive eye movements are not surprising and actually Hyönä and Olson (1995) reported about the same percentages of regressions for younger (10-year-old) normal readers. The reason for the regressions could lie in the complexities of English grapheme–phoneme correspondences. If a dyslexic or a younger reader has initially misread *character* as "chancellor," as in our above example, then there is reason for a regression to this word during sentence processing. Even within the word, a regression to the initial letters would be expected, if decoding of *character* started with "tsh." Besides a high number of regressive eye movements, the other main English-based findings on dyslexic eye movements are more fixations of much longer duration (Rayner, 1998).

In more regular orthographies where even dyslexic readers commit few misreadings, high numbers of regressive eye movements are not expected and recent research with Italian dyslexic children is in line with this expectation. De Luca, Di Pace, Judica, Spinelli, and Zoccolotti (1999) recorded the eye movements of 12-year-old dyslexic children during passage reading and found no difference with percentages of regressions of about 19% for both dyslexic and normal readers. In a second study, children had to read lists of words and pseudowords and percentages of regressive eye movements were as low as 14 and 9% for dyslexic and normal readers, respectively (De Luca, Borrelli, Judica, Spinelli, & Zoccolotti, 2002). What was abnormal about the eye movements of Italian dyslexic children was the high number of fixations resulting from short forward movements of the eyes. For example, during passage reading the dyslexic participants of De Luca et al. (1999) exhibited about twice the number of fixations of the normal readers with about three fixations per word. Furthermore, increased word length had a stronger effect on number of fixations for dyslexic than for normal readers.

De Luca and colleagues characterized the problem of their dyslexic readers as reflecting reliance on phonological recording to compensate for an impairment in the ability to store or access the letter pattern of frequently encountered words, an inability termed surface dyslexia (Coltheart, Masterson, Byng, Prior, & Riddoch, 1983). Phonological recording in the case of Italian is indeed a viable compensatory strategy. Italian syllables such as in *mano* (hand), *pane* (bread) or *strada* (street) tend to be short and open, often consisting of only a single consonant followed by a vowel. For such syllables, assembly of phonemes should be very easy. Furthermore, the graphemes often are single letters with simple relations to phonemes.

The main goal of our study was to broaden the empirical basis on eye movement characteristics of dyslexic children during reading and contrast the eye movements of 14-year-old German dyslexic children with those of normally reading age-matched controls. Given that German, similar to Italian, exhibits relatively simple grapheme–phoneme relations, one may expect that the mentioned Italian eye movement findings will also be found for German dyslexic children. However, there are linguistic differences. In particular, German does not have the preponderance of short open syllables that characterizes Italian. German syllables, similar to English, often are closed and exhibit consonant clusters at the beginning and/or the end. Accordingly, syllable assembly may be less easy for German than for Italian and this may be reflected in prolonged fixation durations.

In the present study, eye movements were recorded for two reading tasks—passage reading and pseudoword reading. Passage reading should reveal abnormal eye movement patterns of the dyslexic children in everyday reading situations. Pseudowords are new letter strings for which new pronunciations have to be assembled. Obviously, for such items, even normal readers have to resort to some sort of phonological recording. Therefore, one would expect a reduced difference in eye movements between dyslexic and normal readers if dyslexic children suffer only from surface dyslexia, that is, a difficulty in storing or accessing the letter patterns of frequently read words.

2. Method

2.1. Participants

Dyslexic readers and normal readers (all boys in Grade 7) from a large longitudinal study of more than 500 boys were invited to participate based on their reading and spelling performance in Grade 3. Criteria for dyslexic reading were a reading rate of lower than percentile 15 in an individually administered standardized reading test in Grade 3 and a present (Grade 7) reading score of lower than percentile 10 on a sentence reading test mentioned below. Control children both in Grade 3 and in the present study had to obtain reading and spelling scores above percentile 20. Exclusion criterion was a low nonverbal IQ (85 or lower) based on three scales (spatial sequences, spatial integration, and spatial concepts) from the Primary Test of Cognitive Skills (Huttenlocher & Cohen-Levine, 1990) administered at the end of Grade 1. For only 11 of the 20 participants of each group, eye movement recordings were obtained. Some participants were lost due to a failure to acquire reliable infrared images of the pupil. The majority was lost due to track loss during the reading tasks and the complexity of recalibration during task presentation. We examined separately for each group whether the excluded participants differed from the remaining participants on the descriptive measures of Table 1 and found no reliable differences. Actually, the remaining 11 dyslexic participants tended to show lower reading performance than the excluded ones.

