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The Effects of a Reading Racetrack Intervention on the Sight Word Fluency of Learning Disabled Elementary School Students With German as Second Language

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The ability to read is the gateway to success in modern knowledge-driven societies. Thus, it is vital to make sure that no child is left behind in his or her endeavor to acquire the cognitive processes needed to understand age-appropriate texts. One significant milestone on the way to reach proficiency in this respect is memorization of certain frequently used whole words. Foreign language students and those with learning disabilities are especially at risk for failing to master the various intermediate steps toward text comprehension, the ultimate goal of reading instruction. Reading racetracks are a promising technique to help even very challenged children improve their sight word fluency. In the present study, we examined the benefits of this approach with three learning disabled students from a German elementary school who spoke German as their second language. A multiple baseline design (AB) was used to assess the effectiveness. During the intervention, all three participants significantly improved their speed of naming sight words. The results indicate that sight word fluency can be increased with very simple means. A discussion and implications for practice and further research are provided.

Keywords: **reading problems, single-case research, reading racetracks, second language learners, drill and practice**

Introduction

Reading is a complex skill that is necessary to acquire to be successful in both private and professional matters of life. It can be seen as a key qualification and one of the most important competencies students are expected to secure during their elementary education (National Reading Panel, 2000). Research on cognitive processes that involve decoding symbols to arrive at meaning reveals that students who struggle with reading at a primary level often have problems with reading at a secondary level as well (Ravitch, 2010). To comprehend age-appropriate texts, a learner must (a) demonstrate sufficient phonological awareness, (b) be able to blend letters into words, (c) be in a position to read text

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quickly and accurately with few miscues and little effort, (d) possess a large vocabulary, and (e) be proficient in the process of selecting facts, information, or ideas from printed or written materials (National Reading Panel, 2000).

Although each of these reading skill areas is vital, the third seems to be a key one, especially in languages with many irregularities, such as English, French, or German. Memorization of a certain amount of frequently used whole words (sight word fluency) is necessary, particularly if they do not lend themselves to phonetic analysis (Browder & Lalli, 1991). As Adams (1990) appropriately pointed out, "Human attention is limited. To understand connected text, our attention cannot be directed to the identities of individual words and letters. In reading . . . , the process of individual word perception must proceed with relative automaticity" (p. 228f.).

The dual route theory of reading (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001) offers further explanation for why sight word fluency is so critical in the process. In this approach, two cooperative systems are postulated: the lexical and the non-lexical route. The lexical route is described as a dictionary lookup procedure or a mental database of words that allows one to recognize known words by sight. The second pathway is said to be the non-lexical route that enables skilled students to identify the word's constituent parts and apply their knowledge of how these parts are connected with each other (letter-sound system; Coltheart, Curtis, Atkins, & Haller, 1993). Children with problems in reading often rely on the latter. They can decode non-words but cannot differentiate between words and non-words. This shows that they have limited access to their internal lexicon (De Jong, Licht, Sergeant, & Oosterlaan, 2012). Sight word fluency is highly correlated with the lexical route. Learners who are fluent in reading are able to focus their attention on understanding a certain text, whereas weaker students are more focused on decoding words and are unable to comprehend the meaning of the material (Samuels, 2006).

Even though the vast majority of students reach proficiency in sight word fluency in particular and in reading in general by the end of their elementary education, a considerable share of them do not. Two groups that are especially at risk for developing severe difficulties in this area are children with learning disabilities (LDs) and second language (L2) learners. When it comes to decoding symbols to arrive at meaning, only 11% in the first group perform at an acceptable proficiency level (OECD, 2016). In fact, more than 80% of students with LDs are also affected by a reading disability (Lerner, 2003). Those who belong to the second group typically score considerably lower in reading-related test rubrics than their peers without an immigrant background. In an epidemiological study by Lesaux and Kieffer (2010), 60% of all students with serious reading difficulties were L2 learners, whereas only 40% were native speakers. As Obiegbu (2018) described fittingly, "Reading competence in a sec-

ond language (L2) has been a matter of concern among scholars because of the observed tendency among L2 and foreign language (FL) readers across the globe to manifest profound reading difficulties" (p. 1).

