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# The impact of reading material's lexical accessibility on text fading effects in children's reading performance

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## Abstract

The *acceleration phenomenon* (AP) is defined by improvements in reading speed and reading comprehension, induced by an artificial text fading procedure corresponding to the previously determined fastest individual reading rate. Recent results, however, indicated that fading that is slower than the self-paced reading rate can produce comparable reading enhancements. As reading performance can be strongly influenced by the reading material, this study aimed at investigating to which extent reading enhancements induced by text fading depend on the reading material's characteristics. We confronted 39 German third graders with a previously utilized text fading procedure, which was slower than their self-paced reading rate. Included text varied regarding to the *lexical accessibility* (LA), representing how well information can be accessed from the mental lexicon. Children's reading rates increased statistically significant due to text fading for all LA levels. However, reading comprehension was sensitive to the text material's characteristics: Reading comprehension enhancements were observable for easily accessible reading material, but not for material with intermediate or difficult levels of LA. Material that was difficult to retrieve from the mental lexicon even resulted in reduced reading comprehension in the fading condition. Possible influences on immediate lexical access, the impact of working memory capacity and implications for future AP research are discussed.

**Keywords:** acceleration phenomenon, lexical accessibility, reading comprehension, reading performance, reading rate

## Introduction

Breznitz (1987) reported the counter-intuitive finding that improvements in reading speed and reading comprehension can be induced by using an artificial text fading procedure, based on the previously determined fastest individual reading rate. This pattern of results has been known as the *acceleration phenomenon* (AP). The typical paradigm used in AP studies is based on a three-block design. Participants read computerized text at their individual routine reading rate in the first and third block. In the second block, text is faded out continuously, based on the previously determined fastest self-paced reading rate. Reading rates and comprehension, measured by multiple-choice questions referring to the read sentences, are assessed and compared over the three blocks. Studies showed that the fading manipulation in the second condition induced higher reading rates as well as statistically significant increases in comprehension scores compared to the self-paced reading condition (Breznitz, 1987, 1997a, b; Breznitz & Berman, 2003). Characteristically, participants only showed higher reading rates and comprehension scores in the second block, but during the third block, they relapsed to their initial self-paced reading behavior determined in the first block. These effects were demonstrated in numerous studies (for a review, see Breznitz, 2006) of children and adults (Breznitz, 1987; Breznitz & Leikin, 2001), relating to different languages and writing systems (Hebrew, English; Breznitz, 1997a, b, 2006).

Breznitz assumed that the AP paradigm may foster attention by reducing distractibility and by increasing the individuals' focus on the reading material. This hypothesis was tested in a reading task that utilized pictorial distractors once under fading conditions and once without text fading (Breznitz, 1988). Since readers in the fading condition could not recall as many distractors as the readers in the control group, Breznitz concluded that the fading led to reduced distractibility. A second explanatory approach for AP effects refers to an enhanced utilization of the individuals' short-term or working memory capacity. Sets of single experiments were conducted to test the influence of computerized acceleration through the fading manipulation on different working memory tasks (Breznitz, 1997a; Breznitz & Share, 1992). A statistically significant gain was observable for working memory tasks in the fading condition indicating that the manipulation may directly influence memory processing. It was assumed that due to the faster reading activity, short-term memory capacity may have been relieved and working memory processing was optimized, leading to better reading comprehension scores in the fading conditions.

The faster reading rate due to the fading manipulation seems to be highly relevant for producing AP effects. Based on findings showing that slowing participants reading rate resulted in decreased comprehension performance (Breznitz, 1987), previous AP studies usually worked with fading rates based on the fastest measured individual reading rate determined in the first self-paced block, to assure an acceleration of the individual reading speed. However, a recent study showed that reading speed improvements can also be induced through fading that is slower than the self-paced reading rate (Nagler et al. 2016). In this study the authors addressed the question whether a non speeded fading procedure may also result in improved reading speed and enhanced reading comprehension in an AP setting. Third grade children improved their reading rates even with fading rates 40 and 70 % slower than the individual self-paced reading rate, even though they were not forced to read faster. However, the reading rate acceleration was statistically significant more pronounced in the 40 % reduced fading condition than in the 70 % reduced fading condition. More precisely, while children read 6.1 % faster in the 70 % reduced fading condition than during self-paced reading, they increased their reading speed up to 12.4 % in the 40 % reduced fading condition. Therefore, compared to average reading rate increase reported by Breznitz (15 % for normally reading elementary school children; Breznitz & Berman, 2003), the reading rate enhancement in the 40 % reduced fading condition was close to previously observed patterns. Interestingly, reading comprehension enhancement was only observable in the 40 % reduced fading condition. It was hence assumed that the reading rate possibly needed to be