Table 1 shows the low reading and spelling performance of the eleven dyslexic readers compared to the eleven control readers and the absence of a reliable difference in nonverbal IQ and age. The reading measures in Table 1 show the pervasive nature of the slow reading of the dyslexic children. The criterion measure for inclusion of participants in the dyslexic and normal reader group was based on an individually administered, standardized sentence-reading test developed in our laboratory. This paper and pencil test measures reading speed by presenting 70 sentences of very simple content with a time limit of 3 min and the instruction to mark each sentence as correct or incorrect and to do so as quickly as possible. Only very few wrong markings occurred. The means for correctly marked sentences of the dyslexic and control readers in Table 1 correspond to percentiles 5 and 60, respectively. Because the mean IQ of the dyslexic children was 9 points lower than that of the controls, we checked the influence of IQ on sentence processing and found the correlation between IQ and the correctly marked sentences to be small, $r(22) = .23$; $p > .29$.

The following reading rate measures (syllables per minute) are based on reading aloud a short text and a list of pseudowords. As evident from the means, the reading rate of the dyslexic readers was about half the rate of the normal readers for text reading and was also severely impaired for reading of pseudowords. Error rates for text and pseudowords were low even among the dyslexic readers with 12.5 and 7.9%, respectively.

Table 1 also shows the syllables per minute measures for the reading tasks used for eye movement recordings. As these tasks were based on silent reading (see Section 2), it is important that the reading rate deficit of the dyslexic readers on the eye-tracking reading tasks corresponds to that on the reading aloud tasks. Table 1 shows that (in absolute numbers) the size of the dyslexic rate deficit—in syllables per minute—was larger for the silent reading tasks used for eye-tracking recording than for the reading aloud tasks. Furthermore, the correlations between the silent reading rates on the eye-tracking tasks and the reading aloud rates were $r(22) = .86$ and $.87$, $p < .01$, for text and pseudoword reading, respectively. These high correlations and the similar rate deficit of the dyslexic readers for silent reading and reading aloud supports the conclusion that the reading behavior of the dyslexic participants on the eye-tracking reading tasks is a valid reflection of their everyday reading difficulties.

2.2. Apparatus and procedure

Eye movements were recorded every 20 ms from the left eye in a natural binocular viewing situation with an ISCAN (Model RK-464) video-based eye tracking system. Participants sat at a distance of 120 cm in front of a Belinea 21 in. Computer monitor connected to a Pentium II (233 MHz) computer used for stimulus presentation. Letter size of reading material on the monitor

Table 1
Descriptive characteristics and reading speed measures for the 11 dyslexic and the 11 normal readers included in analysis of eye movements

Measure	Poor readers[a]		Good readers[a]		Difference	t[b]
	M	*SD*	*M*	*SD*		
Sentence reading (N sentences)[c]	24	5	42	7	−18	8.74***
IQ	100	13	109	13	−9	1.75
Age (months)	163	5	160	4	3	1.69
Spelling (% correct)	25	18	82	12	−57	6.80***
Reading aloud (syllables per minute)						
Text	119	36	239	20	−120	9.60***
Pseudowords	80	21	126	17	−46	5.50***
Silent reading (syllables per minute)						
Text	173	51	374	64	−201	8.15***
Pseudowords	72	26	140	32	−68	5.42***

[a] $n = 11$.
[b] $df = 20$.
[c] Administered in Grade 7.
*** $p < .001$.

(12 mm height for upper-case letters) was chosen in such a way that it corresponded to a natural reading situation with a letter size of 3 mm height for upper case letters at a distance of 30 cm, that is, a visual angle of .6°. Items were presented in yellow on black background in a dimly illuminated room. The brightness of the monitor was adjusted to a comfortable level and was the same for all subjects. A headrest stabilizing the forehead was used. The initial calibration of the system took about 2 min. The more natural passage reading task was presented before the pseudoword reading task and a visual search task (not reported here). Each reading task was preceded by a short familiarization trial with two lines of material only. To motivate careful reading, participants were made aware that the experimenter followed their eye-movements on his monitor.

2.3. Stimulus material

2.3.1. Text reading

The two passages of Appendix A were presented separately on the monitor for silent reading. Each passage was presented in five lines. The content of the passages was simple. Altogether the two passages presented on two subsequent screens consisted of 60 words (120 syllables).