The two populations (LD and L2 students) are often mistakenly considered mutually exclusive. Children and adolescents who grew up speaking a language other than the one that is normally used in the country they currently live in oftentimes do not perform well in school. However, their deficits are frequently not viewed as an indication of an LD. If an L2 student shows serious weakness in reading or other academic areas, the difficulties are usually attributed to language barriers, not to intrinsic problems "in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities" (National Joint Committee on Learning Disabilities, 1988, as cited in Hammill, 1990, p. 77). Thus, they do not receive special education assistance, even though they desperately need it (Gunderson & Siegel, 2005). Gunderson and Siegel (2001) rightly pointed out that "it is often difficult to determine which individuals are learning disabled when they are native speakers of a language. However, the task is considerably more complex when they are second language (L2) learners" (p. 48). Unfortunately, there is no easy solution to this dilemma. The identification of LDs requires IQ testing. However, this is very problematic when complex linguistic and cultural differences confound the assessment process (Gunderson & Siegel, 2005).

In their comprehensive meta-analysis, Chard, Vaugh, and Tyler (2002) asserted that sight word fluency can best be enhanced through drill and practice in the form of repeated reading. This procedure provides guidance and feedback to help students improve in the areas of word recognition, fluency, and comprehension (National Reading Panel, 2000). Chard et al. (2002) focused on repeated reading in isolation (Cohen's $d = 0.68$) and with multiple components (Cohen's $d = 0.71$). Their findings indicate that this intervention is remarkably effective. Furthermore, another meta-analysis that was based on empirical studies from the past 25 years on the effects of repeated reading yielded an estimated overall Hedges' g of 1.41 (Lee & Yoon, 2017).

Despite its effectiveness, drill and practice is often perceived as dull and dreary. One promising option to remedy this challenge is adding gamification elements to the intervention (Koskimaa & Fenyvesi, 2015). As Lämsä, Hämäläinen, Aro, Koskimaa, and Äyrämö (2018) pointed out, "games can support a student's motivation for practicing the compromised skill for extended periods, which is usually required in the case of learning difficulties" (p. 598). Probably the most common examples of bringing a drill and practice procedure into a playful format are so-called racetracks. A racetrack is a game board, often designed to look like a Formula 1 circuit, with a predetermined number of blank cells (see Figure 1).

