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Is there a Speed-Accuracy Trade-off in Reading?
The Effects of Reading Speed on Word Processing and Comprehension

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DECLARATION OF AUTHORSHIP

I, Laura Schwalm (born March 12, 1993 in Oberhausen, Germany), hereby attest that the present doctoral thesis entitled "Is there a Speed-Accuracy Trade-off in Reading? The Effects of Reading Speed on Word Processing and Comprehension" is my original work.

Wuppertal, 18.06.2025

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ABSTRACT

The relationship between speed and comprehension remains a pivotal and highly debated topic in the field of reading research within cognitive science. While commercial programs claim to enhance reading rates without comprehension loss, there is limited empirical evidence to support such claims. The present dissertation examines whether a strict speed-accuracy trade-off (SAT) applies to reading, or, alternatively, readers can adapt to accelerated reading without compromising understanding. In three experiments employing a novel line-by-line technique, reading speed was systematically manipulated. Experiment 1 demonstrated that native English readers are able to maintain high comprehension levels up to 360 words per minute (wpm). Declining performance was only observed at 405 wpm, with detailed analyses suggesting adaptations mainly in late processing stages. In contrast, Experiment 2 revealed that second-language (L2) English readers experienced significant comprehension losses even at moderate speed increases, despite similar oculomotor adjustments. The third experiment utilized individualized speed increments with German native readers, with a focus on lexical processing and comprehension monitoring as reflected in semantic plausibility violations. Findings demonstrated that while maintaining lexical access at higher speeds, there was a decrease in the reprocessing of implausible words. At the same time, no significant decline in general comprehension scores occurred. Collectively, these findings challenge the notion of a universal SAT in reading, at least for skilled native speakers. Results underscore the capacity for strategic adaptation and resource reallocation to sustain comprehension under time pressure. In contrast, L2 readers encounter more significant limitations, indicating that reading speed thresholds are strongly influenced by language proficiency and automated cognitive resources. This work contributes to a nuanced understanding of reading adaptability, offering insights for both theoretical models and practical applications in reading instruction and technology.

CONTENTS

1 Introduction

Reading is an essential cognitive skill that individuals rely on daily in both personal and professional contexts. Its primary purpose is to acquire and retain information, regardless of whether the material is read for entertainment or education. Given its central role in human life, reading has been a focal point of extensive psychological, linguistic, and educational research. A substantial body of literature aims to uncover factors that enhance reading comprehension and to explore strategies that support individuals – both children and adults – in developing strong reading abilities.

While the ultimate purpose of reading is comprehension, the enhancement of *reading speed*[1] is a secondary yet pertinent objective. The motivation to process written information with greater efficiency has catalyzed the emergence of commercial speed-reading programs, which frequently promise substantial enhancements in reading speed without compromising comprehension. However, these claims necessitate rigorous scientific scrutiny. The central research question guiding this dissertation is whether reading speed and comprehension can vary somewhat independently at high levels, or whether their relationship is constrained by a speed-accuracy trade-off (SAT), as observed in numerous cognitive and motor tasks.

This dissertation delves into the notion of reading speed as an isolated factor, exploring the intricate relationship between speed and comprehension within the broader context of reading research. The central premise of this work challenges a prevailing assumption within the research community, namely the notion that a SAT inherently governs the reading process. While numerous studies have implicitly or explicitly manipulated both reading speed and comprehension simultaneously (e.g., via task instructions or comprehension demands), this work employs a novel methodology to isolate and systematically manipulate reading speed. This method maintains the naturalistic validity of the reading process while enabling precise examination of how varying speeds influence comprehension and moment-to-moment processing.

This approach provides a more precise theoretical understanding of the cognitive and perceptual mechanisms that underpin reading, including the function of specific eye movements, such as *regressions*, in facilitating comprehension. By isolating the factor of speed, this research examines how readers allocate their cognitive resources during the reading process and how speed influences both lexical and higher-order processing.

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[1] For clarity and consistent interpretation, terms highlighted in *italic* upon their first appearance in the text are defined in the comprehensive glossary provided at the end of this dissertation (page 156).

From a practical standpoint, this research seeks to address a salient question: could enhancing reading speed not only preserve but potentially enhance certain aspects of the reading process? Should this be the case, then these findings could have significant implications for the design of reading interventions and training programs, particularly in educational and professional settings. The role of reading speed in supporting or hindering comprehension remains a subject of both public interest and scientific discourse.

The dissertation starts with a thorough review of extant research on reading, with a particular emphasis on the role of oculomotor control and cognitive processing during this activity. This is followed by an exploration of the speed-accuracy trade-off in cognitive and motor tasks, which establishes the foundation for an investigation into whether such a trade-off exists during reading as well. The central research questions are addressed in three experiments, each designed to provide insights into how different reading speeds affect the moment-to-moment reading process and comprehension outcomes. Together, these studies aim to bridge theoretical understanding with practical applications, offering a nuanced perspective on the complex dynamics of reading speed and accuracy.

1.1 Reading research in the context of cognitive science

The field of reading research, which investigates the processes involved in reading and the subprocesses that underpin it, is inherently interdisciplinary in nature. It draws primarily on the disciplines of linguistics and cognitive psychology. The linguistic contribution is mostly descriptive and normative, offering insights into syntax, semantics, and orthography (Rickheit et al., 2003). In contrast, psychology provides the empirical tools necessary to test theories, offering experimental methods and models that are essential for this aim. As stated by Radach et al. (2012), psychological research into reading can be classified into two principal categories: psychometric and experimental approaches.

The main objective of psychometric reading research is to develop assessments that reflect the various components of reading. This enables researchers to uncover relationships and make predictions, such as assessing reading ability or forecasting reading development (Moll et al., 2012). However, psychometric approaches reveal their limitations when addressing detailed questions about the cognitive processes underlying reading. The causal inferences drawn from observed relationships between test performance and reading competence are often constrained by the inability to precisely identify the latent variables being measured (Radach et al., 2012).

This is where the value of experimental reading research becomes apparent. By employing controlled and systematically varied conditions, it is possible to isolate specific subprocesses of reading and gain precise insights into information processing at a detailed level. Two distinct traditions have emerged within the field of experimental reading research. The older of these traditions focuses on word recognition, whereby target words are presented visually for brief periods and the times taken to recognize or react to them are measured. An overview of the insights gained through this methodology regarding fundamental mechanisms of word processing has been provided by Grainger (2018) as well as Radach and Hofmann (2016).

The second branch examines the reading of continuous sentences and texts, addressing the dynamic nature of the reading process. For a historical overview of this approach, see Wade et al. (2003). In addition to examining the properties of individual words, this approach investigates the context of sentences and texts, including semantic and syntactic features, and their impact on reading. The integration of these information sources renders the reading task significantly more complex and leads to mental processes affecting the working memory becoming more relevant (Perfetti, 1985; Perfetti & Roth, 1980).

The most commonly employed experimental methods include the measurement of response times and the observation of eye movements. Eye-tracking, in particular, occupies a unique position due to its ability to capture reading processes in real time under ecologically valid conditions. Eye movements play an interesting dual role – they are part of the reading process itself, and at the same time a tool for its analysis. In eye-tracking studies, controlled sentence materials are typically presented, with experimental conditions manipulating specific variables of interest, such as word frequency. The resulting changes in oculomotor parameters are analyzed to determine the direction and sequence of eye movements, which reflect the focus of processing, while fixation durations provide a measure of the associated cognitive effort (Radach & Kennedy, 2004).

1.1.1 Information processing and eye movements in reading

Eye movements that occur during reading are generally considered to result from two distinct classes of decisions: those related to spatial aspects (where to move the eyes) and those related to temporal aspects (when to move the eyes). While these two processes are largely independent (Reichle et al., 2003), they are inherently linked and can overlap (Rayner et al., 2000). While the spatial aspect concerns word selection and saccade landing position within words, the temporal aspect relates to fixation duration (and other viewing duration measures, see later in this chapter), reflecting both low-level and higher-level processing demands (Rayner, 1998; Rayner et al., 2012; Vitu et al., 2001a).

The "where" decision, determining where the eyes move next, is primarily word-based, aiming to direct the gaze to a specific word (Albrengues et al., 2019; McConkie & Zola, 1984). This involves selecting the target word and the landing position within it (McConkie et al., 1994). Both low-level oculomotor constraints (e.g., word length) and cognitive processes (e.g., word frequency) influence this selection (Starr & Rayner, 2001; White & Liversedge, 2006), with low-level factors potentially explaining more variance (Brysbaert & Vitu, 1998).

The temporal aspect of eye movements during reading, or the "when" decision, pertains to the duration of fixations. Over the past four decades, a substantial body of research has been conducted to examine the influence of both linguistic and non-linguistic factors on fixation durations. However, not every word receives exactly one fixation during reading. Some words, particularly short or highly predictable ones, are often skipped altogether, while others may require multiple fixations before the reader moves on (Drieghe et al., 2004). This variability underscores the need for a more nuanced approach to measuring processing time on individual words. To capture this complexity, different eye movement variables are used to provide detailed insights into moment-to-moment word processing (see Radach & Kennedy, 2004 for an overview).

The duration of the first fixation on a word is generally associated with early word recognition processes and reflects the initial phase of orthographic and lexical information extraction. The sum of all fixations on a word before the reader’s gaze moves to another word is referred to as gaze duration. It captures the total time spent processing a word during *first-pass reading*. These two measures are frequently referred to as first-pass reading measures, in contrast to late reading measures, which include subsequent fixations after the initial gaze. Both *first fixation duration* and *gaze duration* are particularly sensitive to low-level lexical features of words.

Conversely, *total viewing time* is defined as the summed duration of all fixations on a word, encompassing initial fixations and subsequent *regressions* or *refixations*. This measure is profoundly influenced by regressions and widely understood as reflecting the total linguistic processing effort for a given word. It is particularly sensitive to integrative processes, such as resolving ambiguities or linking words to prior context. Increased total viewing time often indicates comprehension difficulties or the need for *rereading*, as challenging or unexpected words require additional cognitive resources for effective integration into the text's overall meaning, leading to an augmented probability of regressions (Just & Carpenter, 1987; Reichle et al., 2009).

However, as previously mentioned not all words are fixated during reading. The probability of fixation is influenced by visual factors, such as word length, with shorter words being less likely to be fixated, and by linguistic factors, such as predictability and frequency (Brysbaert & Vitu, 1998; Drieghe et al., 2004; Radach & Kempe, 1993).

The temporal characteristics of reading are influenced by both low-level and high-level factors. Low-level, non-linguistic factors, such as word length, fixation position within the word, and launch site distance, play a role in determining fixation durations (Vitu et al., 2001). However, higher-level factors, including lexical, syntactic, and semantic elements, exert a more substantial influence, as they directly reflect the cognitive demands associated with word recognition and sentence processing (Rayner, 1998). Two well-established findings are that readers spend more time fixating on longer words compared to shorter ones (e.g., Kliegl et al., 2004; Rayner et al., 1996; Rayner & McConkie, 1976) and on low-frequency words compared to high-frequency ones (e.g., Inhoff & Rayner, 1986; Schilling et al., 1998; Vitu, 1991).

Word frequency, defined as how often a word occurs in a language, plays a crucial role in reading behavior, influencing how quickly and accurately words are processed. Higher-frequency words are generally recognized and understood more efficiently than lower-frequency words, a phenomenon observed across various reading tasks such as *lexical decision*, naming, and sentence reading (Forster & Chambers, 1973; Kuperman et al., 2013; Schilling et al., 1998). Word frequency effects are most evident during the initial processing of a word, encompassing both the first fixation on the word and any subsequent fixations before the next word is fixated. Consequently, these effects are predominantly reflected in first fixation duration and, particularly, in gaze duration. However, subsequent stages of processing can also be influenced, suggesting that word frequency continues to influence reading behavior beyond the initial encounter.

Besides these effects, additional factors influence the ease of word processing. Variables such as the predictability of a word based on the preceding context (Balota et al., 1985; Binder et al., 1999; Rayner & Well, 1996; Zola, 1984) or the age at which a word was acquired (Juhasz & Rayner, 2003) have been shown to significantly impact both the duration and frequency of fixations. While predictability affects early processing measures such as first fixation and gaze duration (Staub, 2015), its influence is most pronounced during later stages of processing, as evidenced by increased refixation probabilities and longer *total reading times*. These findings highlight the intricate interplay between lexical and contextual factors in determining fixation durations during reading.

Models of eye movements in reading aim to provide a comprehensive framework for understanding how linguistic and visuomotor processes interact to produce observable oculomotor behavior. These models integrate the spatial and temporal dimensions of eye movements, addressing where and when readers fixate during text processing. A central goal of these models is to explain how various cognitive and visual factors influence eye movements and how these movements, in turn, reflect underlying reading processes.

A number of computational models have been developed to explain eye movement control during reading, with each model emphasizing different aspects of the interaction between linguistic and oculomotor processing. For instance, the E-Z Reader model (Pollatsek et al., 2003; Reichle et al., 2009; Reichle et al., 1998) focuses on the role of lexical access in triggering saccades, positing that word recognition occurs in two stages and that the completion of the first stage initiates the programming of the next saccade. Conversely, the SWIFT (Engbert et al., 2005) and the Glenmore model (Reilly & Radach, 2006) employ a more parallel approach, proposing that multiple words are processed concurrently within the reader's perceptual span (useful field of view). Additionally, the Über-Reader model (Veldre et al., 2020) extends this framework to simulate reading behavior beyond the word level, incorporating modules for *syntactic parsing* and semantic integration.

Despite their differences, these models converge on the idea that reading behavior results from the interaction of linguistic, cognitive, and visuomotor processes. The influence of lexical and contextual factors on fixation durations underlines the importance of word recognition and comprehension processes in determining when to move the eyes. Importantly, the success of these models has helped to advance the field by offering predictive frameworks for experimental research. However, the focus on modeling low-level phenomena, such as word *skipping* and fixation durations, has also drawn attention to the relative neglect of higher-level comprehension processes. As Radach et al. (2007) point out, eye movement researchers tend to prioritize perception and oculomotor control, while comprehension researchers are often more concerned with issues of language processing and educational implications.

One aim of the present work is to take a step toward bridging this divide by examining the adaptability of moment-to-moment processing to varying reading speeds, with a particular focus on the temporal aspects of eye movements and their relationship to reading comprehension.

1.1.2 Reading comprehension

From a cognitive science perspective, the primary objective of reading is to establish a cognitive representation of the text that is both meaningful and enduring. This process entails the integration of information presented in the text with prior knowledge, thereby forming a coherent and enriched understanding (Gernsbacher, 1997). Text comprehension can be defined as the ability to understand a text, analyze its information, and accurately interpret the author's intended message (Mckee, 2012a). Furthermore, it is seen as the product of the development and coordination of multiple reading skills, including word recognition, reading fluency[2] and syntactic processing (Rayner et al., 2006). To facilitate successful text comprehension, it is imperative that these skills are present, yet it is equally crucial to consider other requirements, such as the possession of a sufficiently extensive vocabulary for the text in question. Empirical evidence suggests that, to achieve full comprehension without any assistance, readers should be familiar with well over 90 percent of the words in a text (Hsueh-Chao & Nation, 2000). Furthermore, the background knowledge available on the critical topic also plays a decisive role in text comprehension as an outcome of the reading process (Elbro & Buch-Iversen, 2013; Marmolejo-Ramos et al., 2009).

The construction-integration model (Kintsch, 1988; 1998) is a widely accepted framework for understanding text comprehension. According to this model, the comprehension process comprises two interrelated phases: the construction phase and the integration phase. During the construction phase, the reader engages in the process of constructing an initial representation of the text's content. The integration phase ensues, during which this representation is connected to prior knowledge, enhancing coherence and depth. Comprehension is theorized to develop across three hierarchical levels of understanding:

(1) Surface representation: This level of understanding can be defined as an explicit representation of the exact wording of the text. It is akin to memorizing lyrics from a song without deeper understanding or contextual enrichment. (2) The second level is *propositional representation*: At this level, the reader processes the meaning of sentences, focusing on the relationships between objects and their actions or attributes. (3) *Situational model*: The highest level of text comprehension involves the creation of a rich mental model of the situation described in the text. This model incorporates dimensions such as space, time, protagonists, causalities, and goals (Zwaan et al., 1995). The construction of a situational model necessitates

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[2] Reading fluency is defined as a combination of accuracy, rate, and prosody in oral reading. It is frequently assessed by having individuals read texts aloud, with errors, reading time, and prosody being monitored to evaluate performance (Hudson et al., 2005).

the ability of the reader to make inferences between statements and enrich the text with their own knowledge. This process is instrumental in ensuring both local coherence, where individual sentences are connected in a meaningful manner, and global coherence, where the entire text coalesces to form a unified understanding (McNamara et al., 1996).