sufficiently accelerated (as in the case of 40 % reduced fading condition) if it was to result in reading comprehension improvements.

Nagler et al. (2016) assumed that sufficient reading rate acceleration might foster the direct retrieval of information. This assumption was based on findings from Breznitz (1987). In her accelerated reading experiment word material was used that included deliberate orthographic mistakes to test correction behavior of participants. The results revealed that individuals seemed to automatically correct the misspelled words when forced to read faster. Breznitz offered the interpretation that due to the fading procedure and the induced faster reading rates, words were recognized at once and their semantic meaning was more often directly retrieved from lexical memory. Hence, it was assumed that AP effects may originate from an increase of direct word retrieval from the mental lexicon. Existing lexical entries might therefore be activated faster, which in turn might facilitate the retrieval of information and improve reading comprehension.

Apparently, fact retrieval plays an important role for the production of AP effects. However, Hiebert and Fisher (2010) pointed out that several characteristics of reading material can affect information processing. They marked three factors as particularly important: (1) the number of syllables per word, (2) the number of words per sentence, and (3) the words' frequencies. These suggestions were supported by various studies; for example demonstrating that words with more syllables take longer to be processed and that words with few syllables are more easily recalled than words with many syllables (e.g., Baddeley, Thomson, & Buchanan, 1975; McNerney, Goodwin, & Radvansky, 2011). Furthermore, highly frequent words are recognized faster and more accurately than less frequent words (Balota & Chumbley, 1984; Gollan, Slattery, Van Assche, Duyck, & Rayner, 2011; Hauk & Pulvermüller, 2004; Hutzler & Wimmer, 2004; Kronbichler et al., 2004; Rabovsky, Álvarez, Hohlfeld, & Sommer, 2008; Walczyk et al., 2007). Assumingly, lexical entries for high-frequency words are more readily available for identification than lexical entries for low-frequency words (Forster, 1976; Seidenberg & McClelland, 1989). Considering that direct fact retrieval seems to play an important role for the improved reading comprehension scores in fading conditions, reading material characteristics may influence the reading performance in AP studies. However, in AP research only reading material that was well adjusted to the reading proficiency level of the sample's participants has been used so far. The impact of different reading material characteristics on the reading behavior and performance has not been investigated yet.

In order to investigate the influence of reading material characteristics on AP effects, we developed a first approach to compile adequate sentences. Based on the findings that sentences containing a small number of words with few syllables and high frequency would be processed more easily than sentences containing a large number of words with many syllables and low frequency (Benjamin, 2012), we generated word material that differed recognizably in its characteristics. The three above-mentioned factors influencing information processing (number of syllables per word, number of words per sentence, word frequency) were therefore considered in this study and were varied systematically to create the new reading material. Thereby, we attempted to define distinguishable reading material categories and include them in this AP study. In this regard, we introduced the term *lexical accessibility* (LA) to label the categories, which differed in how well information can possibly be accessed from the mental lexicon. As a result, sentences were generated which were considered to represent easy, intermediate and difficult levels of LA.

Following Nagler et al.'s (2016) research design, the present study focused on the investigation of reading performance with slow fading rates and reading material with different levels of LA. Considering previous research regarding the reading material's influence on reading comprehension, we proposed that reading performance should be dependent on the reading material's level of LA and that AP effects should differ accordingly. As reading improvements elicited by fading were previously observable in studies using fairly easy reading material, it was assumed that it should be possible to

reveal AP effects for material with easy level of LA. The pattern of results for material with intermediate and difficult level of LA, however, needs exploration regarding its influence on AP effects.