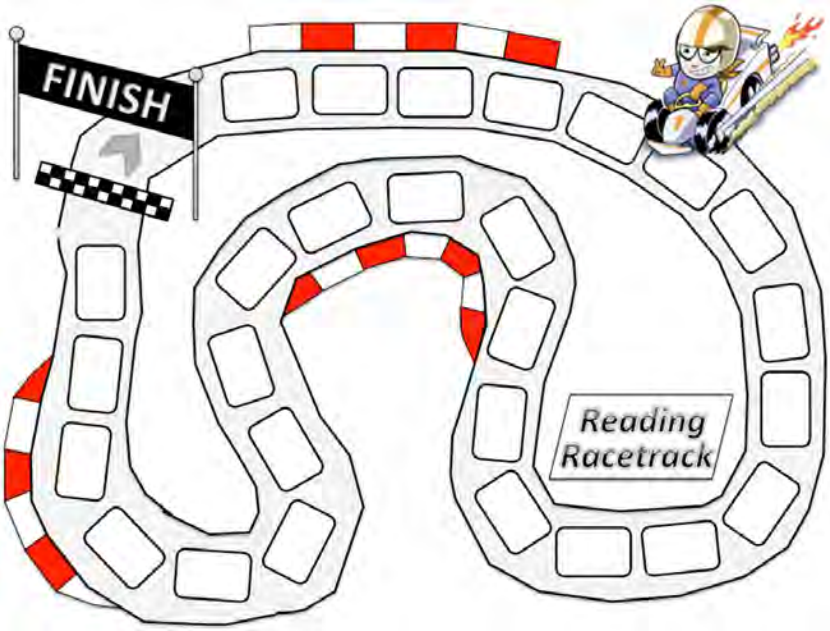

Figure 1. **A simple racetrack board game.**

Its basic idea is rather simple: In the case of a reading racetrack, a child rolls a die and moves a piece (e.g., a small matchbox race car) forward according to the number on the die. On the playing field, flashcards are placed face down on each cell. A teacher or tutor turns the respective card over and asks the child to read the word that is printed on it out loud. If it is named correctly, the teacher or tutor praises the student and the game continuous. If a child misreads a word, he or she gets corrected.

Grünke (2019) summarized the results of nine different studies on the benefits of reading racetracks for elementary school children with various disabilities. Overall, the approach can be considered very helpful in fostering sight word fluency. However, no study has yet been published that focused on struggling L2 learners. As explained above, this population often gets neglected and does not receive proper special education services because even severe LDs are not recognized for what they are. The purpose of the present study was thus to evaluate the effectiveness of reading racetracks for building sight word fluency in L2 elementary school students with severe learning problems. It was conducted in Germany, a country in which the national language is more transparent than English but still orthographically very complex (Goswami, 2010).

Method

Participants and Setting

There were three participants in this study: Aiana (female), Breda (female), and Cosmin (male; names were changed to maintain confidentiality). They all attended an inclusive elementary school in a major city in Northrhine-Westfalia (Germany). About a third of all enrolled students came from an immigrant background. All three participants were referred to the authors by the principal because they demonstrated severe reading problems. Even though they were able to unerringly recognize all letters of the alphabet and could slowly sound out simple words, their reading fluency was far below average. Each of the three students was raised speaking a language other than German, left their countries of origin as refugees, and had most likely been exposed to multiple traumatizing incidents in their home countries or during their escape. According to their main teachers, all of them had noticeable trouble storing, processing, and producing information. Based on this appraisal and on data in the available school records, the three children can be viewed as learning disabled.

At the time of the study, Aiana was 8 years old and attending second grade. She was born in Iran and moved to Germany with her parents shortly before she started elementary school. Everyone in her family spoke Persian at home. According to her class teacher, she was often slow to understand new concepts. Breda was a 9-year-old third grader. She migrated with her family from Romania one year before this experiment started. Until she moved to Germany, she had never attended school. Breda spoke Romanian with her parents and siblings at home. Her class teacher characterized her as an interested girl who was generally eager to learn. However, she had severe problems decoding even the simplest words. Like Breda, Cosmin came from Romania. He moved to Germany about three years prior to his participation in this research. Romanian was the lingua franca in his home. According to his class teacher, he got easily frustrated and was often hard to motivate.

Materials

We used a common die and two self-made playing boards (11.69 x 16.54 inches) with 30 empty rectangular cells (1.02 x 1.46 inches) that were placed on an oval-shaped racecourse for horses (for Aiana and Breda) or on a Formula 1 circuit (for Cosmin). In the case of the first playing board, a little plastic toy horse served as the piece; in the case of the second one, it was a matchbox racecar. We prepared 30 laminated white flash cards (1.02 x 1.46 inches) that each had a different word printed on it. The selection included the 30 most common two-syllable words in the German language. They were taken from a list published by the University of Leipzig (https://wortschatz.uni-leipzig.de/de). None of them was a sight word for any of the three children.