Building on this framework, the Constructionist Theory (Graesser et al., 1994) emphasizes the role of readers' goals and top-down processes in meaning construction. Readers actively seek explanations for text events, guided by narrative structure, causal links, and their reading purpose. The aforementioned objectives exert a significant influence on the depth and elaboration of situational models.

In a somewhat related vein, the Good Enough processing approach (Ferreira et al., 2002) suggests that comprehension is often shaped by efficiency rather than accuracy. Instead of constructing detailed mental models, readers may form partial or superficial representations that are sufficient for their immediate goals. This standpoint accentuates the adaptive and goal-dependent character of comprehension, thereby facilitating comprehension of variability across individuals and contexts, particularly in circumstances where absolute precision is not imperative.

While this approach can explain differences in reading comprehension depending on different goals, many models neglect to explain individual differences. However, the Structure-Building Framework (Gernsbacher, 1990) explicitly accounts for such variation. According to this model, the process of comprehension involves the construction of a cognitive framework through the establishment of a foundational structure and the integration of relevant incoming information. When new information does not align, readers may adapt by constructing a novel substructure to accommodate the incoming data. A pivotal mechanism in this process is suppression – the inhibition of irrelevant or conflicting information to maintain coherence – which varies across individuals. Skilled readers are able to inhibit distracting input, resulting in more coherent mental representations (Gernsbacher & Faust, 1991). This perspective highlights how individual cognitive mechanisms shape the coherence of mental representations.

Building on these theoretical accounts, the *propositional text base* and the *situational* or *mental model* are frequently employed as a foundation for evaluating comprehension (Johnson-Laird, 1983; Kintsch, 1988; Rayner et al., 2006; Van Dijk & Kintsch, 1983). The propositional text base signifies memory for text content and facilitates tasks such as identifying or recollecting explicitly stated information. However, achieving a more profound comprehension of a text necessitates transcending the confines of the propositional text base through the integration of text-related information with prior knowledge, frequently facilitated by knowledge-based inferences.

On a more general level, two defining classes of factors can be identified that determine text comprehension: external and internal factors. As described above, internal factors are the cognitive and linguistic abilities of the reader. External factors have been identified as characteristics of the text, time and place of reading, but also the type of comprehension measurement (McNamara et al., 1996; Perfetti, 1985). There is a variety of ways to conceptualize the measurement of text comprehension. However, it is important to note that different formats are used to measure different aspects of comprehension (Koda, 2005). As Kobayashi (2002) demonstrates, a wide range of test procedures, including cloze tasks, open-ended questions and summary writing, can result in a significant variation in test scores among participants.

A common approach in the field is to evaluate readers' ability to recall details from a text (Allington & McGill-Franzen, 2014). This method frequently relies on factual questions, such as multiple-choice formats, which can determine whether a reader can retrieve specific information. However, multiple-choice questions pose certain challenges, as proficient readers may overanalyze answers, or the provided options may only partially address the question, leading to confusion. Additionally, it is imperative to take guess probability into account during the evaluation process. Conversely, when meticulously formulated, these inquiries facilitate high precision and objectivity (Chen, 2010; Epstein et al., 2002; Paxton, 2000). They are regarded as a dependable method for assessing text comprehension.

A comparable strategy involves the utilization of short-answer questions, which have been observed to engender varying degrees of comprehension and, in some cases, facilitate more precise differentiation of student proficiency levels (Kobayashi, 2002; Zawoyski & Ardoin, 2019). Nevertheless, the evaluation process for these responses is less straightforward, and the subjective interpretations of the test's constructors can exert a more substantial influence, thereby compromising the test's reliability.

An alternative measurement involves the composition of short essays or summaries of the reading material. However, significant disadvantages arise due to confounding skills, such as communication competencies (Mckee, 2012a). Another approach involves the use of cloze tests, which require participants to fill in blanks within a text, focusing primarily on vocabulary knowledge rather than comprehensive text understanding (Mckee, 2012b; Vacca et al., 2021), making them less suitable for measuring deeper comprehension.

The selection of the type of comprehension measurement must be made with great care, as it has the capacity to exert influence both upon the measured text comprehension and the reading process itself (Radach et al., 2008).

1.1.2.1 Reading comprehension and eye movements

The approaches described in the previous chapter, such as multiple-choice questions and summarizing, can be described as ‘offline’ comprehension measurements because they assess understanding after the reading process has been completed. In contrast, there are also approaches that measure comprehension based on moment-to-moment processing, which can be referred to as 'online' comprehension. This section will focus on how eye movements reflect the intricate interplay of information processing during reading and serve as an indicator of online comprehension. Research has consistently shown that patterns of eye movements are closely linked to the demands of comprehension. Fixation durations, gaze durations, and regression patterns are sensitive to lexical, syntactic, and semantic features of the text (Rayner, 1998; Schilling et al., 1998). Beyond such individual measures, recent findings suggest that readers with better comprehension tend to exhibit more structured and similar scanpaths – global patterns of eye movements that reflect streamlined reading with fewer regressions and more consistent left-to-right progression (Mézière et al., 2024).

It appears that higher-order cognitive processes influence ocular movements primarily in circumstances where an individual experiences difficulty in comprehending or processing the presented information. For example, readers tend to spend more time on ambiguous phrases or syntactically complex sentences (Frazier & Rayner, 1982; Rayner et al., 2004). These prolonged fixations often reflect increased cognitive effort required for word recognition (see chapter 1.1.1), syntactic parsing, or integration of information into the ongoing mental model of the text.

Regressions – backward eye movements to previously read texts – are particularly associated with comprehension difficulties or the need to re-evaluate earlier information. This behavior is essential for resolving ambiguities, correcting misinterpretations, and achieving coherence at both local and global levels (Inhoff et al., 2019; Rayner et al., 2006). Moreover, the probability of regressions tends to increase with *text complexity*, further highlighting the dynamic interplay between eye movements and cognitive processes during reading (Oliveira et al., 2013; Rayner et al., 2006).

While regressions often signal efforts to resolve comprehension difficulties, eye movements do not always reflect meaningful engagement with the text. Mindless reading, or mind wandering while reading, occurs when the eyes move over the text without cognitive processing or comprehension. Eye-tracking studies show that fixations during mindless reading are longer and less influenced by word features such as frequency or predictability, suggesting reduced cognitive engagement (Reichle et al., 2010). Other indicators include erratic eye movements, shorter gaze durations, increased word skipping, and attenuated word frequency effects (Luke & Henderson, 2013; Nguyen et al., 2014). While certain eye movement patterns have been associated with error detection failures (Schad et al., 2012), there remains some debate about the reliability of specific eye movement measures for detecting this state (Steindorf & Rummel, 2020). Nonetheless, mindless reading underscores the value of eye-tracking in distinguishing genuine comprehension from superficial reading behaviors.

This disengaged state contrasts sharply with conditions where readers actively work to resolve syntactic or semantic challenges, such as those presented by syntactically ambiguous sentences. Such sentences demand considerable cognitive effort, as readers must integrate conflicting cues to arrive at an accurate interpretation. A frequently employed technique to examine the impact of syntactically ambiguous sentences is the utilization of garden-path sentences. These grammatically correct sentences initially lead readers to an incorrect interpretation due to their ambiguous structure, requiring reanalysis to uncover their true meaning (e.g., the sentence “Since Jay always jogs a mile seems like a very short distance to him.”). This approach enables researchers to identify and analyze the underlying causes of processing difficulties or errors. Research has demonstrated that garden-path sentences frequently prompt increased regressions to critical parts of the sentence, reflecting the reader's attempt to resolve the ambiguity (Frazier & Rayner, 1982; Pickering & Frisson, 2001).

A somewhat similar approach is based on the concept of *comprehension monitoring*, which refers to the active and ongoing evaluation of how well newly encountered information aligns with prior understanding (Smith et al., 2021). This process entails readers deliberately assessing the coherence of the text and the congruence between their interpretation and the provided information (Vorstius et al., 2013). An established method of assessing comprehension monitoring involves the identification of errors by readers, such as nonsensical words or violations of prior knowledge (Baker, 1989; Garner & Reis, 1981; Markman & Gorin, 1981). This approach relies on explicit error detection tasks that highlight a reader's ability to identify and respond to textual inconsistencies[3].

[3] It is important to acknowledge that alternative definitions are prevalent, particularly within the domain of educational research. These definitions emphasize the monitoring of comprehension through the act of listening to internal or vocalized voices during the reading process (Elliott-Faust & Pressley, 1986). While scientific definitions in educational

Eye movement analysis provides a more fine-grained method for studying comprehension monitoring by capturing moment-to-moment processing. For instance, readers tend to fixate longer on implausible or unpredictable words within a given context, indicating increased cognitive effort to integrate these anomalies into their understanding. Existing research has shown that skilled and less skilled readers differ in their ability to monitor comprehension. Van der Schoot et al. (2010) demonstrated that while readers generally fixate longer on textual inconsistencies, proficient readers are more likely to detect global inconsistencies and incorporate them into a coherent situational model (see Chapter 1.1.2). Less skilled readers, by contrast, only exhibited this behavior when the target sentences were short, failing to identify broader inconsistencies. Similarly, Vorstius et al. (2013) manipulated sentence consistency by altering the polarity of causal conjunctions, transforming causal relationships into adversative ones (e.g., "Daniel was shivering because/although he was hot."). Their results revealed a positive correlation between rereading critical parts of inconsistent sentences and correctly answering comprehension questions, underscoring the role of rereading in successful comprehension monitoring. Importantly, rereading also appears to support comprehension in less proficient readers. Tighe et al. (2023) found that among adult struggling readers, increased rereading of critical regions was associated with higher comprehension accuracy.

1.1.3 Reading and comprehension in a second language

Building on the foundations of reading research in native-language contexts, examining second-language (*L2*) reading offers a critical perspective on how linguistic processing and visuomotor control adapt under conditions of reduced proficiency. Reading in a second language is a fundamental skill that is crucial for a significant proportion of the global population in everyday life (Arkoudis et al., 2009; Pecorari & Malmström, 2018). A thorough understanding of these adaptations not only enhances our knowledge of the reading process but also addresses the challenges faced by L2 readers, thus making it an indispensable area of study within reading research.

Word processing and comprehension in a second language have been shown to exhibit striking similarities as well as notable differences in comparison to native language (*L1*) reading. While the fundamental cognitive and linguistic mechanisms remain consistent, L2

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research assume an intentional process, an alternative assumption posits that it can be seen as a skill, thereby suggesting that it is an unconscious process that becomes a natural part of skilled comprehension (c.f. Vorstius et al., 2013).

readers face unique challenges stemming from lower linguistic proficiency and less automatic processing. These differences extend to cognitive strategies, linguistic processing efficiency, and eye movement patterns during reading, providing insights into how L2 readers adapt to the demands of comprehension (Godfroid, 2019).

As one core process, L2 readers require more time for word decoding, resulting in slower *reading rates* and longer fixation durations compared to their L1 counterparts (Beglar & Hunt, 2014; Brysbaert, 2019). The increased cognitive effort is also due to higher load on verbal working memory and lexical access, leaving fewer resources available for higher-order comprehension processes (Morishima, 2013). In accordance with the shallow structure hypothesis (Clahsen & Felse, 2006; 2018), it can be posited that these challenges result in L2 readers engaging in less profound syntactic structure processing compared to L1 readers. Instead, L2 readers are hypothesized to rely on surface-level cues.

Oculomotor research has corroborated these findings, demonstrating that L2 readers are less inclined to skip high-frequency or predictable words and exhibit prolonged fixations on low-frequency words (Berzak & Levy, 2023; Godfroid, 2019). This pattern suggests a reduced capacity for predictive processing, further underscoring the cognitive demands placed on L2 readers (Nahatame, 2023). While second-language readers typically demonstrate reduced reading speeds, recent studies suggest that they can attain comprehension levels comparable to native speakers under ideal conditions (Kuperman et al., 2023).

The role of individual differences in L2 can hardly be overestimated, as they present a highly heterogeneous population (Bernhardt, 2005; Jeon & Yamashita, 2014). Research has identified factors such as vocabulary size, decoding skills, and grammatical knowledge as predictors of L2 comprehension, accounting for approximately half of the observed variance in performance (Bernhardt, 2005; Jeon & Yamashita, 2014; Kuperman, 2024). The residual variance indicates the significance of domain-general cognitive factors, such as *working memory capacity* and reading habits, in L2 reading comprehension (Jeon & Yamashita, 2014).

The degree of fluency in L2 reading, as indicated by shorter fixation durations, increased word skipping, and fewer regressions, exhibits considerable variability among individuals (Cop et al., 2015; Godfroid, 2019). While proficiency in L2 vocabulary and morphological awareness exerts a significant influence on fluency patterns, the data also underscore the predictive power of L1 reading fluency. Proficient L2 readers exhibit more efficient eye movement patterns, resembling those of native speakers, while less proficient readers demonstrate prolonged processing times, similar to developing L1 readers (Parshina et al., 2021).

Including L2 participants in reading experiments provides a valuable opportunity to better identify capacity limits and to uncover potential differences in written language processing as a function of language proficiency. This approach not only deepens our understanding of the cognitive and linguistic mechanisms underlying reading, but also highlights how different levels of proficiency shape the strategies and adaptations that readers employ.

1.2 Speed-accuracy trade-off

The speed-accuracy trade-off (SAT) describes the systematic relationship between the speed at which a task is performed and the accuracy (i.e., specified as absence of errors) that can be achieved. Faster responses often lead to reduced accuracy, whereas slower, more deliberate responses increase accuracy (Forstmann et al., 2008; Standage et al., 2014; Wickelgren, 1977). This principle has been demonstrated in a wide range of tasks, including perceptual decision making, memory recognition, and motor execution, making it one of the most pervasive phenomena in human performance. Because of its broad applicability, SAT is often considered a psychophysical law that highlights how strategies adapt to task demands (Bogacz et al., 2010; Chittka et al., 2009).

Research into the neurobiological mechanisms of the SAT has yielded significant insights. The decision-making process is subject to regulation by neural activity in regions such as the dorsolateral prefrontal cortex, basal ganglia, and premotor cortex (see Bogacz et al., 2010; Van Veen et al., 2008). In scenarios that prioritize speed, these regions demonstrate elevated activity, thereby reducing decision thresholds and accelerating responses. Conversely, when accuracy is emphasized, an increased integration of sensory evidence is required, resulting in longer response times (Ivanoff et al., 2008; Standage et al., 2014). Furthermore, distinct patterns of brain activity, including variations in Bereitschaftspotential and specific Event-Related Potential (ERP) components, have been observed to be associated with either speed or accuracy emphases (Perri et al., 2014).

1.2.1 Speed-accuracy trade-off in cognition and motor control

The speed-accuracy trade-off (SAT) has been a central focus of studies investigating various cognitive and motor tasks. The SAT has been well documented in tasks such as perceptual discrimination (e.g., Rank & Di Luca, 2015; Ratcliff & Starns, 2013), lexical decision (e.g., Rinkenauer et al., 2004), and memory recognition (e.g., Dosher et al., 1989; Hintzman & Caulton, 1997). These tasks require individuals to balance the speed of decision making with the accuracy of their responses, with faster responses typically resulting in higher error rates (Donkin et al., 2014). Models such as the drift-diffusion model explain this phenomenon by describing decision-making as a process of evidence accumulation. Adjusting the evidence threshold can shift the emphasis between speed and accuracy, allowing for flexible adaptation to task demands (Heitz, 2014; Ratcliff & Smith, 2004).

Similarly, in motor control, the SAT is evident in tasks that require precise movements, such as aiming or grasping. According to Fitts' law, as movement speed increases, accuracy tends to decrease due to reduced control and increased variability in motor execution. Conversely, slower movements allow for greater precision, allowing for fine-tuned adjustments (Fitts, 1954; Mackenzie, 2017). These findings demonstrate that cognitive and motor tasks share common mechanisms for modulating the speed-accuracy trade-off.