2.3.2. Pseudoword reading

Similar to passage reading, two lists of pseudowords were presented separately for silent reading. Each list was presented on the monitor in 6 lines with 5 items per line (Appendix B). Of the altogether 60 items (120 syllables), twenty were short (4 letters), and monosyllabic (e.g., DREV, GINZ). The remaining 40 items consisted of 7–8 letters. Half of the long items consisted of two-syllables (e.g., SCHEUBOT) and the other half of three syllables (e.g., TEUPATOL). The two-syllables items included a high number of complex graphemes (e.g., SCH).

3. Results

The comparison of dyslexic and normal readers used as measures the number fixations on a word, the average duration of all fixations (i.e., mean fixation duration), the percentage of backward directed eye movements (i.e., regressions), and the duration of the first fixation on a word (i.e., first fixation duration). Table 2 shows for each task how dyslexic children differed from normal readers in number of fixations per item (including items, that were not fixated), in the duration of the mean fixation on an item and in percentage of regressive eye movements. The measures are based on the two screens of each task, regressions included those within and between items.

The results in Table 2 show a simple pattern with substantial group differences for passage and pseudoword reading: Dyslexic readers exhibited more fixations of longer duration and also more regressions. In the case of passage reading, the fewer fixations of the normal readers to some extent reflected a tendency to skip short words, that is, 36% of all words of the passages did not receive a single fixation. This percentage was only 18% for dyslexic readers. For pseudoword reading there were no group differences in the high percentages of items fixated (about 96%). Although dyslexic readers on the reading tasks showed more regressions than normal

Table 2
Eye movement measures for dyslexic and normal readers for passage and pseudoword reading

Measure	Poor readers[a]		Good readers[a]		Difference	t[b]
	M	*SD*	*M*	*SD*		
Text reading						
Fixations per item (N)	1.53	.20	.83	.20	.70	7.00***
Regressions (%)	16	6	9	7	7	2.57**
Mean fixation duration (ms)	367	132	192	34	175	4.27[c]***
Pseudoword reading						
Fixations per item (N)	2.69	.69	1.84	.31	.85	3.78[d],**
Regressions (%)	17	6	10	3	7	2.90[e],*
Mean fixation duration (ms)	685	272	397	118	288	3.21[f],**

[a] $n = 11$.
[b] $df = 20$.
[c] df corrected: 11.33.
[d] df corrected: 13.86.
[e] df corrected: 14.70.
[f] df corrected: 13.62.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

readers, the proportion of these regressions in relation to the total number of fixations was small. For both passage and pseudoword reading, only 16% of all fixations of the dyslexic readers were followed by a regressive eye movement.

3.1. Short vs. long words

For analysis of a differential effect of word length on the two groups, 20 short ($M = 3.85$ letters) and 20 long words ($M = 9.60$ letters) were selected from the text passages. For this analysis, word length could not be separated from word frequency. The mean frequency of the short ones was 4619 occurrences per million (CELEX database, Baayen, Piepenbrock, & van Rijn, 1993), those of the long ones was 131 occurrences per million. Number of fixations, first fixation duration and gaze duration (i.e., the summed duration of all fixations falling on an item, including only items that were fixated) are given in Fig. 1 and were separately analyzed by ANOVAs with word length (short vs. long words) as within- and group as between-subject factor. In the case of a significant effect involving group in subject-based analyses (F_1), the generalizability over items was examined with items as cases (F_2), whereby all factors were between-item factors.

For number of fixations, the length by group interaction was reliable, $F_1(1,20) = 39.83$; $MSE = .04$; $p < .001$ and $F_2(1,76) = 9.04$; $MSE = .29$; $p < .01$. As evident from Fig. 1, the dyslexic readers exhibited a greater increase in number of fixations from short to long words than normal readers, but even the smaller increase shown by the normal readers was reliable, $F_1(1,10) = 65.46$; $MSE = .03$; $p < .001$ and $F_2(1,38) = 27.80$; $MSE = .15$; $p < .001$. Even for short words, dyslexic readers showed a higher number of fixations, $F_1(1,20) = 33.24$; $MSE = .03$; $p < .001$ and $F_2(1,38) = 10.73$; $MSE = .15$; $p < .01$.

The duration of the first fixation of the dyslexic readers was nearly twice as long as that of the normal readers, $F_1(1,20) = 21.90$; $MSE = 13{,}459$; $p < .001$ and $F_2(1,76) = 56.61$; $MSE = 8{,}186$; $p < .001$. The small effect of length was significant in subject-based analysis, $F_1(1,20) = 4.46$; $MSE = 2{,}021$; $p = .047$, but failed to reach significance in item-based analysis, $F_2 < 1.91$. The length by group interaction was not reliable, $F_1(1,20) = 3.22$; $MSE = 2{,}021$; $p < .09$.