Dependent Variables and Measurement

The number of words read within a minute functioned as the dependent variable. One of two female graduate university students presented each participant successively with as many flash cards as possible. Each child was supposed to name the word on the respective card accurately and as quickly as he or she could. If a participant made a mistake, the respective university student asked him or her to try again. However, she did not provide any assistance. If a word was identified accurately or was autonomously corrected within 5 seconds by the child, she noted this on a checklist.

Experimental Design and Procedure

We applied a multiple baseline across subjects design (Ledford & Gast, 2018). Over the course of the experiment, the participants were presented with 12 daily probes to assess their reading fluency. Aiana's intervention started after the fourth measuring point, Breda's after the fifth, and Cosmin's after the sixth. The three children were taken to a resource room of their school every day of the study, where students typically received individualized help on academic tasks, executive functioning, and emotional regulation. Our participants usually shared the room with two to four other students and a substitute teacher. Thus, there were always conversations going on. Aiana went to the resource room at 8:15 a.m. each day, and Breda and Cosmin went at 8:35 a.m.

During baseline conditions, the three children engaged in various math activities. After 15 minutes, one of the two aforementioned university students asked them to sit down with them in a corner of the room to measure their reading fluency. The procedures in the intervention phase were different from the ones utilized prior to the treatment in that instead of working on math problems, the participants played the reading racetrack game as outlined in the introduction. Each training session lasted 15 minutes.

The intervention was supplemented by providing the children with immediate feedback about their performance on a line chart. It depicted their progress up to that point (including all data from the baseline probe). After each racetrack training session, the university students complemented the charts with the number of words that the participants just read and presented it to them. The children were praised for their accomplishments and motivated to do even better next time.

Treatment Fidelity

To enhance faithful delivery of the training, we provided the interventionists with a detailed script to follow. In addition, the third author stayed in close contact with the two university students at least twice a week through e-mail or phone to check if everything was implemented according to the plan.

Results

Figure 2 depicts the number of words read correctly within a minute by the three children. The graph was produced using the MultiSCED-tool by Declercq et al. (2019).

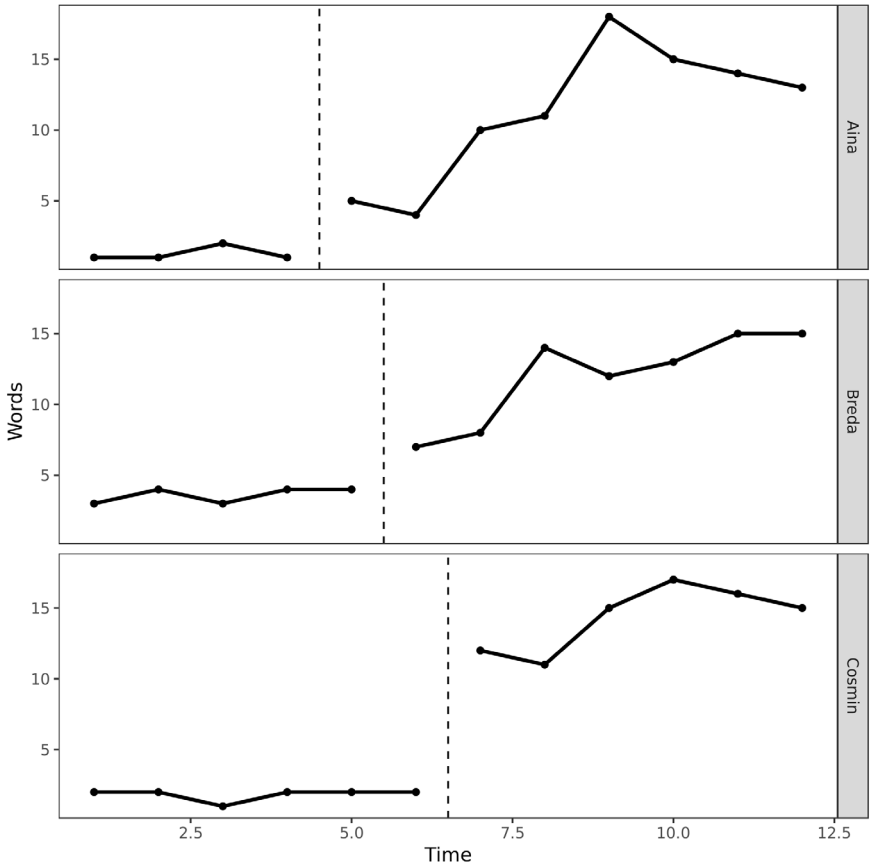

Figure 2. **The number of words read correctly by the three participants in each phase.**