However, the SAT is not universally applicable. In cognitively demanding tasks, such as problem solving or multitasking, the relationship between speed and accuracy becomes less straightforward (Domingue et al., 2022). For example, in such complex scenarios, additional time improves performance only up to a certain threshold, after which the benefits plateau (Chen et al., 2018). Similarly, in motor tasks with cognitive components, such as decision-making in sport, anticipation and practice can even mitigate the SAT (Spieser et al., 2017).

Individual differences, such as personality traits, also modulate SAT performance. For example, impulsive individuals often show superior accuracy on tasks requiring rapid information processing, whereas neurotic individuals do not necessarily benefit from extra time (Dickman & Meyer, 1988; Robinson et al., 2010). In addition, Pacheco et al. (2024) showed that although individuals have stable SAT tendencies, these preferences can adapt with practice. SAT principles do not appear to be fixed, but can vary depending on individual characteristics and learning processes.

In real-world contexts, such as driving, emergency response or language processing, SAT interacts with a variety of external and internal factors. Time pressure, task complexity and individual expertise all influence how the SAT manifests. Under time pressure, individuals may adopt more efficient strategies by ignoring redundant information or prioritizing critical elements, thereby maintaining performance despite the trade-off (Domingue et al., 2022).

These findings suggest that the SAT is influenced by a combination of task characteristics, individual differences, and adaptive mechanisms. While the SAT has been demonstrated to be a robust phenomenon in many controlled experimental tasks, its application to real-world scenarios highlights the dynamic interplay between cognitive and motor processes. This complexity underscores the necessity for a thorough examination of domain-specific adaptations, such as those observed in reading, where the concepts of speed and comprehension are inherently intertwined. The domain of reading offers a unique framework for further exploration of the manifestation of the SAT in naturalistic and multifaceted tasks.

1.2.2 Is there a speed-accuracy trade-off in reading?

Reading is a complex cognitive task that involves a series of interconnected decisions, such as evaluating whether the current word, sentence, or passage has been adequately processed. At the same time, a different level of decision making is used to determine when and where to move the eyes. In contradistinction to less complex decision-making tasks, reading demands the integration of multiple levels of visuomotor, linguistic, and cognitive processing, ranging from letter and word recognition to the construction of meaning across sentences and entire texts (see chapter 1.1.2). These processes underline the dual demands of speed and accuracy in reading: how quickly can a text be processed while maintaining an adequate level of comprehension?

The SAT of reading has been the subject of extensive research at the level of word recognition, particularly through tasks such as lexical decision paradigms. In these tasks, participants are presented with letter strings and must decide whether they form a valid word or a pseudoword. The SAT has been systematically investigated in this context by instructing participants to either prioritize speed – leading to faster but less accurate responses – or accuracy, which results in slower but more precise judgments. Additionally, response deadlines are often used to manipulate SAT, with shorter deadlines leading reliably to decreased accuracy and longer deadlines allowing for more careful processing (Antos, 1979; Rinkenauer et al., 2004; Scaltritti et al., 2024). These patterns have been observed across a range of lexical decision tasks and have been extended to encompass more complex linguistic judgments, such as the determination of the grammatical gender of German nouns (Rinkenauer et al., 2004).

However, reading comprises more than merely isolated word recognition; while word processing is an essential component, reading also involves the integration of words into sentences and broader textual structures. Consequently, reading speed is commonly assessed using global metrics, such as words per minute (wpm). For a considerable period, it was presumed that skilled adult readers sustain a reading rate of approximately 300 words per minute (e.g., Carver, 1977, 1983; Rayner, 1998). However, a meta-analysis by Brysbaert (2019a) suggests that actual reading rates are lower than previously estimated, with nonfiction texts in English being read at an average of 238 wpm and fiction at around 260 wpm. These rates exhibit an inverse relationship with word length and vary across languages. They serve as useful benchmarks for natural reading behavior.

The reading rate is a valid metric for measuring the speed component of reading. However, the accuracy component of reading extends beyond the correct decoding of individual words, as measured in lexical decision tasks, to encompass the comprehension of larger linguistic units. This aligns with the broader definition of reading comprehension as the ability to construct a coherent mental representation of the text (see chapter 1.1.2). The prevailing conception of efficient reading is that it entails the capacity to attain high comprehension at a relatively high speed (Geva et al., 1997)[4].

The question of whether faster readers consistently demonstrate better comprehension remains unresolved. Brysbaert's (2019) review does not include compelling evidence for correlation between reading rate and comprehension, with only a slight trend that faster readers tend to show better comprehension. This lack of clear findings is likely to reflect the influence of multiple interacting factors on the relationship between reading speed and accuracy.

For instance, Vorstius et al. (2013) examined the issue of comprehension monitoring in their study (see Chapter 1.1.2.1), finding no overall effect of reading speed on the accuracy of responses to comprehension questions. However, when analyzing sentences divided into three parts – two coherent sections and one with inconsistencies – they observed a positive correlation between first-pass reading speed in the coherent sections and comprehension accuracy. In contrast, the inconsistent section of the text did not demonstrate a significant difference in reading rate. These results are in harmony with the conclusion that participants with higher comprehension scores exhibited a more effective utilization of their reading time, reading faster in coherent parts of the text but engaging in targeted rereading of relevant information. This suggests that proficient readers allocate their cognitive and temporal resources more efficiently, leading to improved outcomes within the same reading time.

The existence of extremes in reading ability provides an additional perspective on the issue. Individuals with reading or language difficulties tend to exhibit slower reading speeds and lower comprehension, often due to challenges with decoding and lexical access (Carlson, 1949; Lovett, 1987). These findings support the hypothesis of a positive correlation between speed and accuracy on a very general level, as reduced proficiency in fundamental reading skills can impede both.

[4]Indeed, a considerable number of assessments of reading are based on the combination of these two components, including word reading efficiency and reading fluency. In these cases, words (reading efficiency) and sentences (reading fluency) are read aloud, and the time required as well as the correct pronunciation (and prosody in the case of fluency) are tracked (Hudson et al., 2005; Tarar et al., 2015).

The theory of the optimal language intake rate (Carver, 1977) further enriches this discussion. According to this framework, each individual has an ideal rate of linguistic information intake – whether auditory or written – that maximizes comprehension. Rates exceeding or falling short of this optimal point are assumed to impair comprehension. This concept will be explored further in chapter 2.1, where the different intake modalities will be highlighted in more detail.

In addition, reading goals have been shown to have a significant impact on the relationship between reading speed and comprehension (e.g., Strukelj & Niehorster, 2018). Different goals, such as achieving a detailed understanding, gaining a general overview, or detecting spelling errors, have been found to prompt readers to adapt their reading strategies and speeds accordingly (further details on this issue will follow in the upcoming chapter 1.2.2.1). While these goals can be manipulated experimentally through instructions, individual differences have been shown to play a role in how well readers adapt. In a pioneering study, Laycock (1955) demonstrated that some individuals increase their reading speed considerably when instructed to do so, whereas others maintain a stable pace regardless of the instruction. This divergence suggests that certain readers prioritize comprehension over speed, analogous to individual differences in the trade-off observed in the speed-accuracy paradigm across other domains (see chapter 1.2.1).

But how is the reading process affected when an individual's reading speed is changed? A group of very eminent reading researchers provide a comprehensive review of the theoretical perspectives on reading speed and comprehension (Rayner et al., 2016). These authors argue that increased reading speed should result in reduced comprehension, making a strong case for a mandatory speed-accuracy trade-off. A strict SAT in reading would leave no room for faster reading speeds beyond an individual's natural pace; thus, any acceleration, such as through speed-reading training, should theoretically lead to diminished text comprehension. Empirical support for this assertion comes from studies demonstrating that dramatic increases in reading speed following such training coincide with significant declines in comprehension performance (Collins & Daniel, 2018).

Rayner and colleagues propose several mechanisms to explain this trade-off, including the possibility that rapid reading may exceed cognitive capacity, leading to an overwhelming *cognitive load* that hinders the integration of ideas. At a lower level, faster reading may impair word decoding, thereby preventing full extraction of meaning. Additionally, rapid reading reduces opportunities for inner speech, which is thought to facilitate engagement with the text. Furthermore, Rayner and colleagues posit that faster reading diminishes rereading behavior, a critical component for resolving ambiguities and ensuring higher-order integration of textual information (see chapter 1.1.2). According to the authors, this phenomenon disrupts the reading process and often results in a superficial processing style resembling skimming. While skimming can be effective for locating specific information, it generally leads to lower comprehension rates, as critical context and subtleties may be overlooked.

These theoretical considerations are broadly consistent with empirical findings indicating the importance of rereading for comprehension, and highlight the complexity of reading as a cognitive task tied to capacity limitations. However, recent findings by Klimovich (2024) challenge the universality of this trade-off. In their study, participants underwent either app-based speed-reading training, metacognitive training, or no training. Post-test assessments revealed that both training groups achieved significantly higher reading speeds (approximately 20% faster than baseline) without measurable declines in text comprehension. The authors argue that these improvements were not driven by conventional mechanisms (such as expanding the perceptual span) but rather by heightened metacognitive awareness of reading strategies – including the reduction of regressions – and more efficient allocation of attentional resources (see also Korinth & Nagler, 2021). Such findings call into question whether natural reading speed indeed represents the upper limit of cognitive capacity or whether readers can adapt to higher speeds without significant comprehension loss through strategic behavioral adjustments.

To establish the correlation between reading speed and comprehension within individuals, it is necessary to manipulate one variable while measuring the other. This may be achieved through indirect manipulation by setting specific goals or instructions regarding reading speed, or via direct manipulation of reading speed itself.

1.2.2.1 Manipulation of reading comprehension and speed

As discussed in chapter 1.2, various tasks provide different incentives to prioritize either speed or accuracy. In reading research, this can be achieved in a number of ways, including manipulating the depth of comprehension assessment. Comprehension questions can target more superficial understanding at the level of the propositional text base or deeper processing at the level of the situational model (see chapter 1.1.2.1). Research has shown that the level of processing triggered by depth of comprehension questions does indeed influence eye movements during reading (Radach et al., 2008; Wotschack & Kliegl, 2013; Zawoyski & Ardoin, 2019).

In Radach et al. (2008), participants were either asked comprehension questions after reading texts or sentences, or were alternately given a forced choice word verification task. Similarly, Wotschack and Kliegl (2013) manipulated both the difficulty and frequency of comprehension questions in their study. Both experiments showed changes in eye movement patterns, suggesting that reading speed increased when superficial processing was sufficient to meet task demands (e.g., fewer or easier questions or word verification tasks). Although neither study explicitly reported on overall reading speed, their findings regarding moment-to-moment processing on the word level suggest an adaptation of reading behavior in response to this type of task demands.

A more deliberate influence on the reading process can be exerted by formulating explicit reading instructions. By setting specific reading goals – such as reading for comprehension, identifying errors, summarizing the topic of the text, or comprehending its general content – both the level of accuracy and the associated eye movement patterns can be modulated (Biedert et al., 2012; Duggan & Payne, 2011; Kaakinen & Hyönä, 2010; Magliano et al., 1993).

Early evidence for task-dependent reading strategies comes from Aaronson & Ferres (1984, 1986), who found that skilled readers adapt their semantic and syntactic processing according to the demands of the task. For literal recall tasks, readers used a structure-oriented recall strategy, whereas comprehension tasks requiring true/false judgments elicited a meaning-oriented strategy. Similarly, McConkie and Rayner (1974) observed that participants prioritized speed or retention depending on the experimental reward. Groups incentivized for speed read passages approximately 40% faster than controls, whereas those instructed to prioritize retention read more slowly. However, contrary to assumptions based on the speed-accuracy trade-off, this did not result in higher comprehension.

Strukelj and Niehorster (2018), in a more recent study reported the effects of four different instructions on eye movement behavior during paragraph reading. The instructions included regular reading, thorough reading, skimming, and spell checking, each of which resulted in noticeable differences in eye movement patterns, reading speed, and comprehension. The spell-checking and thorough-reading techniques resulted in a noticeable decrease in overall reading speed, with effects on both early and late measures. In contrast, skimming (which involves scanning the text for a specific topic) resulted in faster reading, again at both baseline and late measures. For skimming and spell checking, text comprehension was lower than for regular reading, but thorough reading resulted in higher scores.

White et al. (2015) corroborated these findings, demonstrating that different instructions, such as regular reading versus skimming, led to significant adaptations in eye movement behavior. In their study, different instructions and comprehension questions were used to prompt either detailed understanding or surface-level scanning. While regular reading encouraged deeper processing with longer fixation durations and more regressions, skimming promoted a more rapid processing.

Manipulating reading instructions or comprehension questions can provide incentives to prioritize either speed or accuracy, but the implementation of instructions is left to the individual participant. This introduces individual differences in the possible speed-accuracy trade-off, as participants may interpret instructions differently and adopt different strategies as a response (see Chapter 2.1). While direct manipulation of accuracy might potentially address this issue, it is difficult to imagine how this could be done without creating highly artificial conditions that undermine ecological validity. In contrast, direct manipulations of reading speed offer a more practical and reliable means of investigating the interplay between speed and comprehension.

One prevalent method is rapid serial visual presentation (RSVP). Here, all words of a sentence or text are presented in isolation at a set (usually fast) speed, eliminating the need for eye movements. For example, Rubin and Turano (1992) observed that middle-aged adults could read short sentences at a median rate of 790 wpm, with the fastest participants reaching 1,652 wpm. However, this approach is only effective for brief sentences, and the method severely impairs comprehension when entire paragraphs are presented in this manner (Juola et al., 1982; Potter, 2018). Overall, this method is not well-suited to the investigation of regular reading and is arguably only appropriate for examining theoretical limits of short-term reading rates.

An alternative approach incorporating a dynamic text presentation format is the so-called "fading method" (Breznitz & Berman, 2003). In this method, sentences or text are presented and “erased” at a predetermined rate according to the direction of reading. Studies using this technique have discovered the so-called “acceleration phenomenon”, suggesting that reading performance improves when reading speed is accelerated to some extent. Breznitz (1987, 1997) has shown that experimental increases in reading speed can lead to significant improvements in comprehension and decoding accuracy, particularly in impaired readers such as those with dyslexia.

Training programs such as the Reading Acceleration Program (RAP) are designed to increase reading efficiency by using the fading method as training. The effectiveness of RAP in increasing reading speed while maintaining or even improving comprehension has been demonstrated in empirical studies (Korinth & Nagler, 2021). In their review, Korinth and Nagler (2021) highlight the generalizability of the program across different populations and languages, emphasizing that the phenomenon is effective even among typical readers, but particularly beneficial for those with reading difficulties.

However, this technique is constrained by three main limitations. Firstly, the majority of research employing this method has focused on single sentences, which do not necessarily reflect the cognitive and linguistic demands of reading longer texts. Secondly, the gradual fading of text alters the reading process by preventing regressions and reducing rereading, which are essential for word processing and information integration, ultimately supporting comprehension (Inhoff et al., 2019; Schotter et al., 2014). Finally, the continuous disappearance of text may exert pressure on the reader and, more crucially, hinder local fluctuations in processing depth, such as those required for low-frequency or unfamiliar words and syntactic ambiguities. This method is likely to result in challenges with information integration, particularly when dealing with complex sentences or texts.

In light of these considerations, the aforementioned methods cannot be considered fully appropriate for investigating the factor of “speed” on the reading process and the resulting success in comprehension.

1.3 Motivation for the dissertation thesis

The review of the extant literature reveals significant gaps that this dissertation aims to address. It has been established that there is no consistent relationship between reading speed and comprehension across individuals (Brysbaert, 2019). For instance, it has been demonstrated that individuals who read more slowly do not necessarily do so because they read more carefully and achieve higher level of comprehension. Similarly, faster readers do not necessarily sacrifice understanding in order to achieve greater speed. Nonetheless, within the reading research community there is a prevalent assumption that a speed-accuracy trade-off (SAT) exists, similar to other cognitive domains (see chapter 1.2.2). This view is predicated on the premise that increasing reading speed beyond the individual's natural rate invariably leads to a decline in comprehension. This idea was strongly advocated by a group of eminent reading researchers in 2016 (Rayner et al., 2016).