For gaze duration there again was a reliable length by group interaction $F_1(1,20) = 26.85$; $MSE = 11{,}133$; $p < .001$ and $F_2(1,76) = 19.84$; $MSE = 36{,}462$; $p < .001$ with poor readers showing a greater increase from short to long words than good readers. The smaller increase for the good readers was reliable in subject-based analysis, $F_1(1,10) = 10.95$; $MSE = 2{,}506$; $p < .01$ but not in item-based analysis $F_2(1,38) = 2.80$; $MSE = 12{,}344$; $p = .10$.

3.2. Short vs. long pseudowords

For analysis of a group specific length effect the pseudowords consisting of two and three syllables were collapsed into long items (7–8 letters) and contrasted with the short pseudowords consisting of a single syllable (4 letters). The pattern of results in Fig. 2 is similar to the one for short and long words. Here obviously no confound between length and frequency is possible.

For number of fixations the length by group interaction was reliable, $F_1(1,20) = 5.77$; $MSE = .13$; $p < .05$ and $F_2(1,116) = 93.71$; $MSE = .17$; $p < .001$. Similar to the findings for words, the increase in number of fixations from

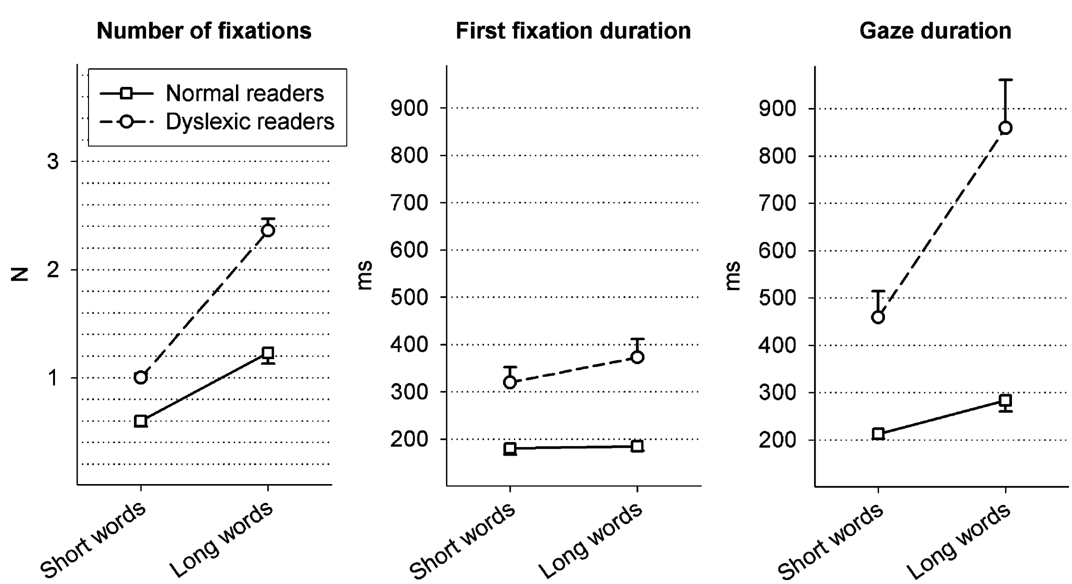

Fig. 1. Number of fixations, duration of the first fixation, and gaze duration for short and long words for dyslexic and normal readers (bars indicate standard errors of the mean).