## Method

### Participants

Thirty-nine third graders (17 females) from elementary schools in Wiesbaden, Germany, and its surroundings were selected to participate in the study ( $M$  age: 9.4 years; SD 7.9 months). Parental informed and written consent was obtained for each child. To ascertain children's reading proficiency a standardized reading achievement test was conducted (ELFE 1–6; Lenhard & Schneider, 2006). Intellectual ability was measured using Raven's (2009) SPM Plus. All participants showed average levels of reading performance in ELFE's subtest for text reading comprehension (mean reading percentile rank: 63.5; SD 15.1) and performed within the range of normal intelligence regarding deductive reasoning measured by the SPM Plus ( $M$  IQ: 94.2; SD 10.8).

### Materials

The reading material consisted of sentences and questions with four alternative answers. Three parallel versions of sentences were generated. For each sentence, two parallel sentences were compiled which were matched regarding the number of syllables per word, the words per sentence and the word frequency. The parallel sentences furthermore had an identical syntactic structure. Overall, 30 sets including three parallel sentences with the same level of LA were generated amounting to a total of 90 sentences. With regard to the three factors identified by Hiebert and Fisher (2010), three different levels of LA (easy, intermediate, difficult) were determined. This was operationalized based on the *Flesch Reading Ease* (FRE) Index (Flesch, 1948), and the word frequency provided by a lexis corpus from the University of Leipzig (Quasthoff, Goldhahn, & Heyer, 2013).

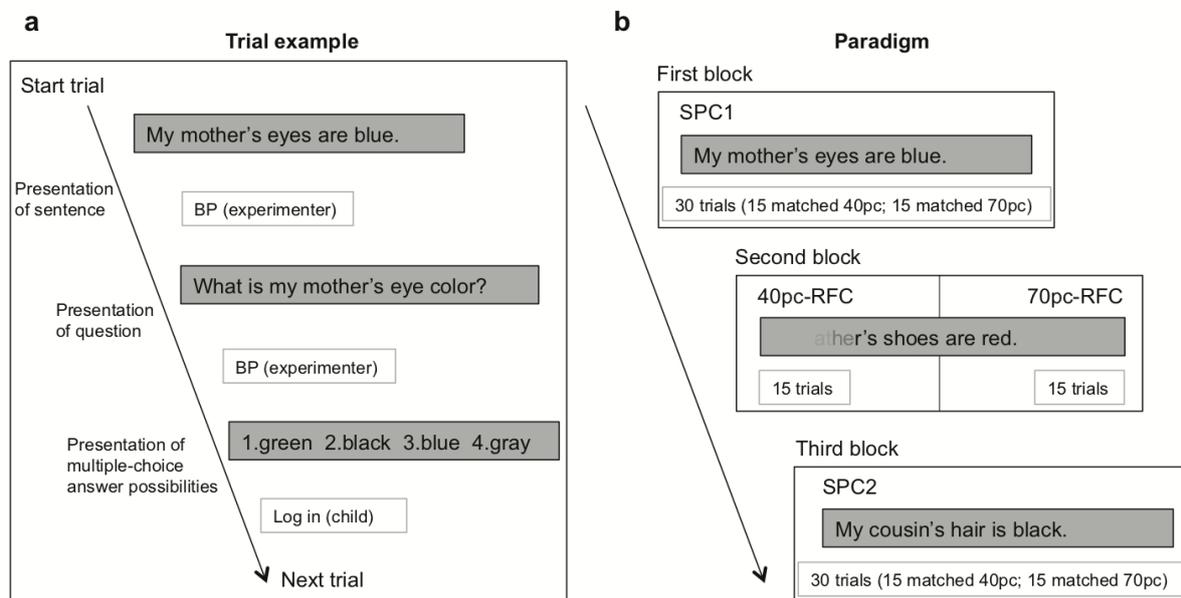
The FRE Index considers the number of syllables per word as well as the overall number of words per sentence to compute the readability of reading material. The FRE Index ranks text on a scale ranging from 0 to 100 with high FRE scores indicating text which is easy to read, and low FRE scores representing text which is difficult to read (Flesch, 1948). Amstad's (1978) FRE formula, adapted to the German language, was used in this study ( $FRE_{\text{german}} = 180 - \text{Average Sentence Length (ASL)} - \text{Average Number of Syllables per Word (ASW)} \times 58.5$ ).