To evaluate this assumption, two critical factors must be examined: the accuracy of reading (in terms of comprehension) and the velocity of information acquisition, measured as reading speed. As argued in chapter 1.2.2, comprehension is best understood as an outcome variable, as its direct manipulation is challenging. It is crucial to use reliable and consistent dependent measures of comprehension that can be applied across different reading conditions, such as varying speeds. A widely used and validated method for assessing comprehension is the administration of multiple-choice comprehension questions. When properly designed and utilized consistently, as in Strukelj & Niehorster (2018), these questions can provide an effective and reliable measure of text comprehension.

However, it is important to acknowledge that comprehension questions do not function as purely passive measures; their presence can shape reading behavior by encouraging readers to adopt specific processing strategies (see Chapter 1.1.2.1). For instance, readers anticipating comprehension questions may engage in more deliberate or strategic reading, adjusting their pace or attention allocation accordingly. Given these considerations, it is valuable to explore complementary methods for assessing comprehension that do not rely on explicit questioning. One such approach is comprehension monitoring, which captures real-time detection and integration of textual inconsistencies (see Experiment 3 and Chapter 1.1.2.1).

The second critical factor, reading speed, presents an equally significant challenge for experimental manipulation. While reading speed is straightforward to measure (e.g., in words per minute), directly manipulating it without confounding additional variables is far more complex. The existing body of research frequently varies reading instructions, resulting in differing reading goals and subsequent speed adjustments. However, in such studies, reading speed is an outcome of the instruction, not an independently manipulated variable. If readers are told to read faster or slower, they may constantly remain aware of this expectation and try to adjust accordingly, therefore deliberately modifying reading in unpredictable ways.

Direct manipulations of reading speed, such as those using the fading method or Rapid Serial Visual Presentation (RSVP), have been employed in the past but come with significant limitations (see chapter 1.2.2). These methods restrict natural reading behaviors, such as regressions, thereby failing to capture the full complexity of the reading process (see chapter 1.1.1).

To address the methodological limitations and the resulting gaps in understanding of the effects of reading speed, a novel method was developed for this dissertation: the line-by-line technique. This technique involves systematically varying reading speed while preserving the natural dynamics of the reading process, including unrestricted eye movements. This methodological approach constitutes the foundation of the present dissertation and is employed across three experiments to examine how systematic variations in reading speed influence both the reading process and comprehension outcomes.

Experiment 1 explores how proficient English readers process and comprehend texts presented at varying speeds, especially those exceeding the average *natural reading rate*. This study establishes a baseline for understanding the effects of speed manipulations in first-language (L1) readers and provides insights into how comprehension is maintained at elevated speeds. Experiment 2 extends this approach to second-language (L2) readers of English, addressing whether the effects observed in L1 reading generalize to a non-native context. Both experiments employ a standardized comprehension test, ensuring consistency and comparability across conditions. Experiment 3 builds upon the findings of the first two studies by introducing individually tailored reading speed manipulations for German participants reading texts in their native language. Unlike Experiments 1 and 2, where fixed speed levels were applied, Experiment 3 adjusts speeds relative to each participant's baseline rate, enabling a more personalized assessment of reading adaptability. Furthermore, Experiment 3 emphasizes lexical processing and comprehension monitoring, using controlled text materials to manipulate word frequency and *plausibility*. This allows for a detailed examination of how readers integrate information and detect inconsistencies during real-time processing in reading.

Collectively, these experiments aim to bridge critical gaps in our understanding of adaptability to varying reading speeds, both in terms of moment-to-moment cognitive processing and comprehension. This is supplemented with additional explorations of individual differences in terms of *baseline reading rate*, overall reading efficiency and working memory capacity.

The findings of these experiments are intended to contribute both to the theoretical understanding of reading processes and to practical applications, such as the design of effective reading interventions and training programs.

1.4 Overview of the experiments

1.4.1 Experiment 1: Effects of reading speeds on word processing and comprehension

The objective of Experiment 1 was to investigate the influence of systematically manipulated reading speeds, ranging from moderately below to significantly above the average natural reading rate, on text comprehension and word processing. Utilizing the novel line-by-line technique, five distinct reading speeds were induced (ranging from 225 to 405 words per minute). This technique was designed to vary reading speed without restricting natural reading dynamics, making it suitable for broader application in future research.

The experiment addressed a fundamental research question: At what point does an increase in reading speed lead to a decline in comprehension? Text comprehension was assessed using a standardized multiple-choice test to allow comparison across all speed conditions. Furthermore, moment-to-moment processing was analyzed through eye-tracking measures, with a particular emphasis on late-stage metrics such as total viewing time and regressions.

Lexical benchmark effects, including word length and frequency, were also examined based on their natural variation within the text material. It was hypothesized that these effects would remain relatively stable at faster reading speeds, at least until the onset of comprehension difficulties, since intact lexical access is the basis for comprehensive understanding. Furthermore, the role of individual differences was explored, including natural reading rate and *word reading efficiency*, to determine how these factors influenced participants' ability to adapt to varying speeds.

Experiment 1 yielded important insights into the relationship between reading speed and comprehension. The results indicate the adaptability of reading processes to increased speeds, as well as the thresholds beyond which comprehension begins to deteriorate, while word processing remains relatively stable. This research provides a foundation for further investigation into the mechanisms of reading and the broader applicability of the line-by-line technique.

1.4.2 Experiment 2: Effect of reading speeds in second language readers

The objective of Experiment 2 was to expand upon the findings of Experiment 1, examining how non-native English speakers (L2 readers) process and comprehend texts when reading at systematically manipulated speeds. In alignment with Experiment 1, the line-by-line technique was employed to regulate reading speeds; however, the range was modified to match the predominantly slower reading rates observed in L2 readers. The range of speeds used in this experiment varied from 180 to 360 wpm, which reflected a progression from moderately below to well above the average natural reading rate for this population (see chapter 1.1.3).

Participants' comprehension was assessed using the same standardized multiple-choice test that was employed in Experiment 1, allowing for consistent comparisons across the two experiments. Eye movement measures were recorded to analyze moment-to-moment processing, with particular attention to late-stage metrics such as total viewing time and regression rates, which were hypothesized to show notable changes under increased reading speeds. Lexical benchmark effects, such as word frequency and word length, were examined based on their natural variation within the text material. This approach allowed examining these effects under the additional processing demands of reading in a second language.

This experiment explored whether individual differences, such as natural reading rate and word reading efficiency, influenced participants' ability to adapt to higher speeds. A critical question was whether L2 readers would exhibit a similar point at which comprehension declines as observed in L1 readers, and how this decline might manifest in their eye movement patterns. Given the additional cognitive demands associated with second-language reading, it was hypothesized that any breakdown in comprehension might occur at lower speeds compared to those observed in Experiment 1.

By focusing on L2 readers, Experiment 2 provided an opportunity to test the generalizability of the findings from Experiment 1 while addressing the unique challenges of reading in a second language. The findings offer valuable insights into the interaction between reading speed, comprehension, and eye movement behavior in bilingual contexts.

1.4.3 Experiment 3: Effects of incremental reading speed increase on lexical processing and comprehension monitoring

In Experiments 1 and 2, a uniform approach was adopted, with a fixed reading speed applied to all participants. However, significant variability in natural baseline reading speeds was demonstrated by the readers. For some participants, the manipulated speeds far exceeded their typical reading rates, presenting a substantial challenge, while for others, they constituted only a minor increase. To address this disparity, Experiment 3 introduced individually tailored speed increments based on each participant's natural baseline speed. The objective of this approach was to establish a more equitable framework for assessing participants' adaptation to increased reading demands, thereby facilitating a detailed investigation into the role of baseline speed in determining adaptation potential. The experiment was designed to test the hypothesis that readers' adaptability depends on proportional increases relative to individual baselines. To implement this idea, participants read texts at four individually adjusted speeds: their baseline natural rate, baseline speed with the line-by-line technique (100% of the baseline), and increments of 125% and 150% of their baseline rate.

In Experiment 3, a greater emphasis was placed on lexical processing and information integration. In addition, the use of a standardized multiple-choice comprehension test was avoided. While comprehension tests do offer valuable insights, they have the potential to influence the reading process itself, thereby modifying the mechanisms under investigation (see chapter 1.1.2.1). More specifically, it may be the case that readers place more emphasis on maximizing comprehension as they would do in their normal reading. This was considered a potential methodological objection, as in this experiment an important focus was on measuring online comprehension through the process of *comprehension monitoring* (see chapter 1.1.2.1).

More specifically, participants were asked to read five or six-line paragraphs, where the third sentence did or did not contain a noun that was implausible (or atypical) with respect to an event or action described in the preceding sentence. Comprehension monitoring was determined in terms of *oculomotor responses* to such inconsistencies. In addition, sentence four included highly controlled target words differing in word frequency, as an indicator for the processing of lexical information. This shift in focus enabled a more nuanced examination of lexical and integrative processes under increased reading speed conditions.

In addition to these primary aims, the experiment also explored the role of individual differences, including baseline reading speed and working memory capacity, in shaping reading adaptability. These analyses offered valuable insights into how cognitive and behavioral factors modulate the effects of individualized speed manipulations. Baseline reading speed, as it directly determined the proportional speed increases, was expected to play a significant role in determining participants' adaptability. Two competing scenarios were considered: either faster readers demonstrate less flexibility due to limited residual reserve capacity, or slower readers struggle more due to inefficiencies in lexical processing at baseline.

Working memory capacity was explored as a further factor, reflecting its role in supporting both lexical access and higher-order comprehension processes under increased processing demands. It was hypothesized that participants with higher working memory capacities would demonstrate greater resilience to speed increases, maintaining efficient word processing and information integration even under heightened constraints.

Integration of individually tailored speed adjustments, controlled lexical manipulations, and an emphasis on comprehension monitoring constituted a refined framework for investigating the adaptability of reading processes in Experiment 3. This design addressed the variability in baseline reading speeds observed in Experiments 1 and 2, while also allowing for a deeper exploration of the cognitive mechanisms underlying lexical access and semantic integration under increased speed conditions.

1.4.4 General Methodological Framework

The following section outlines the overarching methodological principles and statistical approaches employed across all three experiments in this dissertation. By consolidating these shared elements, this framework aims to enhance transparency and ensure consistency in the presentation of the research process.

1.4.4.1 Transparency and openness

In accordance with the standards for quantitative research in psychology established by Appelbaum et al. (2018), the methodology of each experiment is outlined in the respective section, including the determination of sample size, the exclusion of data, the implementation of manipulations, and the measurement of outcomes. The underlying data, the analysis code, and the supplementary materials are permanently available for review at: https://osf.io/bz6mg/.

Experiments 1 and 2 were conducted as part of the author's research stay at McMaster University in Hamilton/Canada. Experiment 3 was conducted at Bergische Universität Wuppertal. Despite the different locations, all three experiments were carried out using the same eye-tracking equipment, the SR Research EyeLink 2k system, ensuring consistency in data collection procedures. Additionally, all experiments were designed and implemented using SR Research Experiment Builder (SR Research, Version 2.4.1), maintaining uniform experimental presentation and data acquisition across studies.

Parts of the data and results presented in this dissertation are linked to external academic works. Specifically, Experiment 1 has been submitted for publication in its modified form as a manuscript (Schwalm et al., 2024, submitted), Experiments 2 and 3 are currently in preparation for submission (Schwalm et al., in preparation a, b). Additionally, partial data from Experiment 3 were included in a Master's thesis, which analyzed a subset of the participant sample and focused on a related research topic (Rohrschneider, 2023).

For clarity and consistent interpretation of the terminology employed, a comprehensive glossary of key terms used throughout this dissertation is provided at the end of the dissertation, before the references, starting on page 153. Terms defined in the glossary are highlighted in *italic* upon their first appearance in the main text.

1.4.4.2 Statistical considerations

Statistical analyses across all experiments were designed to address the complexity of the data while adhering to best practices for robust and reliable modeling in eye-tracking and reading research. For the analyses of all three experiments, the lme4 package (version 1.1–32) within the R statistical computing environment (version 4.0.0, R Core Team, 2020) was utilized to analyze raw fixation duration measures. Generalized linear mixed-effects models (GLMMs) with a Gamma distribution and the identity link were fitted to these measures, treating viewing duration measures as dependent variables. This approach allowed us to bypass the requirement for normally distributed viewing duration data, thereby eliminating the need for any prior data transformation (Lo & Andrews, 2015). The generation of all figures was executed through the utilization of the ggplot package (version 3.2.1).

Initially, models were fitted with the maximal random effects structure, following Barr et al.'s guidelines (2013). In cases where the models failed to converge, the random effect structure was systematically simplified by first removing interactions between random effects and then eliminating slopes. All findings reported in this study are derived from models that successfully converged after this trimming process.

All full models include estimated beta values (β), standard errors (SE), and either the *t*-statistic for comprehension scores, viewing durations, and count measures or the *z*-statistic for all binary variables, as well as the associated *p*-values. All full models are listed in the Appendix. Due to the substantial number of dependent variables and the numerous levels of independent variables, the results of the GLMMs are presented in the form of ANOVA-style summaries. This approach enhances readability and provides a clearer overview of the main effects and interactions. These ANOVA-style reports, which were generated using the anova() function in R, include chi-square values (χ^2) to assess the contribution of each effect to the model's explanatory power, degrees of freedom (*df*) to indicate the model's complexity, and associated p-values to evaluate statistical significance.

2 Experiment 1: Effects of reading speeds on word processing and comprehension

2.1 Introduction

Reading is a dynamic cognitive process where individuals continuously balance the need for efficient information acquisition with the goal of deep comprehension. This inherent tension raises fundamental questions about the limits of human processing capacity, particularly when readers attempt to accelerate their pace.

The present study investigated the critical relationship between *reading speed* and comprehension by addressing two central questions: (1) Does reading faster than the natural average *reading rate* necessarily reduce text comprehension? (2) How does the moment-to-moment reading process adapt when reading faster than normal? These questions are related to the concept of the speed-accuracy trade-off (SAT), which posits that faster performance often comes at the expense of accuracy (see chapter 1.2). In reading, this suggests that prioritizing speed could lead to a loss of comprehension (see chapter. 1.2.2). This concept is in line with the widely held assumption that reading at a speed above the natural rate necessarily leads to superficial processing, up to a point where reading essentially becomes “skimming”, according to Rayner et al. (2016).

Carver's Rauding Theory (1982) proposes an optimal rate of language intake for reading and listening (auding), beyond which comprehension declines. Hausfeld (1981) estimated this rate to be about 290 wpm, while Carver (1982) suggested a threshold of 300 wpm for both modalities. This theory is countered by the observation that reading typically occurs at twice the rate of speaking, suggesting different processing demands for these modalities (Brysbaert, 2019). However, Kuperman et al. (2021) extended this line of research by comparing *natural reading rates* with manipulated listening rates. In their study, 165 proficient English-speaking adults read six texts at their own pace and listened to six (mostly) time-compressed texts at different rates (180-405 wpm). Comprehension remained stable up to 315 wpm for listening, which closely matched the average reading rate of 269 wpm (Brysbaert, 2019). The findings suggest that individuals possess the capacity to process time-compressed auditory speech at rates that exceed the typical speaking speed (see Murphy et al., 2022 for a study on compressed video presentation). The observation that the highest possible listening speed without loss in comprehension is similar to the natural reading speed may indeed be indicative of a shared optimal intake rate, as originally suggested by Carver (1977). While Kuperman et al.'s study highlights potential untapped capacities in listening, it leaves open the question of whether similar capacities exist in reading. Kuperman did not manipulate reading speed, which limits the generalizability of their findings to this modality.

As discussed in Chapter 1.2.2.1, previous studies have examined the impact of task demands and reading instructions on eye movement behavior and comprehension. For instance, instructing participants to skim, scan, or proofread results in distinct eye movement patterns and reading speeds (Biedert et al., 2012; Duggan & Payne, 2011; Kaakinen & Hyönä, 2010; Magliano et al., 1993; Schotter et al., 2014; White et al., 2015). Skimming tends to reduce fixation durations and word fixation probabilities, reflecting a focus on extracting gist rather than detail. In contrast, thorough reading or proofreading has been shown to result in longer fixations and increased *rereading*, indicating deeper processing (Strukelj & Niehorster, 2018).