Table 1 displays some descriptive data for the three children.

Table 1. ***Overview of Study Results per Phase***

Student		Phase A_1	Phase B
Aiana	*N* (Probes)	4	8
	Scores	1; 1; 2; 1;	5; 4; 10; 11; 18; 15; 14; 13;
	Mean	1.25	11.25
	Mean Increase	-	900.00%
	PND	-/-	100.00%
	IRD	-/-	1.0
Breda	*N* (Probes)	5	7
	Scores	3; 4; 3; 4; 4;	7; 8; 14; 12; 13; 15; 15;
	Mean	3.60	12.00
	Mean Increase	-	333.33%
	PND	-/-	100.00%
	IRD	-/-	1.0
Cosmin	*N* (Probes)	6	6
	Scores	2; 2; 1; 2; 2; 2;	12; 11; 15; 17; 16; 15;
	Mean	1.83	14.33
	Mean Increase	-	783.06%
	PND	-/-	100%
	IRD	-/-	1.0

Baselines can be considered quite stable in each case. All participants showed an apparent improvement in their performance as soon as the intervention was introduced. Overall, the mean scores of the elementary school students increased remarkably from baseline to treatment. Aiana started out with a mean score of 1.25 and was able to boost her performance by 900.00% to an average of 11.25. However, after the number of words that she read within a minute reached a peak of 18 at the ninth measurement point, it decreased continuously to 15, 14, and 13. Of the three participants, Breda started with the highest mean value (3.60) and achieved the lowest but still remarkable gain of 333.33%. She showed an overall steady increase in performance until she was able to read 15 words per minute at the end of the last two treatment sessions. Cosmin's proportionate growth was 783.06%, starting out with a mean value of 1.83 during baseline and reaching an average score of 14.33 during treatment. Like Aiana, Cosmin did not reach his personal high score at the end of the intervention. His last two values (16 and 15) fell below his peak of 17 at probe number 10. What is noteworthy in the case of Cosmin is his sudden increase in performance as

soon as he started playing the racetrack game. Before the training, he never read more than two words per minute. However, after the first treatment session, he recognized 12 words correctly. Obviously, the student felt very motivated by participating in the game.

The percentage of non-overlapping data (PND; Scruggs, Mastropieri, & Casto, 1987) yielded perfect scores of 100 in all three cases. PND is the most frequently used effect size for quantifying treatment benefits in single-subject analyses. It is calculated by counting the number of treatment data points that exceed the highest baseline data point and then dividing this figure by the total number of data points in the treatment phase. With the improvement rate difference (IRD; Parker, Vannest, & Brown, 2009), we applied another quantitative reflection of the magnitude of the treatment effect. The IRD is defined as the improvement rate of the treatment phase minus the improvement rate of the baseline phase. This non-overlap index is often considered an improvement over the PND. All participants reached the maximum score of 1.00. The PND and IRD scores in this study are evidence of very high treatment gains.

Finally, we calculated Tau-U according to Tarlow's (2017) method, using an online calculator (see Tarlow, 2016) as a complete measure to include both trend and level. Tau-U is defined as the ratio of data that show improvement over the course of a treatment, derived from a combination of the Mann-Whitney U-test and Kendall's rank correlation (Parker, Vannest, Davis, & Sauber, 2011). In all cases, there was no need for baseline correction. Aiana reached a value of Tau-U = 0.713 (p = 0.008; SE = 0.286), Breda of Tau-U = 0.757 (p = 0.005; SE = 0.267), and Cosmin of Tau-U = 0.809 (p = 0.004; SE = 0.240). Thus, with a probability of less than 1%, the combined differences in trend and level between the two phases can in no case be attributed to chance.