The word's frequency was considered using the lexis corpus of the University of Leipzig, which uses openly accessible sources (e.g., newspapers, books) with German text to determine the frequency of words (Quasthoff et al., 2013). In this corpus, words are ordered in a Zipfian distribution depending on their frequency of use (Zipf, 1945). Using a double logarithm, words can be ranked according to how often they are used compared to the most frequent German word (*der*; English: *the*; frequency class 0). Any other word is set in relation to this most frequent word. The appointed frequency value for each word hence represents an exponent, reflecting how far less frequent the word is compared to the most frequent word *der*. For example, the word *Auto* (English: *car*), with a frequency class of 8, is 256 times ( $2^8$ ) less frequent than *der*.

The three levels of LA were composed basing on classified FRE Indexes, according to Flesch's classification recommendations, and the word frequency as follows: Sentences with easy LA comprised FRE Indexes between 100 and 86 as well as words in a frequency class below 10, which were considered to be highly frequent. Sentences with intermediate LA contained FRE Indexes between 85 and 71 as well as words in a frequency class between 11 and 15, which were considered to be intermediately frequent. Sentences with difficult LA included FRE Indexes between 70 and 40 as well as words in a frequency class above 15, which were defined as infrequent.

## Procedure

The children participating in this study were tested individually in soundproof cabinets installed in mini-busses parked on the school ground. The reading tasks were presented left-justified central in black print (font: Arial, letter size: 14 pt.) against a grey background on a 15.4-inch laptop running Presentation<sup>®</sup> software (Neurobehavioral Systems, Inc.). A single trial started with the presentation of a sentence, followed by a question referring to the content of the sentence and ended with the presentation of four multiple-choice answer alternatives (see Fig. 1). The children were instructed to start reading out loud as soon as the text appeared on the screen. The experimenter pressed a button immediately after the child had finished reading the sentence, stopping the computerized measurement of the individual reading time for the respective sentence. Subsequently, a question referring to the previous sentence was presented on the screen. The children again had to read the text out loud. When finished, the experimenter pressed the button to activate the measurement of reading time and the multiple-choice answers were presented. The alternative answers presented on the screen were labeled with numbers (1, 2, 3, and 4), the correct answer being randomly assigned to one of the four numbers. Four keys on the keyboard were marked with the numbers. The children were asked to opt for one of the alternative answers and to press the corresponding key.



**Fig. 1** Details of experimental procedure. Examples of a trial sequence (a) and the different experimental conditions (b). The *arrow* represents the course of time. SPC1 = Self-Paced Condition 1; 40pc and 40pc-RFC = 40-percent-Reduced Fading Condition; 70pc and 70pc-RFC = 70-percent-Reduced Fading Condition; SPC2 = Self-Paced Condition 2; BP = Button Press

## Design

Overall, 90 sentences were presented to each child in three different blocks (see Fig. 1). The first block (Self-Paced Condition 1; SPC1) consisted of 30 sentences in which the children were instructed to read the presented sentences at their own comfortable reading speed. After 15 trials the children were offered a break. The individual reading time needed was separately determined for each sentence. Using the corpus of parallel sentences, the recorded individual reading time for a given sentence was used to define the fading speed for the respective parallel form of this sentence in the second block. In the second block, sentences were faded out continuously in reading direction. Following the research design of Nagler et al. (2016), this block was divided into two fading conditions with 15 trials each. In the 40-percent-Reduced Fading Condition (40pc-RFC), the fading speed was 40 % slower than the self-paced reading rate. In the 70-percent-Reduced Fading Condition (70pc-RFC), the fading speed