The effects of task instructions on lexical benchmark effects, such as word length and frequency (see chapter 1.1.1), have also been examined. In particular, it was found that word frequency has no effect on eye movement behavior when searching for specific words in texts (Rayner & Fischer, 1996; Rayner & Raney, 1996). This contrasts with findings that word frequency effects were similar for regular reading and skimming during *first-pass reading* but diminished in later processing stages under skimming conditions. Conversely, word length effects persisted across conditions but were even more pronounced during thorough reading (Kaakinen & Hyönä, 2010; Strukelj & Niehorster, 2018; White et al., 2015). This work demonstrates that word processing is sensitive to task demands.

However, any manipulation of reading instruction poses the inherent problem of compliance. In addition, comprehension questions, which are used to measure understanding, may interact with instructions, making it difficult to disentangle their effects. For example, more superficial processing during skimming might lead to difficulties in answering comprehension questions, prompting more careful reading. When instructions vary, but comprehension questions remain identical (as in Kaakinen & Hyönä, 2010 and Strukelj & Niehorster, 2018), such confounds become particularly challenging. But when both the instructions and the difficulty of the comprehension questions are manipulated (as in White et al., 2015), it becomes problematic to determine which factor is actually responsible for the potential changes.

Additionally, individual differences appear to modulate how participants interpret and implement instructions. In an early work, Laycock (1955) demonstrated that proficient readers could flexibly adjust their speed when instructed, reducing fixations and *regressions* as needed, while less proficient readers maintained a more constant rate.

In view of the limitations in the extant literature, this study's primary objective was to ascertain whether there is a critical text reading speed at which comprehension declines. A secondary objective was to understand how the reading process adapts to variations in speed. To achieve these objectives, the present work investigated moment-to-moment processing as reflected in eye movements and text comprehension under experimentally manipulated reading speeds. A novel line-by-line method was employed to regulate reading speed without constraining local eye movements. Participants were presented with texts at five systematically altered speeds. In addition to these conditions, a baseline regular reading condition was also included. This methodological approach was designed to minimize confounding variables and to directly induce changes in reading speed. Unlike indirect methods that rely on reading instructions, this approach ensured that reading speed is the cause rather than the consequence of changes in reading behavior.

The comprehension of texts was assessed via multiple-choice questions, employing the same comprehension test as Kuperman et al. (2021) thereby enabling a direct comparison of results. Assuming that the natural reading rate aligns with the optimal intake rate, it was predicted that comprehension will decrease at speeds exceeding 270 words per minute (Brysbaert, 2019). Conversely, if comprehension remains stable at higher speeds, this would call into question a strict speed-accuracy trade-off in reading and suggest the presence of as yet unexplored cognitive capacities. Eye movements were expected to adapt to higher speeds, particularly in late processes, indicating reduced capacity for text integration and reanalysis. The hypothesis guiding this focus was that early routines of information acquisition and *orthographic processing* may prove to be relatively robust, while the full lexical processing of more difficult words and the subsequent information integration may reach their limits earlier under the demands of higher and higher speeds.

2.2 Methodology

Participants

To ensure that the study was adequately powered to detect a meaningful difference in reading comprehension across different speed conditions, a power analysis was conducted using the power.prop.test (version 3.6.2) function in R. The comprehension rate for regular reading, as reported by Kuperman et al. (2021), was used as a reference point (baseline comprehension accuracy = 0.66 or 8 out of 12 questions), as the same text material and comprehension questions were employed. It was aimed to provide sufficient power to detect even the smallest meaningful decrease in this baseline comprehension, to an accuracy of 0.577

(7 out of 12 questions). The power analysis was conducted with a difference of 0.083 units in comprehension accuracy (0.666 – 0.577), the significance level (α) of .05 and the power of .80 as parameters. The resulting calculation indicated that 422 observations were necessary to achieve sufficient statistical power. Each observation was based on a comprehension question with four possible answers, resulting in a chance level of 25%. Each participant answered 72 questions in total, with 6 questions per text and two texts per speed condition. Given that each participant contributed 12 observations per speed condition (6 questions per text x 2 texts), a minimum of 35 participants were needed to achieve the required 422 observations.

Forty-six students at McMaster University (Hamilton/Canada) participated in the experiment. All participants were native English speakers, defined as individuals who began acquiring English before the age of schooling (four years old) and rated their English proficiency in reading, writing, and comprehension at a minimum of 7 out of 10. Additionally, participants had normal or corrected-to-normal vision and were unaware of the experiment's objectives. Participants' average age was 19.82 years (*SD* = 1.3). Of these, 37 participants identified as female, 8 as male, and 1 selecting other. Participants received partial course credit as compensation for their involvement.

Materials

The textual stimuli for this study were selected from the Rutgers University Oral History Archives, featuring personal life experiences. These narratives were originally part of the Lectures, Interviews, and Spoken Narratives (LISN) test for listening comprehension (Sommers et al., 2011; Tye-Murray et al., 2008). From the 16 available narrative passages, 12 were chosen, with word counts ranging from 427 to 671 words per passage (*Mdn* = 619 words).

Reliability analyses revealed moderate to high internal consistency across a wide age range (20–89 years), with Cronbach's α values exceeding .70 for all groups (Sommers et al., 2011). Readability, measured by Flesch-Kincaid scores, ranged from 4.3 to 8.6 (*M* = 6.38, *SD* = 1.47), which corresponds to a sixth-grade reading level. The average word length was 4.1 letters (inter-text range for average word length: 3.8–4.5), predicting a reading rate of 267 wpm based on Brysbaert's (2019) formula.

Each narrative passage was followed by six comprehension questions designed to assess various levels of understanding. These questions were categorized into three types: information questions, which required participants to recall specific details from the text; integration questions, which assessed the ability to synthesize multiple pieces of information; and inference questions, which tasked participants with deriving implications from the text (Sommers et al., 2011). The employment of these three question types permitted the assessment of comprehension on the level of propositional representation and situation model as delineated by Kintsch (1988) (see Chapter 1.1.2). Each passage included two questions of each type, totaling six questions per passage. The questions were presented in a multiple-choice format with four options per question. Throughout the experiment, participants answered a total of 72 questions, with 12 questions for each reading speed condition (two passages per condition followed by six questions each). The full text material and comprehension questions can be found in Appendix A1.

Apparatus

Eye movements were recorded using an SR Research Eyelink 2k eye tracker running at a sampling rate of 2000 Hz. Participants were seated approximately 70 cm away from a 21-inch CRT monitor with a screen resolution of 1682 x 1050 pixels and a refresh rate of 120 Hz. A chin and forehead rest were used to minimize movements of the head. At this distance, three characters subtend approximately 1° of visual angle.

Procedure

The study was approved by McMaster University's ethics committee (protocol #2396). The data collection process was performed in 2022. Prior to the initiation of the study, participants were provided with comprehensive information regarding the procedure and gave their written consent to the conduct of the study and the use of the data collected.

At the beginning of the experiment, participants completed the Language Experience and Proficiency Questionnaire (LEAP-Q; Marian et al., 2007), Canadian version. The questionnaire assessed participants' language acquisition history, contexts of acquisition, present language use, language preference and proficiency (see Appendix A2).

Participants then took the Test of Word Reading Efficiency Second Edition (TOWRE-2; Torgesen et al., 2012) to assess their sight word efficiency and phonemic decoding skills. This test requires participants to read as many words as possible from a list of 104 words within 45 seconds and a separate list of 63 non-words within the same time interval. A score calculated from the total number of words and non-words read out loud correctly provided an indication of *word reading efficiency*.

Following these assessments, the eye tracking experiment was initiated. Participants began by reading two texts presented in random order at their natural reading rate, without any text manipulation, to establish a baseline. In this dissertation, the term "reading rate" is employed to signify the natural reading rate in the condition without manipulation, whereas the term "reading speed" is utilized to denote the experimentally manipulated rate at which the stimuli are presented to the participants.

Participants were instructed to read carefully and were informed that questions would follow each text. Subsequent to the baseline phase (two texts read at their natural rate), participants completed 10 additional texts presented in random order. Reading speed manipulation was achieved using the newly developed line-by-line technique. This method involved presenting a paragraph in grey font, with only one line highlighted in black, with the highlighted line moving at a predefined speed line-by-line from top to bottom (see supplementary material for a video demonstration of the methodology). This allowed for manipulation of reading speed with minimal disruption to the reading process.

The duration of each line's highlight was determined by the number of characters in the line and average word length in the texts (4.1 letters), ensuring alignment with the target words per minute rates. The speed at which the highlighting moved over the text was randomly assigned to each text, with speeds set at 225, 270, 350[5], 360, and 405 wpm. Speeds were selected such that the slowest speed was slower than the natural reading rate for most readers, the second slowest was approximately at the average natural reading rate, and the remaining speeds represented slight to moderate to substantial increases, up to 150% above the average natural reading rate (Brysbaert, 2019). The difference in 45 wpm between adjacent speeds corresponds to 20% of the lowest speed.

It is important to note that this study was not designed to assess the efficacy of training in speeded reading. The reading speeds were presented in a randomized order, rather than in a progressive sequence (as is the case in Experiment 3). This design avoids confounding effects of habituation, fatigue or training with the speed level variable.

Prior to the start of each trial, participants received the following instructions: "In this experiment, you will be presented with various texts. Please read them carefully. You will be guided through the text line by line by highlighting the text to be read in black. The remaining text will be displayed in gray. Please make sure to always read only the black text. Follow this marking line by line through the text and adjust your speed accordingly."

The experiment commenced with a nine-point calibration. At the onset of each trial, participants were presented with a fixation cross in the same position as the first letter of the text. Tracker accuracy was monitored throughout the experiment, and recalibrations were performed when calibration errors exceeded 0.3 degrees of visual angle.

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[5] The intended speed was 315 wpm but due to a programming error it resulted in an effective speed of 350 wpm.

Variables

Dependent variables in this study (see Inhoff & Radach, 1998, for a general discussion of eye movement measures) were: *fixation probability* (the likelihood of a word being fixated, i.e., the inverse of the more frequently used *skipping* probability), *first fixation duration* (duration of the first fixation on the target word), *gaze duration* (sum of durations of all fixations on the word before the gaze moves to another word), *total reading time* (sum of all fixation durations on the word), probability of a *refixation* (likelihood of more than one fixation on the word in one gaze), probability of a *regression-in* (likelihood of the incoming saccade to originate from a fixation position to the right of the current word), and text comprehension.

The critical independent variable was speed, a categorical factor with six levels (baseline natural reading rate and five manipulated speeds). The first set of analyses below examined the main effect of speed on the dependent variables.

To gain further insight into how lexical benchmark effects are influenced by reading speed, the interactions with word frequency and word length (in letters) were examined. Word frequencies were derived from the SUBTLEX-US corpus (Brysbaert & New, 2009), which is based on 51 million words from subtitles of American films and media.

In addition to investigating these word-level effects, the study sought to explore individual differences among participants. These differences were defined by *baseline reading rate* and *word processing efficiency*. Baseline reading rate was calculated from the average reading rates of the two texts read in the baseline condition. Word reading efficiency was determined by the sum of the two scores from the TOWRE-2 test: sight word efficiency and phonemic decoding efficiency scores. Specifically, the study investigated whether individual baseline reading rate and word reading efficiency could predict text comprehension at different reading speeds.

Statistical Considerations

For a comprehensive overview of the statistical considerations that pertain to all experiments, please refer to Chapter 1.4.4.

2.3 Results

Four participants were excluded from the analyses due to their baseline comprehension scores being below 30%: These scores were not significantly different from the chance level of 25% as indicated by the one-sample proportion test (see Kuperman et al., 2021). Therefore, the results presented are based on data from 42 participants. This sample size exceeds the requirement for a well-powered experiment (see power calculations in Chapter 2.2). These participants had an average baseline sentence comprehension score of 53% (range = 33%–92%).

Following conventional criteria, fixations shorter than 80 ms or longer than 600 ms were eliminated (4.48% of total fixations). Gaze durations exceeding 1,000 ms (0.23% of trials) and total reading times over 1,500 ms were also excluded (0.17% of trials). Additionally, trials where a word was fixated more than six times (0.11%) or where no saccade amplitude was detected (0.75%) were excluded. These criteria left 160,203 trials (94.22% of the data) available for analysis (see Inhoff & Radach, 1998, for a discussion of data selection criteria).

The two primary objectives of the analyses were to identify the reading speed at which significant declines in text comprehension occurred and to examine the adaptivity of eye movement patterns across varying speed levels. The statistical approach to meet these objectives amounted to identifying the speed at which there were significant changes in comprehension and eye movement patterns compared to the subsequent, slower speed. Table 1 lists the descriptive statistics for all reported eye movement measures and comprehension scores under different speed conditions.

To compare the effects of different speeds, backward difference contrast coding was used. This coding resulted in stepwise comparisons of successive speeds: coefficient labeled Speed 1 compared the baseline (natural reading) to 225 wpm, coefficient labeled Speed 2 compared 225 wpm to 270 wpm, and so on, with coefficient labeled Speed 5 showing the comparison of 360 wpm to 405 wpm.

Effects of reading speed on Comprehension

Reading comprehension scores were calculated for each participant and each speed condition and expressed as percentages of correct responses based on the total responses. As shown descriptively in Table 1, comprehension scores remained relatively stable across different speeds and fluctuated around 57%. A noticeable drop in comprehension, down to 49%, was observed only at the highest speed of 405 wpm. A corresponding LMM confirms these observations: comprehension is significantly higher at 360 wpm compared to 405 wpm, while no significant differences (at the 5% level) were observed across the successive lower speeds (see Appendix B1 for the full model). Until the readers reach a speed of approximately 150% of the average natural reading speed, there does not appear to be any loss in the comprehension of texts.

Table 1

Descriptive statistics of eye movement measures and comprehension scores by reading speed (Experiment 1)

	Speed					
	Baseline *M* (*SD*)	225 wpm *M* (*SD*)	270 wpm *M* (*SD*)	350 wpm *M* (*SD*)	360 wpm *M* (*SD*)	405 wpm *M* (*SD*)
Comprehension (percentage)	56 (50)	58 (49)	56 (50)	58 (49)	57 (50)	49 (50)
Fixation probability	.65 (.48)	.65 (.48)	.61 (.49)	.55 (.50)	.54 (.50)	.43 (.49)
First fixation duration (ms)	210 (79)	224 (88)	220 (84)	212 (80)	211 (78)	201 (71)
Gaze duration (ms)	230 (104)	246 (116)	240 (111)	229 (100)	228 (100)	211 (84)
Total reading time (ms)	300 (184)	313 (191)	287 (164)	255 (131)	252 (129)	223 (101)
Refixation probability	.10 (.30)	.10 (.31)	.10 (.30)	.09 (.28)	.08 (.28)	.06 (.24)
Regression-in probability	.14 (.35)	.16 (.37)	.15 (.36)	.13 (.34)	.13 (.34)	.10 (.31)

Exploration of individual differences. As an additional level of analysis, individual characteristics of participants were incorporated, focusing on the impact of baseline reading rate and word reading efficiency. The mean reading rate across all participants was 273 wpm ($SD = 71.13$), a value that comes very close to Brysbaert's (2019) general estimate of 260 wpm. The lowest individual reading rate was 128 wpm, while the highest was 467 wpm. Word reading efficiency was determined by calculating the sum of the two subtests of the TOWRE-2: sight word efficiency and phonemic decoding skills. These factors were analyzed to ascertain the impact of individual differences in reading proficiency on comprehension across the varying reading speeds.