Discussion

This experiment constitutes the first study that evaluated the benefits of reading racetracks on sight word fluency for L2 learners with LDs. The results indicate that playing the game was very helpful in increasing the number of words the participants were able recognize quickly without mediation. Prior to the intervention, the children were able to only read between one and four simple words per minute. However, the treatment lead to a considerable increase. The mean gains ranged from 333.33% to 900.00%. All effect size indices (PND, IRD, and Tau-U) speak to the high potency of this approach. An interesting side result is the fact that the student who started out with the highest baseline score (Breda) profited the least from the treatment. Her peers scored a considerably higher mean difference increase than she did. This finding is not surprising. The phenomenon that especially low-achieving students demonstrate greater gains during the course of an intervention than high-achieving ones has been reported

many times and is sometimes referred to as the Robin Hood effect in education (Häfner et al., 2017). The overall analysis of this single-case study confirms previous research on the topic and provides evidence that reading racetracks can be successfully implemented not only with weak readers in general but also with learning disabled L2 learners.

However, our study features limitations that need to be considered when interpreting the results. First, we employed only a small sample of three participants from a distinct age bracket. On this account, generalization is limited. Furthermore, the experiment focused on German L2 learners with different mother tongues (Persian and Romanian). Even though the intervention worked well with the participants, we must be cautious with drawing conclusions about the effectiveness of the training with children who were raised with different language backgrounds. Furthermore, this study was conducted in Germany and directed at teaching elementary school children German sight words. Additional research is required to test the benefits of reading racetracks with L2 learners acquiring a language other than German. As indicated above, German has many irregularities, yet it is more transparent than, for example, English or French. It is yet to be determined if reading racetracks work just as well with non-German as with German L2 learners.

Another limitation pertains to the lack of follow-up data. No assumptions can be made on how stable the treatment effects were over time. Future studies should consider collecting information on long-term effects and retention. A last shortcoming concerns the identification of the participants. As discussed above, it is very problematic to diagnose L2 learners with a disorder in one or more academic areas. Their lack of knowledge of a language that they did not grow up with has important consequences for their performance on an IQ test. Based on such distorted data, it is difficult or even impossible to reliably estimate how much knowledge a student can be expected to acquire (Gunderson & Siegel, 2001). In our study, we were not able to solve this problem in a satisfying manner. We based our decision to consider the participants learning disabled on the judgement of their teachers and on the school records. These included, among other information, data on their intellectual capacity. However, this was not based on the results from one particular IQ test but on different ones, varying in the degrees to which they can—at least in part—be considered relatively culture free.

Despite its shortcomings, this study provides valuable information regarding the efficacy of reading racetracks on improving sight word fluency in L2 learners with LDs. This approach supplies teachers with an easy-to-implement tool that elicits improvements in basic sight vocabulary. To foster fundamental academic skills in a student body growing in diversity is becoming ever more challenging. The usually very high percentages of children with an immigrant

background in many societies around the globe makes it especially challenging to do justice to every learner. Far too many students fail in acquiring an adequate competence level and leave school without graduating. This study reveals that simple techniques such as reading racetracks can help close the gap for struggling L2 learners between underdeveloped skill levels and respective curriculum standards.

Future research should focus on implementing this technique in a peer-tutorial setting for a class-wide activity. The method is simple enough for children to work with it independently. Furthermore, it is cost effective, requires virtually no training to implement, and could help teachers tackle the challenge of providing ways and means to individually support students who are part of very diverse groups of learners always in danger of getting into an educational offside.

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