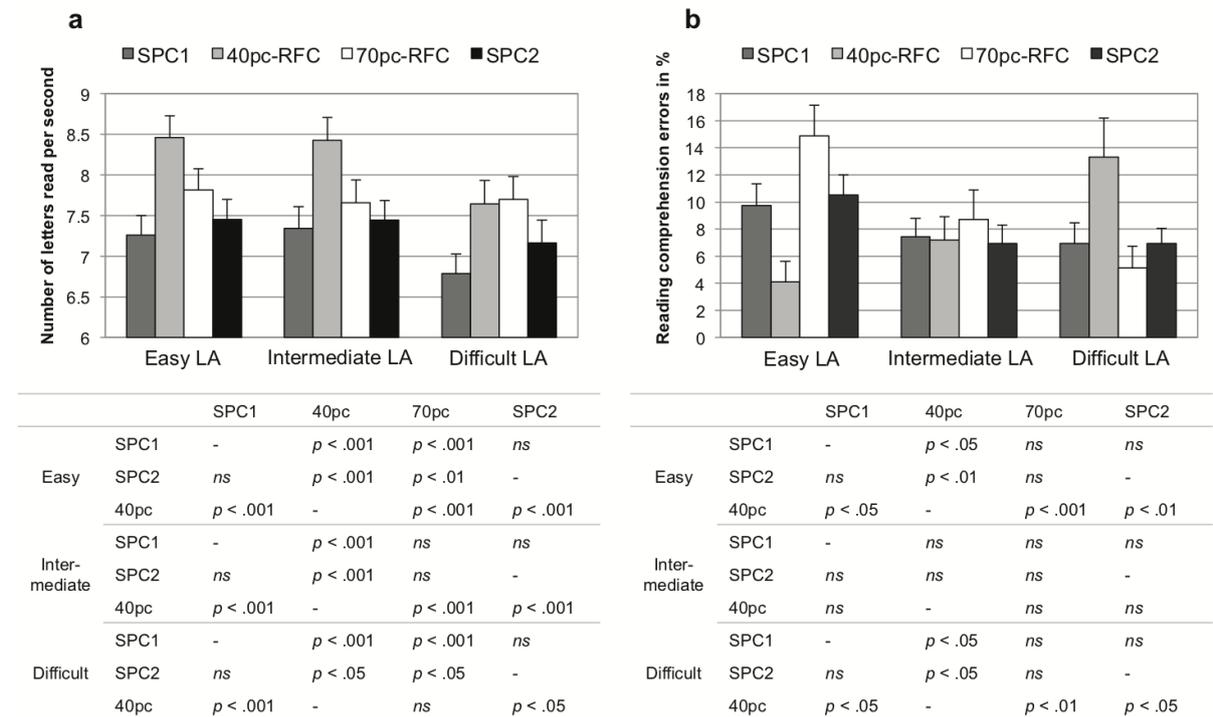
was 70 % slower than the self-paced reading rate. As there was a break between the fading conditions, the course of events equaled the self-paced conditions in which 2 x 15 trials were accomplished as well. Therefore, the second block was experienced as a single block although two conditions were conducted. The order of the 40pc-RFC and the 70pc-RFC was counter balanced so that half of the participants were presented with 40pc-RFC trials first and subsequently with 70pc-RFC trials and vice versa. In the third block (Self-Paced Condition 2; SPC2), children again read 30 sentences at their own comfortable reading rate in a similar manner as described for the SPC1. The parallel forms of all sentences were presented in each of the three blocks so that all parallel items were once presented in each block. The children were introduced to three practice runs ahead of every block after which remaining questions were discussed. Children were instructed before every block and were asked to read as fast and as accurately as possible. Breaks were assured between blocks and a child-friendly environment was provided. To retain children's motivation, a board game was introduced to track how many trials had been accomplished and how many still had to be completed.