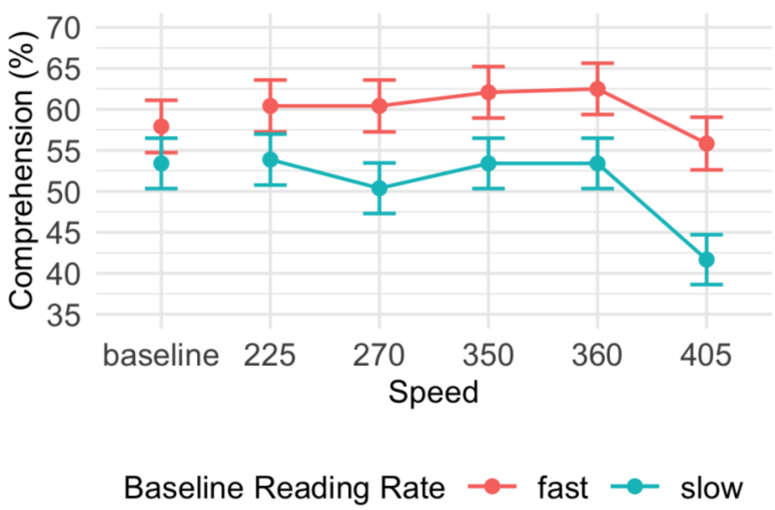
A correlation analysis revealed a significant but small positive relationship between baseline reading rate and word reading efficiency scores, $r = .055$, $t(175299) = 23.18$, $p < .001$, 95% CI [.051, .060]. This indicates that participants with higher TOWRE scores tended to read slightly faster, though the effect size suggests a weak association.

Figure 1 and Figure 2 provide a nuanced depiction of comprehension scores as a function of reading speed and either individual readers' baseline reading rate (Figure 1) or word reading efficiency (Figure 2). For illustrative purposes, the figures categorize participants into faster and slower readers as well as high and low word reading efficiency groups based on median splits. However, the actual models incorporated these variables as continuous measures to more accurately capture their effect on comprehension.

Both figures indicate that text comprehension remained largely stable even at high reading speeds, with a notable decrease only at the top speed level of 405 wpm. The data also revealed a consistent trend: participants with faster baseline reading rates and higher word reading efficiency tend to achieve better comprehension scores. The corresponding LMMs confirmed these observations: there were significant main effects of baseline reading rate and word reading efficiency on reading comprehension, see Table 2 for ANOVA-style results; full model details are provided in Appendix B2 & B3). Both very fast and highly efficient word readers maintained their advantage in comprehension even at high speeds. Additionally, there was a significant interaction between baseline reading rate and the speed manipulation, indicating that for faster readers, comprehension drops to a smaller extent at the highest speed. This suggests that faster readers and readers with high word reading efficiency still had some reserve capacity left for text comprehension, even when faced with significant speed demands.

Figure 1

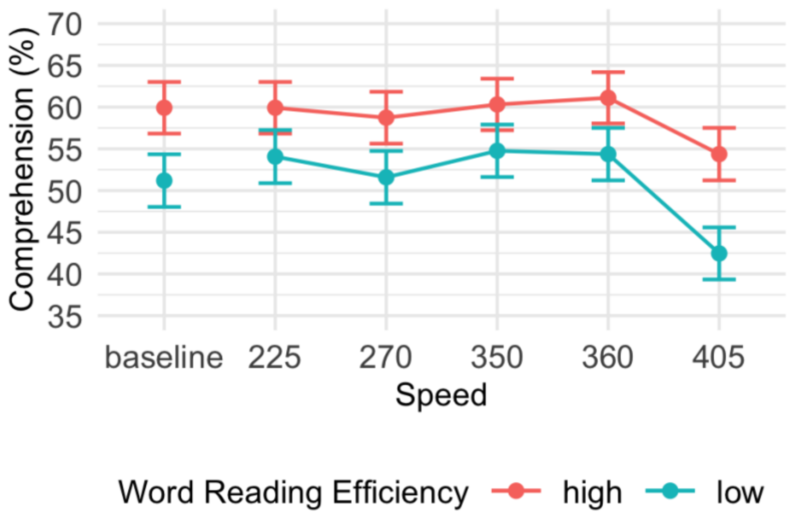
Effect of reading speed and baseline reading rate on text comprehension



Note. Error bars represent ±1 SE.

Figure 2

Effect of reading speed and word reading efficiency on text comprehension



Note. Error bars represent ±1 SE.

Table 2

ANOVA-style summary of comprehension as a function of reading speed and baseline reading rate (A), and reading speed and word reading efficiency (B) (Experiment 1)

	Factor	χ^2	*Df*	*p*
A	Speed	**14.68**	**5**	**.01**
	Baseline wpm	**8.51**	**1**	**<.001**
	Speed*Baseline wpm	**13.79**	**5**	**.02**
B	Speed	**14.97**	**5**	**.01**
	Word Reading Efficiency	**5.50**	**1**	**.02**
	Speed*Word Reading Efficiency	2.20	5	.82

Note. Values with p< .05 are presented in **bold**.

Effect of reading speed on eye movements

Table 1 presents a summary of how eye movements change with the different speed conditions, while Figure 3 further illustrates the composition of total reading time, broken down into first fixation duration, refixation time, and rereading time across various levels of speed. It appeared that first fixation duration remained relatively stable across the speed range, and the shorter total reading times at higher speeds were mainly due to reduced refixation and, predominantly, lower rereading times. Figure 4 shows the probability of fixating from zero to more than three times on a word. The fixation probability decreased, the likelihood of skipping (zero fixations on the word) increased, and the total number of refixations also decreased at higher speeds.

GLMMs indicated that all oculomotor measures were significantly affected by the manipulation of reading speed (see Appendix B4 – B9 for the full models and Table 3 for the ANOVA-style results including word length and frequency effects). First fixation durations and gaze durations were longest at the 225 wpm reading speed level and then systematically decreased with each subsequent speed increase, except for the comparison between 350 and 360 wpm. However, the numerical differences between speed increments are relatively moderate, with a maximum decrease of 12 ms for first fixation duration (about 5 percent points of relative change) and 17 ms for gaze duration (about 7 percent points) between 360 and 405 wpm. Total reading time showed a significant effect of reading speed across all conditions. It systematically decreases from 225 wpm throughout higher speeds, with the largest decrease observed again between 360 and 405 wpm (30 ms or 12% of relative change). Fixation probability and regression-out probability also decreased when the manipulated speed increased, except for the step from 350 wpm to 360 wpm. Notably, there was a significant drop in fixation probability from 360 wpm to 405 wpm, with an 11% decrease. Refixation probability decreased between the 225 wpm and 270 wpm, with an even more pronounced reduction between the 360 wpm and 405 wpm (2% of relative change). These results indicate that all oculomotor measures were affected by the reading speed manipulation, with the most substantial effects observed for total reading time and fixation probability at the highest speeds.

Figure 3

First fixation duration, refixation duration and rereading time as a proportion of total reading for the different speed conditions

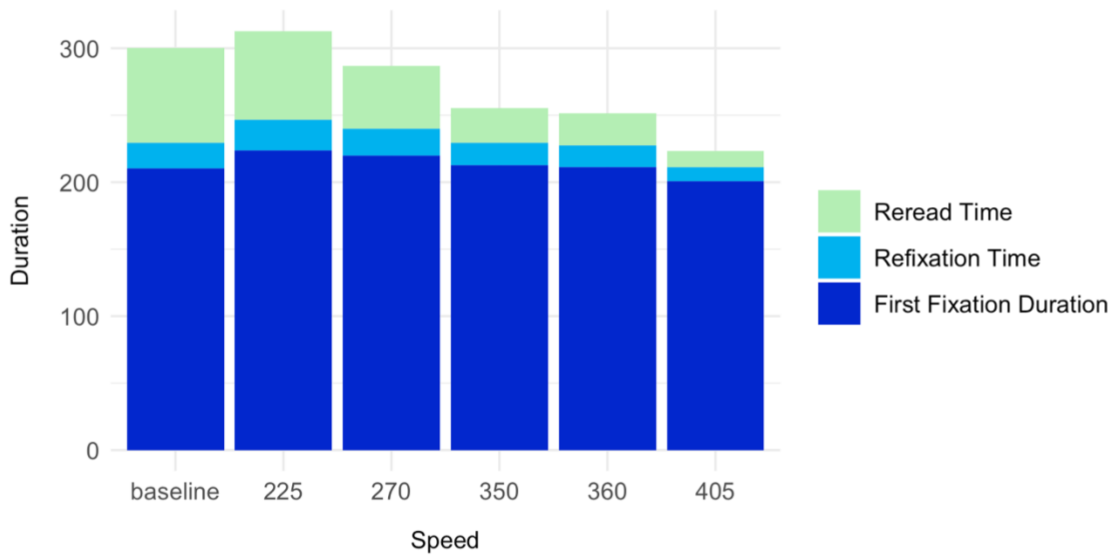
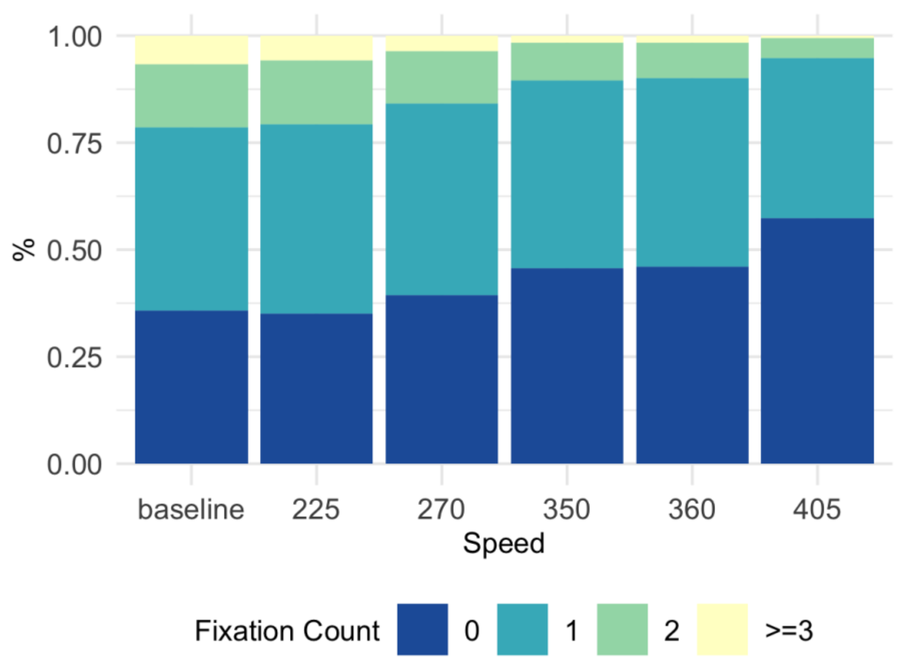


Figure 4

Proportion of fixation count per word for the different speed conditions



Reading speed and lexical benchmark effects. The next step was to examine the effects of reading speed on word-level effects found robustly in the eye movement record, i.e., the lexical benchmark effects like word length and frequency (Kliegl et al., 2004). It was hypothesized that reading speed would modulate the relationship between these word characteristics and eye movement behavior, as previous research indicates that frequency and word length effects, while ubiquitous in natural reading, can be influenced by reading tasks (see chapter 1.2.2). To investigate their persistence across varying reading speeds, word frequency and word length were included as variables in the GLMM analyses. Detailed outputs are available in Appendix B10 - B15, with an ANOVA-style report summarized in Table 3.

Word length. Analyses revealed that, with the exception of first fixation duration and regression-in, all oculomotor measures exhibited significant main effects of word length. Specifically, longer words resulted in slightly increased fixation durations, fewer fixations, and reduced refixation probabilities (see Figure 5). Additionally, interactions with reading speed were evident. At lower speeds, word length had a smaller impact on first fixation durations but a larger effect on refixation probability. This corresponded to stronger word length effects on total reading time at slower speeds. As reading speed increased, the approach to processing longer words shifted. At slower speeds, longer words were managed with more refixations and extended total reading times, while at higher speeds, initial fixations on longer words were prolonged, reducing the need for subsequent refixations. This was especially salient in the transition from a decrease to an increase in first fixation for longer words in the faster reading speed conditions (see Figure 5A).

Word frequency. Findings also indicated significant main effects of word frequency on all oculomotor measures except regression-in (see Figure 6). The interaction patterns show a similar trend to those observed for word length. For first fixation duration, the effect of word frequency was weaker at lower speeds and strengthened at higher speeds, with the only significant interaction found in this measure (see Figure 6A). Notably, low-frequency words received longer first fixation durations, especially at higher speeds. While refixation probability and total reading time decreased overall with increasing reading speed, the frequency effect persisted (see main effects), exhibiting only a slight trend towards reduction (see Figure 6C and E). Therefore, even at higher reading speeds, the strategy for lexical processing as expressed in word frequency remained relatively stable.

Table 3

ANOVA-style summary of eye movement measures as a function of reading speed, word length and word frequency (Experiment 1)

Measure	Factor	χ^2	*df*	*p*
Fixation probability (%)	Speed	**8375.32**	**5**	**<.001**
	Word length	**1675.95**	**1**	**<.001**
	Word frequency	**121.58**	**1**	**<.001**
	Speed: Word length	**23.01**	**5**	**<.001**
	Speed: Word frequency	6.89	5	.23
	Word length: frequency	**8.49**	**1**	**<.001**
Refixation probability (%)	Speed	**494.13**	**5**	**<.001**
	Word length	**523.26**	**1**	**<.001**
	Word frequency	**56.02**	**1**	**<.001**
	Speed: Word length	9.59	5	.09
	Speed: Word frequency	4.86	5	.43
	Word length: frequency	0.01	1	.99
First fixation duration (ms)	Speed	**1061.57**	**5**	**<.001**
	Word length	1.42	1	.23
	Word frequency	**32.76**	**1**	**<.001**
	Speed: Word length	**12.49**	**5**	**.03**
	Speed: Word frequency	**21.94**	**5**	**.01**
	Word length: frequency	3.31	1	.07
Gaze duration (ms)	Speed	**1686.27**	**5**	**<.001**
	Word length	**155**	**1**	**<.001**
	Word frequency	**84.85**	**1**	**<.001**
	Speed: Word length	10.29	5	.07
	Speed: Word frequency	**12.25**	**5**	**.03**
	Word length: frequency	**23.62**	**1**	**<.001**

Experiment 1

Measure	Factor	χ^2	*df*	*p*
Total reading time (ms)	Speed	**6466.99**	**5**	**<.001**
	Word length	**185.01**	**1**	**<.001**
	Word frequency	**114.53**	**1**	**<.001**
	Speed: Word length	**57.87**	**5**	**<.001**
	Speed: Word frequency	10.66	5	.06
	Word length: frequency	**22.15**	**1**	**<.001**
Regression-in (%)	Speed	**1408.5**	**5**	**<.001**
	Word length	**22.42**	**1**	**.59**
	Word frequency	0.55	1	.06
	Speed: Word length	**14.99**	**5**	**<.001**
	Speed: Word frequency	4.84	5	.44
	Word length: frequency	**4.62**	**1**	**.03**

Note. Values with $p < .05$ are presented in **bold**.