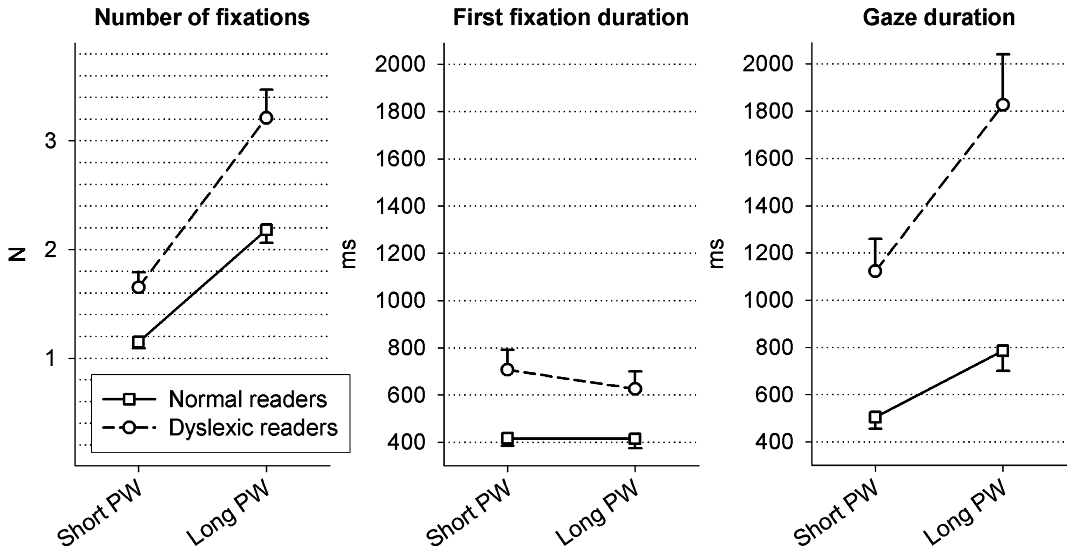

Fig. 2. Number of fixations, duration of the first fixation, and gaze duration for short and long pseudowords (PW) for dyslexic and normal readers (bars indicate standard errors of the mean).

short to long items was larger for dyslexic than for normal readers with even the smaller increase of the normal readers being reliable, $F_1(1,10) = 107.73$; $MSE = .06$; $p < .001$ and $F_2(1,58) = 184.48$; $MSE = .08$; $p < .001$. Furthermore, the smaller group difference for short pseudowords was reliable, $F_1(1,20) = 11.75$; $MSE = .12$; $p < .01$ and $F_2(1,38) = 39.90$; $MSE = .06$; $p < .001$.

Again, as for words, the dyslexic readers showed much longer durations of the first fixation (about 250 ms longer) than normal readers, $F_1(1,20) = 9.09$; $MSE =$ 75,935; $p < .01$ and $F_2(1116) = 65.74$; $MSE =$ 25,702; $p < .001$. Neither the effect of length nor the group by length interaction were reliable, $F_1s < 2.3$.

For gaze duration, there was a reliable group by length interaction, $F_1(1,20) = 14.31$; $MSE =$ 34,288; $p < .001$ and $F_2(1,116) = 25.92$; $MSE =$ 47,135; $p <$ .001, with poor readers exhibiting a larger increase from short to long pseudowords than good readers. Even the smaller increase of the good readers was reliable, $F_1(1, 10) = 32.92$; $MSE =$ 13,186; $p < .001$ and $F_2(1,58) =$ 69.67; $MSE =$ 15,884; $p < .001$. Already the smaller group difference for the short pseudowords was reliable, $F_1(1,20) = 18.43$; $MSE =$ 113,878; $p < .001$ and $F_2(1, 38) = 106.42$; $MSE =$ 34,889; $p < .001$.

4. Discussion

Because German similar to Italian exhibits relatively simple grapheme–phoneme relations, a main expectation was that the eye movements of German dyslexic children would be similar to those of the Italian dyslexic children examined by De Luca et al. (2002, 1999) (Judica, De Luca, Spinelli, & Zoccolotti, 2002; Zoccolotti et al., 1999). The main eye movement abnormality of the Italian dyslexic children were short rightward movements resulting in a high number of fixations for longer words. In contrast to English-based findings, regressive eye movements were infrequent and fixation durations were only slightly prolonged compared to normal readers. This Italian dyslexic eye movement pattern was interpreted as reliance on a phonological syllable-by-syllable reading strategy to compensate for surface dyslexia, that is, an impaired ability to store or access the letter patterns of frequently encountered words.

There are correspondences between this pattern of Italian dyslexic eye movement findings and the present findings. Similar to the Italian findings and different from the English-based findings mentioned in the Introduction, the number and proportion of regressive eye movements was small. In specific correspondence is the finding that our German dyslexic children exhibited a substantially higher number of fixations than the normal readers and showed a disproportional increase in number of fixations for longer words and pseudowords. This increased number of fixations in conjunction with few regressions suggests that the German dyslexic children similar to their Italian counterparts differed from normal readers by shorter forward movements of the eyes.