## Results

In a first step of analysis, two 4 x 3 (Condition [SPC1, 40pc-RFC, 70pc-RFC, SPC2] x Level of LA [easy, intermediate, difficult]) factorial analyses of variance (ANOVA) with repeated measures were conducted with reading rate (number of letters read per second) and comprehension error percentages as dependent variables. The analysis of reading rate revealed main effects for Condition,  $F(1, 36) = 38.01, p < .001, \eta_p^2 = .76$ , and for Level of LA,  $F(1, 37) = 21.70, p < .001, \eta_p^2 = .54$ . Furthermore, a statistically significant Condition x Level of LA interaction,  $F(1, 33) = 4.47, p < .01, \eta_p^2 = .45$ , was detected. As displayed in Fig. 2 and supported by *Least Significant Difference* (LSD) post hoc pairwise comparisons, reading rate was comparable in SPC1 and SPC2 ( $p > .05$ ) in all LA levels. However, reading rates in both fading conditions differed with regard to the reading rates shown in the SPC's. Reading rates in the 40pc-RFC were statistically significant faster than in the SPC1 and SPC2 for easy, intermediate and difficult levels of LA ( $p < .05$ ). Reading rates in the 70pc-RFC were also statistically significant faster than reading rates in both SPC's for easily and difficult accessible reading material ( $p < .05$ ). The reading rate increase for intermediately accessible reading material marginally failed to reach statistical significance in the 70pc-RFC in comparison to the SPC1 ( $p = .06$ ). Nevertheless, the increase of reading rate was more pronounced in the 40pc-RFC than in the 70pc-RFC for easy and intermediate LA, as LSD post hoc pairwise comparisons showed that both conditions differed statistically significant from one another, indicating faster reading rates in the 40pc-RFC compared to the 70pc-RFC ( $p < .001$ ). Reading rate increase for difficult LA was comparable in the 40pc-RFC and the 70pc-RFC ( $p > .05$ ).

The analysis of reading comprehension error rates did not reveal a main effect for Condition,  $F(1, 36) = .31, p > .05, \eta_p^2 = .03$ , or for Level of LA,  $F(1, 37) = 2.09, p > .05, \eta_p^2 = .1$ . However, a statistically significant Condition x Level of LA interaction was found,  $F(1, 33) = 4.8, p < .01, \eta_p^2 = .47$ . These effects remained stable even after controlling for participants' reading comprehension level as covariate. As illustrated in Fig. 2, LSD post hoc pairwise comparisons showed that comprehension error percentages in both SPC's did not differ between the levels of LA ( $p > .05$ ). While reading comprehension scores in the 70pc-RFC did not differ from the SPC1 and the SPC2 for all LA levels ( $p > .05$ ), reading comprehension in the 40pc-RFC differed statistically significant between levels of LA. In the case of easily accessible reading material, fewer reading comprehension mistakes were made in the 40pc-RFC than in the other three conditions ( $p < .05$ ). The reverse pattern emerged for reading material that was difficult to retrieve. Here, LSD post hoc comparisons revealed statistically significant more comprehension errors in the 40pc-RFC compared to all other conditions ( $p < .05$ ).

The number of comprehension errors for reading material with intermediate LA did not differ statistically significant between conditions ( $p > .05$ ).



**Fig. 2** Results of reading behavior analyses. Reading rate in number of letters read per second (**a**) and reading comprehension errors in percent (**b**) for all conditions and levels of LA. The standard error is indicated above the *bars*. Tests of significance between conditions and levels of LA are depicted in the tables underneath the bar charts. SPC1 = Self-Paced Condition 1; 40pc and 40pc-RFC = 40-percent-Reduced Fading Condition; 70pc and 70pc-RFC = 70-percent-Reduced Fading Condition; SPC2 = Self-Paced Condition 2; *ns* statistically not significant