Figure 5

Effects of reading speed and word length on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), and regression-in probability (F) (Experiment 1)

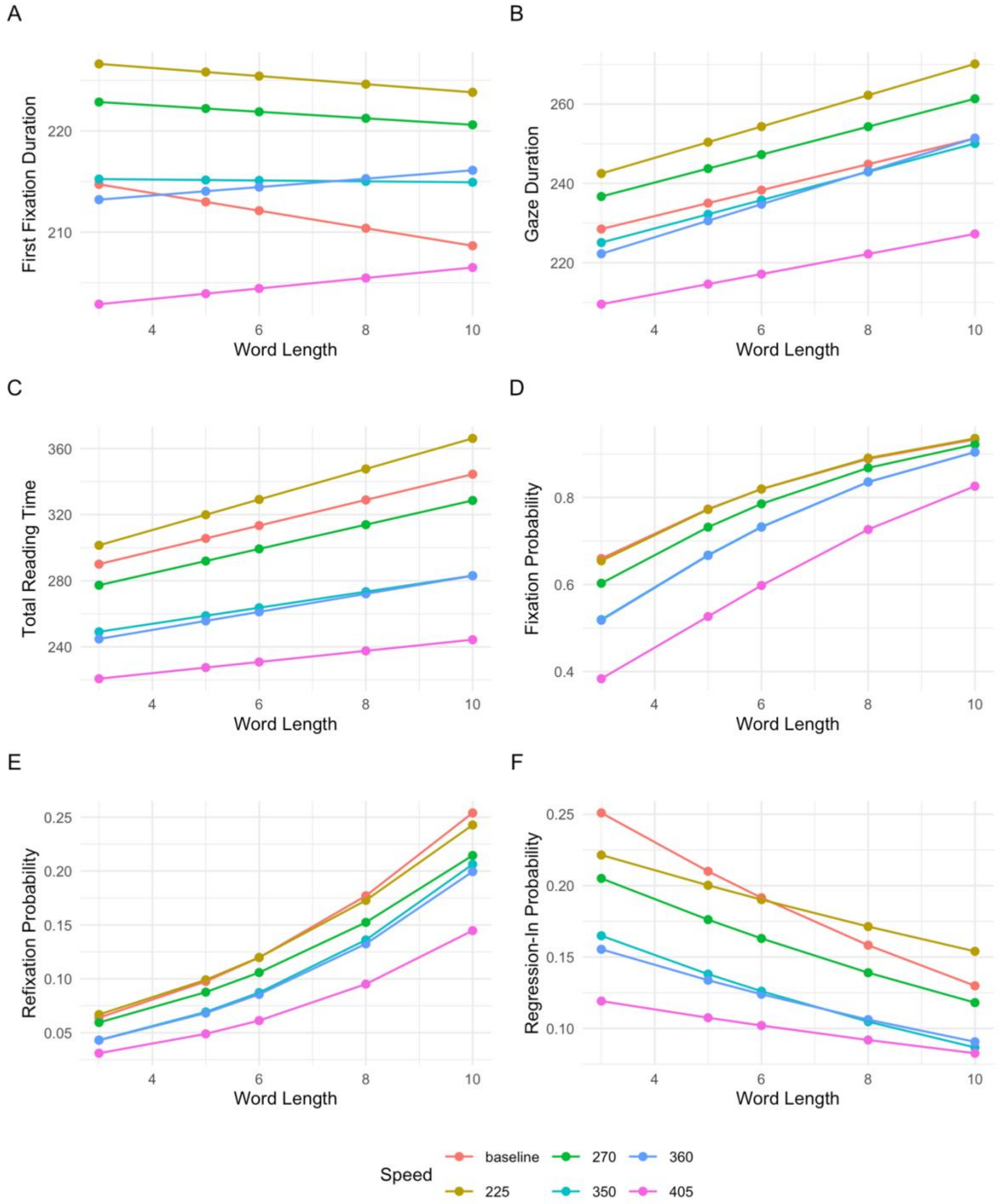
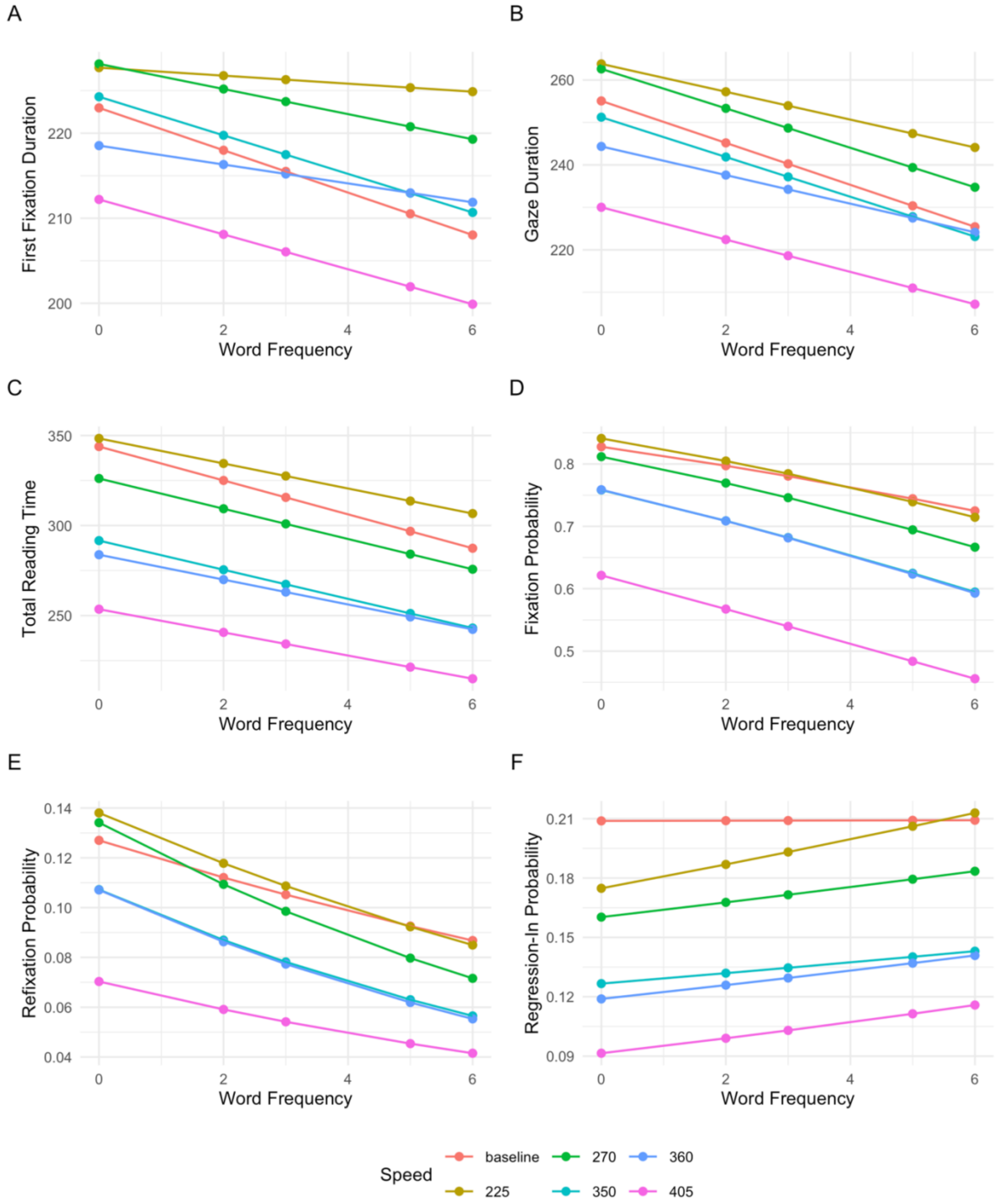


Figure 6

Effects of reading speed and word frequency on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), and regression-in probability (F) (Experiment 1)



Supplementary analyses

Distribution of fixations in the paragraph. The findings indicated that as reading speeds increase, the number of words fixated decreased (see above). Although participants were instructed to read only the text on the highlighted line, it is possible that they did not fully adhere to these instructions. Particularly at higher speeds, where comprehension is known to decline, participants may have struggled to keep up with the rapid pace and skipped large portions of the text instead of reading continuously. This tendency has been documented in studies involving skimming instructions under time constraints, as evidenced by Duggan's (1990) findings. In this study, readers exhibited a propensity to prioritize the initial sections of texts and often bypassed subsequent content.

To examine whether fixations were distributed unevenly across the paragraph, the current analysis used the relative position of each word within its paragraph as a continuous predictor. This allowed for a fine-grained assessment of whether fixation probability decreased for words occurring later in the paragraph. For visualization purposes, paragraphs were divided into four equal sections, and fixation probabilities were averaged across these bins (see Figure 7).

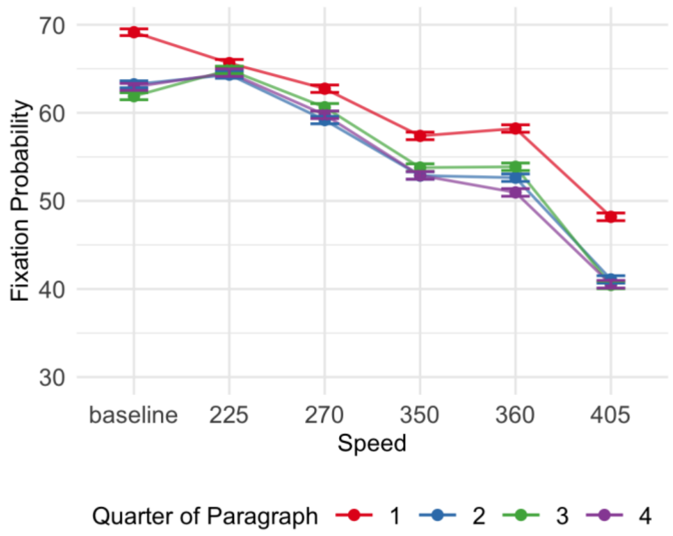
The results revealed significant main effects of reading speed and word position within the paragraph, as well as a significant interaction (see Table 4 for ANOVA-style results and Appendix B16 for the full model). As previously reported, fixation probability declined with increasing speed. In addition, a main effect of word position showed that words appearing later in the paragraph were fixated less frequently. As visible in Figure 7, this trend was most pronounced when comparing the first quarter of the paragraph to all subsequent sections.

The interaction between speed and word position indicated that the word position effect was most pronounced in the baseline condition, with fixation probabilities decreasing more steeply across the paragraph compared to the 225 wpm condition. A smaller interaction effect also suggested that word position played a slightly stronger role at 360 wpm than at 405 wpm.

Crucially, there was no indication that participants systematically avoided or skipped the final sections of the paragraph at higher speeds. This suggests that reading behavior did not deteriorate toward the end of the paragraph, and that readers were generally able to adapt to the constraints of the speed manipulation.

Figure 7

Effect of reading speed and position within the paragraph (visualized in four sections) on fixation probability (Experiment 1)



Note. Error bars represent ±1 *SE*.

Table 4

ANOVA-style summary of fixation probability as a function of reading speed and word position in paragraph (Experiment 1)

Factor	χ^2	*df*	*p*
Speed	**6944.36**	**5**	**<.001**
Word position in paragraph	**77.60**	**1**	**<.001**
Speed*word position in paragraph	**15.18**	**5**	**.009**

Note. Values with p < .05 are presented in **bold**.

2.4 Discussion

Experiment 1 examined how experimentally induced changes in reading speed impact text comprehension and eye movements in native English speakers. Specifically, it sought to determine whether increasing reading speed beyond an average natural reading rate necessarily results in a decline in comprehension and how the reading process adapts to these varying speeds. Additionally, it was analyzed how lexical benchmark effects, such as word length and frequency, were modulated by reading speed, and explored how individual differences in reading proficiency impacted text comprehension.

Reading speed and comprehension

The concept of an optimal language intake rate, as proposed by Carver (1977, 1982) in his Rauding Theory, suggests that there is a specific rate for both reading and listening that maximizes the efficiency of information-processing both in reading and listening without a loss in comprehension. It was hypothesized that this intake rate would be analogous to the natural reading rate (Carver, 1982; Kuperman et al., 2021). However, the present findings challenge this assumption. Text comprehension remained relatively stable across a broad range of reading speeds, with a significant decline occurring only at the highest speed tested (405 wpm). This indicates that readers can sustain comprehension at speeds well above the average natural reading rate, which has been estimated at around 268 wpm for fiction reading (Brysbaert, 2019). The current findings align with the work of Kuperman et al. (2021; see also Murphy et al., 2022), who observed reserve processing capacities in auditory comprehension under accelerated speech conditions. In a similar vein, findings of this study implied the existence of a reserve capacity in visual-linguistic processing, which enabled readers to sustain comprehension at moderately to substantially elevated speeds.

The decline in comprehension at 405 wpm likely reflects a cognitive threshold where the demands of accelerated reading surpass the resources available for effective text integration. This finding is in harmony with the cognitive load theory, which posits that processing limitations are reached when the demands of a task exceed the capacity of working memory (Sweller, 2011). In contrast to a moderate speed increase, which may represent an equilibrium between processing efficiency and effort, very high speeds may force readers to allocate more resources to lexical access and sentence parsing, leaving fewer resources for constructing a coherent mental representation of the text.

The findings further underline the pivotal influence of individual variability in reading, both from a procedural (information processing) and comprehension (memory) perspective. Notably, word reading efficiency was strongly linked to better comprehension, suggesting that individual differences in word reading efficiency play a significant role in how well readers adapt to changes in reading speed.

Looking at the reading rate in the baseline condition, findings align with Brysbaert (2019) in showing no significant correlation between the natural reading rate and comprehension (see also Thalberg, 1967). However, there was a trend suggesting that individuals with higher natural reading rates also might have slightly better comprehension. Although higher baseline reading rates were associated with generally better comprehension across all speeds, a significant decline in comprehension was observed between 360 and 405 wpm. This appears to indicate that beyond a certain threshold, reading speed impairs the ability to fully integrate information, regardless of the reader's initial skill level.

Adaptivity of eye movements as a result of reading speed

Experiment 1 demonstrated that eye movement patterns undergo substantial adaptation when reading speed is adjusted. While it was expected that eye movements would change to accommodate faster text presentations, it was less clear which specific eye movement parameters would be most affected. As it turned out, all eye movement measures, particularly those reflecting later stages of reading, underwent significant changes with increasing speed.

The largest differences were observed in *total viewing time* and *fixation probability* when comparing speeds of 360 and 405 wpm. These findings indicate that as reading speed increases, the tendency to reread words (usually after a regressive saccade) decreases, and visual attention may broaden to encompass more information within shorter periods (see Kaakinen & Hyönä, 2010). In their study comparing proofreading and regular reading, these authors found that proofreading, which requires slower, more deliberate reading, resulted in longer fixation durations, more fixations, and shorter saccades. This aligns with the results of Experiment 1, as all eye movement measures exhibited a shift in response to changes in speed, with late-stage measures demonstrating a particularly strong sensitivity to these alterations.

As the present work is the first using the novel line-by-line technique, there was no prior research that could be directly compared. To some extent, the findings were similar to those of Strukelj and Niehorster (2018) who discovered that skimming resulted in shorter average fixation durations, a greater number of words skipped, and prolonged total reading times. However, their work revealed only slight effects on first-pass oculomotor measures, with no effect on first fixation duration. In contrast, White et al. (2015) reported longer fixation durations for first-pass and rereading times in regular reading compared to skimming (scanning for absent topics). They further observed that first-pass reading times for relevant information were shorter during skimming, while late eye movement measures and average fixation duration remained unchanged.

The findings of White et al. indicate that during the process of skimming for specific information, readers tend to rely on a shortened first-pass reading behavior, which facilitates rapid but relatively superficial processing. Upon the detection of relevant information, the participants transitioned to a regular reading behavior, exhibiting no discernible differences in late measures such as rereading. In the context of Experiment 1, it was neither necessary nor advisable to implement such a shift, given that the pertinent information was distributed in a balanced manner and the objective was to achieve a comprehensive understanding of the text. The results indicate that even at high reading speeds, readers adapted to the demands of the task and retained the required level of comprehension. In the case of skimming, a more superficial understanding is completely sufficient. There are more reasons why a direct comparison with the work of White et al. is difficult, including the level of text analysis (sentence-level versus paragraph-level reading) and the lack of precise words-per-minute metrics and comprehension assessments in their study.

In Strukelj and Niehorster's (2018) work, the skimming instruction led to speeds nearly double those of regular reading and a notable decline in text comprehension. In contrast, the current work found that readers could maintain high comprehension levels despite adaptations in eye movements at increased, but not extreme, reading speeds. As previously discussed, while eye movements adapt to higher reading speeds and these patterns resemble those seen in skimming, comprehension remained intact up to a specific threshold.

The investigation extended beyond word-level processing to examine whether readers could maintain pace with the line-by-line highlight, or if the accelerated speed resulted in the skipping of specific paragraph sections. However, an observation revealed that as reading speed increased, readers fixated less frequently but still maintained pace with the indicated speed.

A notable finding was the considerably elevated probability of fixation in the initial segment of a paragraph relative to the subsequent text, a pattern also reported under normal reading conditions by Strukelj and Niehorster (2018). This observation may be attributed to the establishment of a situation model that is as precise as possible at the onset of a content section, with the objective of generating context for the subsequent content. The contextual information thus generated can potentially promote accelerated processing in the form of expectations, resulting in a decline in fixation rates.

These findings lend support to the proposition that the line-by-line technique is indeed suitable for manipulating reading speed while allowing for a reading process that is close to natural reading.

Lexical benchmark effects. To understand how word processing is maintained across varying reading speeds, word frequency and word length effects were examined. Results of Experiment 1 indicate that these effects remained largely intact even at high speeds, suggesting that effective lexical access can occur at speeds as high as 405 wpm. This aligns with White et al. (2015) and Strukelj and Niehorster (2018), who reported that frequency effects in first-pass reading times were preserved in tasks that are associated with higher speeds, such as topic scanning and skimming. This suggests that the initial stages of word processing, including orthographic processing and lexical access, are remarkably robust and can withstand variations in speed and task demands.