The main difference to the Italian findings was the massively prolonged fixation duration of our German dyslexic participants. For passage reading, the mean fixation duration (i.e., the average duration all fixation on an item) of the Italian dyslexic readers (12-year-old) of De Luca et al. (1999) was 290 ms and only 60 ms longer than that of the normal readers. The present German dyslexics were about 2 years older, but their first fixation duration for passage reading was 360 and 170 ms longer than that of the normal readers. Even more dramatic are the Italian-German differences for pseudoword reading. The mean fixation duration reported by De Luca et al. (2002) for the Italian dyslexic sample was about 280 ms and only about 30 ms prolonged. In contrast, the first fixation duration found here for the older German dyslexic participants was about 652 and 240 ms longer than normal. For younger 11-year-old German dyslexic children, Heller (1979) found a mean fixation duration of about 600 ms for pseudowords consisting of 3 letters only (compared to 300 ms for normal readers). This massively prolonged fixation duration of the German compared to the Italian dyslexic children may result from the different nature of German and Italian syllables. German syllables—similar to English syllables—often are closed and contain initial and/or final consonant clusters, which pose difficulties for syllable assembly in reading. In contrast, Italian syllables predominantly are open and often consist of a single consonant followed by a vowel and, therefore, pose little difficulty for syllable assembly in reading.

As an aside, it should be mentioned that the first fixation duration of about 190 ms for the present good readers during passage reading is short compared to mean fixation durations between 200 and 250 ms typically reported for competent readers of English (see Rayner, 1998). To a small extent (about 10 ms on average), the present fixation duration must be underestimated by the temporal resolution (20 ms) of our recording system. Comparison with other German and Italian studies suggests that mean fixation durations of about 200 ms are not unusual. For normally reading German children (about 11-years-old), Heller (1979) reported fixation durations of about 170 and 210 ms for simple and difficult passages, respectively. For Italian children (10.5-year-olds), Zoccolotti et al. (1999) found a mean fixation durations for passage reading of about 200 ms and De Luca et al. (1999) reported found a mean fixation duration of about 230 ms.

As noted in Section 1, the Italian research group interpreted the short forward eye movements and the resulting high number of fixations of their dyslexic participants as indication of surface dyslexia, that is, an impairment to store and/or access the letter patterns of frequently read words. The Italian dyslexic children of the studies by DeLuca and collaborators—similar to the present German dyslexic children—were not selected to conform to a surface dyslexia subgroup and, therefore, the surface dyslexia interpretation was intended as general characterization of Italian dyslexic reading difficulties. The present pattern of findings does not allow a straightforward interpretation as surface dyslexia. The higher number of fixations und the prolonged fixation duration exhibited by the dyslexic participants were found not only for words—as expected from the surface dyslexic account—but also, and even more massively so, for pseudowords. Obviously, our comparisons of how the eye movement characteristics of the present German dyslexic readers relate to eye movement characteristics of English and Italian dyslexic were based on comparisons between studies. Such comparisons are fraught with uncertainties such as noise in the temporal resolution of the eyetracking systems, which only can be avoided in direct comparative studies.

Appendix A. Texts used for passage reading

Die besten Schüler der Welt in Mathematik leben in Asien. Das haben Forscher mit einer Untersuchung herausgefunden. Sie gaben Kindern aus verschiedenen Ländern unterschiedliche Aufgaben und verglichen die Ergebnisse.
Der Name Olympia stammt von einer griechischen Ortschaft. Während der Spiele herrschte im ganzen Land Frieden. Die Sieger der Wettkämpfe wurden mit einem Lorbeerkranz belohnt und mussten keine Steuern mehr zahlen.

Appendix B. Lists used for pseudoword reading

SCHLUDOH, LOGADETH, SCHOBEUT, DESPASCH, SPAT, TIVS, GLIERALT, SEPUDOH, FEHM, FITOSAL, REMT, JALUSCHA, PFIR, VEMS, GINZ, PREM, ZWAB, LAGEITOR, SPIRATOL, DREV, SPOLTACH, DEUSPAT, SATOPAL, BECH, STABOSCH, TEISAPOT, SIPP, ZOSUGLI, TAPFOSCH, ZOHSENT, RAPEUTOS.

THALSPO, PFIEBAGO, DISTUFAG, SPEROSCH, TREGOLAS, PFAGOCK, PUKS, FOLT, TEISCHOP, FAMP, PAUTOGES, TOLG, TEUPATOL, SABOTACK, STEIBAL, ZWEGATOL, KLAP, JOTASOM, ZWISTOCH, SCHNEPU, PFESCHAT, VITEMPU, PRATUSEM, KRES, PROG, ROLS, SPEIGAHL, POVETSCH, SCHATOCK.

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