## Discussion

The main goal of this study was to find out to which extent reading enhancements induced by text fading in an AP setting depend on the reading materials' level of LA in elementary school children. The analysis of reading rates showed that reading speed improved in both fading conditions, but did not differ between SPC1 and SPC2 for all LA levels. However, the reading rate increase was overall more pronounced in the 40pc-RFC than in the 70pc-RFC. Hence, although both fading rates were in fact slower than the individual self-paced reading rate, the measured reading rate was the highest in the 40pc-RFC. This pattern of AP effects was in line with previous AP studies and corresponding to Nagler et al.'s (2016) findings of faster reading rates for the 40pc-RFC in comparison to the 70pc-RFC. Furthermore, we examined reading comprehension performance over the conditions, comparing reading performance for sentences with different LA levels. While reading comprehension scores in the SPC1, the SPC2 and the 70pc-RFC did not differ for the three LA levels, we found statistically significant differences in the 40pc-RFC depending on the respective level of LA. We were able to demonstrate a statistically significant improvement in reading comprehension for easily accessible material in the 40pc-RFC compared to the three other conditions. In contrast, no improvements in reading comprehension were found for reading material with an intermediate level of LA. We did not find positive comprehension effects of the fading manipulation for material with difficult level of LA. More precisely, we even observed a statistically significant negative effect of the fading reflected by more reading comprehension errors for material with difficult level of LA in the 40pc-RFC compared to the other three conditions. Hence, while reading rate increase was observable in both fading

conditions, reading comprehension enhancements were only observable in the 40pc-RFC. As reading speed was the highest in the 40pc-RFC and statistically significant faster than in the 70pc-RFC, we suppose that the reading rate needed to be sufficiently increased in order to result in reading comprehension enhancements, as observable in the 40pc-RFC.

Against this background Breznitz' (1987) findings do not seem to contradict our results. Breznitz (1987) showed that slowing participants reading rates resulted in a decline of reading comprehension performance and also resulted in a reduced reading rate. As reading rate was increased in our study, and reading comprehension gains were observable for easily accessible material, the pattern of results even strengthens the assumed relevance of fast reading rates for comprehension enhancement.

The results further imply that the AP is not only influenced by the fading rate, but the fading manipulation's effectiveness is also dependent on sentence difficulty. These complex findings are interpreted along previously proposed explanatory approaches suggesting that working memory capacity and direct fact retrieval is positively affected by the fading manipulation (Breznitz, 1987, 1997a; Breznitz & Share, 1992). In this study, material with easy level of LA had all the prerequisites to be directly retrieved from the mental lexicon and to be automatically processed as it consisted of highly frequent words and was well readable. Most children show well-established associative paths to the mental lexicon for frequent words (Farrington-Flint, Coyne, Stiller, & Heath, 2008; Lindberg et al., 2011). We therefore suggest that reading material with easy level of LA was more efficiently retrieved from the mental lexicon in the 40pc-RFC. Hence, the existing paths for frequent words might have been used even more successfully in the 40pc-RFC than during self-paced reading conditions, resulting in better reading comprehension. It is assumed that processes running at a high level of automaticity provide more efficient processing in working memory and thus foster complex comprehension processes (Perfetti, 1992). In line with Breznitz and Share's (1992) explanatory approach, we therefore further suggest that for materials with easy level of LA, working memory capacity may have been used more efficiently due to the faster reading rates, which was a result of the fading procedure: As the overall act of reading was faster, more of the information was successfully processed. This suggestion corresponds with Baddeley's (1981, 1992) findings that faster rehearsal allows people to maintain a larger amount of information in phonological working memory. Working memory enhancement might therefore be triggered by a more efficient utilization of information, which can be achieved through a higher speed of processing (Fry & Hale, 2000; Just & Carpenter, 1992).

Reading comprehension data analysis also showed that reading material with a difficult level of LA seems to produce opposite effects compared to reading material with an easy level of LA. Although the reading rate was increased due to the fading procedure, participants showed more comprehension errors compared to their self-paced reading performance. Since material with a difficult level of LA comprised low-frequency words and was more demanding to read due to low FRE Indexes, we assume that processing this kind of material was challenging under fading conditions. According to Young and Bowers (1995), material that is difficult to retrieve from the mental lexicon challenges the reader in such a way that only few cognitive resources are left to process information. As Baddeley (1981) pointed out, in cases of working memory overload, attentional resources are focused on the task itself and only little is left for reasoning, resulting in erroneous performance. Hence, if sentences containing material that is difficult to retrieve are faded out, the individual's capacity to process information is likely to be overburdened. This argumentation is in line with cognitive load theories such as Just and Carpenter's (1992) *capacity theory of comprehension*, stating that working memory constraints are primarily manifest when processing demands exceed capacity.

The comprehension performance analysis for reading material with intermediate level of LA revealed null findings as reading comprehension remained equal for all conditions. In other words, the fading manipulation neither effectively enhanced nor did it decrease comprehension for this kind of material

compared to the performance in both SPC's. It might be argued that material with intermediate level of LA neither overloaded children's capacity nor did it facilitate more automatic processing. Although reading speed tended to increase in both fading conditions, the reading comprehension performance was not affected: Children neither improved their comprehension scores under fading conditions nor did they make more mistakes. Hence, it might be possible that material with intermediate level of LA was not easy enough to improve retrieval through text fading, but was also not too difficult as to overstrain processing. However, these results can only be interpreted theoretically and further evidence is needed to sufficiently investigate possible underlying mechanisms when reading sentences with intermediate level of LA.

Although analysis did not reveal statistically significant differences between the reading comprehension scores of material with different level of LA in the 70pc-RFC, the tendency of results should be reflected. As reading comprehension scores in the 70pc-RFC show a declining tendency for material with easy level of LA and a tendency to increase for material with difficult LA level, it might be supposed that attention played an additional role in information processing under fading conditions. Breznitz (1988) also depicted the relevance of attention and offered the explanation that decreased distractibility and focused attention are accountable for AP effects. Relating to this approach, it could be argued that participants in this study were possibly not as focused on the reading material with easy level of LA in the 70pc-RFC compared to the 40pc-RFC because the comparatively slower fading might not have been perceived as a limitation of processing time. On the contrary, for material with difficult level of LA, the rather mild time pressure in the 70pc-RFC might have permitted attentional processes to operate effectively and prevented potential working memory overload. This suggestion is based on findings of previous studies (Veenman & Elshout 1999; Walczyk, Kelly, Meche & Braud 1999), which reported that text studying under mild time constraint enhances text comprehension, while severe time constraint decreases comprehension. This time constraint approach might additionally be an alternative explanation for the comprehension decline while processing material with difficult LA level in the 40pc-RFC: The fading procedure in the 40pc-RFC might have been too fast while processing material with difficult level of LA and it was experienced as a severe time constraint, resulting in a decrease of comprehension. However, as there were no statistically significant differences in the 70pc-RFC, further research is needed to test this assumption. Future studies should therefore concentrate on a controlled variation of fading rates in combination with varying reading materials with different characteristics.

Certainly, there are also limitations to this study. The applied segmentation of three levels of LA was a first attempt to include reading material characteristics into AP research. As all three factors (number of syllables per word, number of words per sentence, word frequency) were consolidated and varied to create different levels of LA, it is not possible to identify the influence each single factor has on AP effects. It might also be possible that other factors are more appropriate to categorize reading material by difficulty or may even have a greater influence on AP effects. Hence, it would be important to identify specific factors most influential for AP effects in the future. As the influence of reading material characteristics on reading performance is a generally understudied field, future studies should follow to investigate the influence of a variety of different factors in more detail and should further focus on the effect each factor has on AP effects.

In summary, although reading rate improvements were detectable in this study under both fading conditions, the speed increase was more pronounced in the 40pc-RFC than in the 70pc-RFC and reading comprehension enhancements were only observable for reading material with easy level of LA in the 40pc-RFC. We therefore suppose that the reading rate needs to be sufficiently increased due to the fading manipulation in order to result in reading comprehension enhancements. Furthermore, a facilitated retrieval of semantic information may only be possible for material with well-established associative paths to the mental lexicon. Our findings therefore show that the level of LA highly

influences the reading comprehension performance under fading conditions. In this regard, our data suggests that there is a fine line between reading comprehension improvement, stagnation and decline when using a fading procedure. Future studies should hence carefully consider the reading material characteristics and further investigate the influence of fading rates as well as different LA levels on reading performance. In the future, the fading manipulation might then offer a promising tool that could be integrated in potential adaptive training programs, aiming at gradually improving individual reading performance.

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