However, the study also showed that as reading speed increased, processing strategies shifted to deal with longer and less frequent words. Results indicate that the frequency effect on initial fixation duration became more pronounced at higher speeds. Together with the finding that rereading decreased as speed increased, this suggests that at higher reading speeds, more emphasis was placed on initial processing to reduce the need for later reanalysis. This interpretation was supported by the pattern found in the baseline condition, where longer words received shorter initial fixations but were refixated more frequently. At higher speeds, this pattern was reversed: longer and less frequent words received longer initial fixations, while the effect on refixations decreased for longer words.

A comparison of the results for slower speeds with studies in which proofreading was induced is of interest, as the reading speed is also reduced in these cases. In Kaakinen and Hyönä's (2010) study, proofreading led to enhanced frequency and word length effects in gaze duration, with additional word length effects emerging in refixation probability. In contrast to the current study, where frequency effects became more pronounced at higher speeds, Kaakinen and Hyönä (as well as Strukelj & Niehorster, 2018) observed stronger frequency effects during slower reading. However, the present findings align with their observation that longer words were refixated more often at slower reading speeds, suggesting that readers allocate more time to processing complex lexical items when reading at a reduced pace. The observed differences in reading times provided support for the hypothesis that proofreading does not exclusively reflect reading speed, but rather modulates information processing itself. Due to the emphasis on orthographic processing, in which bottom-up processes are particularly relevant for recognizing errors such as transposed letters, initial word processing is more challenging and therefore requires more time. In contrast, utilizing a slower reading speed did not lead to a fundamental change in the focus of processing. When reading at a slower pace, there was sufficient time for refixations, thereby allowing the initial fixation to occur without necessitating complete lexical access. Conversely, when reading at faster speeds, the time available for refixations became limited, prompting the initial fixation to be adjusted upwards to facilitate lexical access within a single fixation.

In a similar vein, the enhanced reading speeds observed can be compared to experiments in which participants were instructed to skim or engage in topic scanning, resulting in elevated reading speeds. Concerning the frequency effect, Strukelj and Niehorster (2018) identified significant main effects of word frequency for initial reading but also for late reading measures, though these effects did not interact significantly. Conversely, White et al. (2015) observed diminished frequency effects in late reading measures during topic scanning. These findings were consistent with the present results, which demonstrated relatively stable frequency effects, particularly in first-pass reading measures, with only a slight reduction in total viewing time at higher speeds. Lexical access seemed to remain effective even at highly elevated reading speeds, but the results also pointed to a direction that higher-level integration may fall somewhat short, since late processes seem to be shortened.

Regarding word length effects, Strukelj and Niehorster (2018) similarly reported weaker effects on total reading time and fewer refixations during skimming. However, in their study, word length effects in first-pass reading measures remained stable across task and speed conditions, which is consistent with the present findings. These results further support the notion that while initial lexical processing remained intact under increased reading demands, late-stage processing adjustments may have occured to accommodate faster reading rates.

Conclusion

The integrated results highlight a nuanced understanding of the manner in which reading tasks, reading speed, and lexical processing interact. While elevated reading speeds could yield efficient initial lexical access, the capacity for deeper processing appears to depend critically on the specific demands of the reading task and the allocation of attentional resources. Notably, the present findings indicate that even at high speeds, the effects of word frequency and word length remained robust in early processing stages, particularly in measures such as first fixation duration and gaze duration. This persistence, and in the case of word length, even intensification, suggests that under accelerated conditions, readers increasingly rely on initial word processing to extract essential lexical information. In this scenario, longer words, which inherently demand more extensive processing, trigger compensatory mechanisms that manifest as prolonged initial fixations, ensuring accurate word recognition despite reduced opportunities for subsequent reanalysis. Furthermore, at reduced speeds, an adaptive pattern emerges, whereby an increased number of fixations is associated with shorter initial fixations. This suggests a potential strategy to distribute processing efforts efficiently across multiple fixations when necessary.

While Experiment 1 demonstrated that native speakers can adapt to increased reading speeds without substantial losses in comprehension, it remains unclear whether these findings also extend to second-language readers. L2 reading is characterized by slower speeds, less efficient lexical access, and greater reliance on lower-level processing, which may constrain the ability to adapt to accelerated conditions (Morishima, 2013; Whitford & Titone, 2015). Experiment 2 investigates whether L2 readers exhibit similar reserve capacities and adaptive eye movement patterns when reading in a non-native language. By comparing *L1* and *L2* readers, the influence of linguistic proficiency on the relationship between reading speed and comprehension is elucidated.

3 Experiment 2

3.1 Introduction

Reading fluency in a second language is a fundamental skill that is crucial for success in academic, professional, and everyday contexts for a significant proportion of the global population (Arkoudis et al., 2009; Pecorari & Malmström, 2018). Despite attaining high levels of proficiency, L2 readers often demonstrate slower reading rates compared to native language readers, even when their comprehension performance is comparable (Brysbaert, 2019; Siegelman et al., 2024). This discrepancy underscores the necessity of elucidating the mechanisms underlying L2 reading, with particular emphasis on whether and how L2 readers can augment their reading speed without compromising comprehension. The acquisition of such knowledge is imperative for the advancement of our understanding of bilingual reading processes and the development of effective educational interventions.

Research has demonstrated that individuals can process time-compressed speech presented auditorily at speeds significantly above the normal speaking rate in their L1 without experiencing any deficits in comprehension (Conrad, 1989; Kuperman et al., 2021; Murphy et al., 2021). However, even highly proficient L2 readers appear to suffer comprehension losses under similar conditions (Conrad, 1989; Griffiths, 1990). Yet this L1-L2 discrepancy cannot be easily generalized to the case of reading, because of the fundamental differences in the cognitive processing demands associated with reading and listening. Unlike listening, the act of reading allows for moment-to-moment adjustments to the specific demands of the reading situation, such as changes in pace, text difficulty, or specific task requirements. Nevertheless, it is not yet established how L2 readers adapt their linguistic processing and comprehension to manipulated reading speeds or whether individual differences, such as the natural reading rate or word reading efficiency, influence their reading performance under these conditions.

L1 and L2 reading likely differ not only in linguistic proficiency but also in the cognitive strategies employed to achieve reading for understanding. L2 readers typically require more time and cognitive resources for word decoding, resulting in slower reading rates and longer fixation durations (Beglar & Hunt, 2014; Fraser, 2007; Kuperman, 2022; Nisbet et al., 2022; Siegelman et al., 2024; Whitford & Titone, 2015). This increased *cognitive load* can be attributed to less efficient lexical access, as L2 readers rely more heavily on lower-level processes, leaving fewer resources for higher-level processing (Morishima, 2013).

In contrast to L1 readers, who frequently skip highly frequent or predictable words, L2 readers demonstrate a stronger influence of word frequency, with a reduction in the number of skipped words and an increase in the duration of fixations on lower-frequency words. This also reflects their diminished capacity to generate expectations during reading, as less proficient L2 readers exhibit reduced sensitivity to word predictability (Berzak & Levy, 2023; Godfroid, 2019; Nahatame, 2023;see chapter 1.1.3 for a more detailed discussion).

As found for L1 readers, there is also no significant correlation between reading speed and text comprehension in L2 readers (Wijaya, 2018). Experienced and proficient L2 readers in some studies read as fast as L1 readers and resemble very similar eye movement patterns (Kuperman et al., 2023; Nisbet et al., 2021; Siegelman et al., 2024). These effects may indicate that proficient L2 readers have some sort of reserve capacity for faster reading as well. However, as described in the previous section, there is evidence to suggest that the cognitive demands of L2 reading are significantly higher. Consequently, it appears to be a reasonable expectation that L2 readers can adapt to a higher reading speed with varying degrees of ease because they are a very heterogeneous group.

Individual differences among L2 readers, such as vocabulary size, word reading efficiency, and *working memory capacity*, are likely to influence their ability to adapt to varying reading speeds (Godfroid, 2019; Parshina et al., 2021; see chapter 1.1.3). For instance, more proficient L2 readers, who tend to exhibit shorter fixation durations and more efficient eye movement patterns, may be better equipped to maintain comprehension at higher speeds. Conversely, readers with lower proficiency levels may encounter challenges in adapting to these changes, which can result in a more significant decline in comprehension.

The primary aim of Experiment 2 is to investigate whether L2 readers exhibit similar untapped cognitive capacities during reading as has been observed in Experiment 1 for L1 readers (see also Korinth et al., 2016). This would enable them to increase their reading speed without compromising comprehension of the texts they read. To examine this question, bilingual university students were asked to read English texts while the speed of text presentation was manipulated using the line-by-line technique. Reading speeds were manipulated across five levels, ranging from 180 to 360 wpm. Should an untapped cognitive capacity exist during natural reading, it is expected that comprehension levels will remain high even at elevated reading speeds, thereby challenging the traditional notion of a speed-accuracy trade-off. This would suggest that the natural reading rate does not necessarily correspond to the optimal reading speed for L2 readers, thereby illuminating the similarities between L1 and L2 reading. An equally important objective of this research is to examine how L2 readers adapt their moment-to-moment linguistic processing and *oculomotor control* to varying reading speeds.

Additionally, this study explores individual differences among L2 readers. To this end, both baseline reading rates and word reading efficiency were employed as predictors of comprehension at varying reading speeds. This multifaceted approach was deemed the most appropriate method for assessing whether individual differences in reading proficiency significantly influence L2 readers' ability to maintain comprehension at elevated reading speeds.

3.2 Methodology

The design of this study closely followed Experiment 1. The design will be briefly described, and differences between the experiments will be highlighted.

Participants

To ensure sufficient statistical power to detect small differences in text comprehension, the same power analysis approach as in Experiment 1 was employed, utilizing the power.prop.test function in R. It can be assumed that experienced L2 readers achieve comprehension scores comparable to those of L1 readers (see Kuperman et al., 2023) and chapter 1.2.2.1), and accordingly, the same baseline comprehension accuracy value was adopted. Based on this, a target sample size of at least 35 participants was calculated to detect a one-question difference in comprehension across speed conditions.

The study was conducted with a sample of 36 students from McMaster University (Hamilton/Canada), with an average age of 20.99 years (*SD* = 1.8). Of the participants, 29 identified as female and 7 as male. The participants had normal or corrected-to-normal vision and were unaware of the aims of the experiment. All subjects had a native language other than English and began learning English at the age of four at the earliest. The mean age at which English was acquired was 7.48 years (*SD* = 3.02). The age range was from 4 to 14 years. The mean self-reported reading proficiency on a scale of 0 to 10 was 7.49 (*SD* = 1.65), with a minimum of 5 and a maximum of 10. Additional information regarding these participants, including their native language and country of origin, can be found in the supplementary materials S 2.

Materials

The stimuli for Experiment 2 were selected from the same set of personal narratives used in Experiment 1, sourced from the Rutgers University Oral History Archives and originally utilized in the LISN test for listening comprehension (Sommers et al., 2011; Tye-Murray et al., 2008). The same 12 of the 16 available texts were chosen for this experiment.

As in Experiment 1, each passage was paired with six multiple-choice questions designed to evaluate recall, detail integration, and inferential reasoning, resulting in a total of 72 questions across the three reading speed conditions. Each condition included two passages and 12 questions, ensuring consistency in stimulus selection and comprehension assessment across both experiments.

Apparatus

Eye movements were recorded using an SR Research Eyelink 2k eye tracker, operating at a sampling rate of 2000 Hz. The participants maintained a seated position at a distance of approximately 70 centimeters from a 21-inch CRT monitor, with a resolution of 1682 x 1050 pixels and a refresh rate of 120 Hz. To minimize head movement, a chin and forehead rest was employed. At this viewing distance, the angular dimensions of three characters corresponded to approximately one degree of visual angle.

Procedure

The procedure for Experiment 2 largely followed that of Experiment 1, with key modifications to accommodate the L2 participant population and adjusted speed conditions. Data were collected in 2022 and 2023, and the study was approved by the McMaster University Research Ethics Board (#2396). At the outset of the experiment, participants completed the Canadian Language Experience and Proficiency Questionnaire (LEAP-Q; Marian et al., 2007) to assess their language history, current use, and proficiency. Subsequently, participants were required to complete the Test of Word Reading Efficiency (TOWRE-2; (Tarar et al., 2015), which entailed reading aloud from lists of 104 English words and 63 non-words over a 45-second period per list. The total number of correctly read words served as a measure of word reading efficiency.

The eye-tracking setup, instructions and general calibration procedures (nine-point calibration, monitoring for accuracy > 0.3 visual degrees) were identical to those described in Experiment 1. Participants began by reading two texts at their natural pace to establish a baseline. Subsequently, 10 additional texts were presented in randomized order, with speeds manipulated using the line-by-line method, as detailed in Chapter 2.2. Speeds were randomly assigned at 180, 225, 270, 350[6] and 360 wpm, spanning slower-than-average, typical, and moderate to substantial increases, up to 150% of the average natural rate of L2 readers (Cop et al., 2015; Dirix et al., 2019). The 45 wpm interval between speeds represents a 20% increment from the slowest rate. It is to be noted that, in comparison with Experiment 1, a slower condition has been incorporated and the fastest condition has been eliminated. As a result, the speeds partly overlapped with the ones used on L1 readers of English in Experiment 1, which started at 225 wpm as the minimum and went up to 405 wpm, in the same increments of 45 wpm.

Variables

As in Experiment 1 the *dependent variables* related to the eye movements were as follows: fixation probability, first fixation duration, gaze duration, total viewing time, refixation probability and regression-in probability. Additionally, comprehension accuracy was assessed. The exact definitions of the variables can be found in the Methods section of Experiment 1, and an overview of the various eye movement parameters can be found in Inhoff and Radach (1998).

The primary *independent variable* was reading speed, which was categorized into six levels: the natural reading rate and the five experimentally manipulated speeds.

To further investigate the influence of reading speed on lexical processing, an analysis of the interactions between reading speed and both word frequency and word length (in letters) was conducted. word frequencies were obtained from the SUBTLEX-US corpus (Brysbaert & New, 2009), which is based on 51 million words from American film and media subtitles.

In addition, the influence of individual differences on reading performance was examined. The baseline reading rate was determined from the two texts read at each participant's natural pace, while word reading efficiency was assessed using combined scores from the TOWRE-2 test. These individual factors were then analyzed to predict comprehension across varying reading speeds.

Statistical considerations

For a comprehensive overview of the statistical considerations that pertain to all experiments, please refer to Chapter 1.4.4.

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[6] The intended speed was 315 wpm but due to a programming error it resulted in an effective speed of 350 wpm.

3.3 Results

Given that comprehension scores below 30% do not differ significantly from the chance level of 25% (see Kuperman et al., 2021), two subjects with scores below this threshold were excluded from the subsequent analyses. The remaining 36 subjects exhibited a mean comprehension score of 60% (ranging from 33% to 92%).

Fixations that were shorter than 80 ms or longer than 600 ms were excluded from the analysis, representing 5.24% of the total number of fixations. Additionally, observations with gaze durations exceeding 1,000 ms (0.33%), total reading times above 1,500 ms (0.17%), more than six fixations on a word (0.20%), and undetected saccade amplitudes (0.72%) were excluded. The remaining data consisted of 149,248 observations, representing 93.32% of the initial dataset.

The following analyses were designed to provide information about the reading speed at which text comprehension begins to suffer, the manner in which eye movements adapt to varying speeds, and the role that individual differences play in this process. Backward difference contrast coding was employed to facilitate a comparative analysis of the various speed conditions. In the initial comparison (Speed 1), the baseline reading rate was contrasted with the speed of 180 wpm, followed by a comparison between 180 wpm and 225 wpm, and so forth. The impact of the speed manipulation on text comprehension and eye movement measures can be observed in Table 5. A subsequent section will present the analyses of individual differences, and a final section will compare the results with the L1 sample from Experiment 1.

The mean baseline reading rate for the L2 sample was 197 (*SD* = 51) wpm. Similarly, Dirix et al. (2019) documented an average reading speed of 174 wpm among L2 readers of English texts.

Table 5

Descriptive statistics of eye movement measures and comprehension scores (Experiment 2)

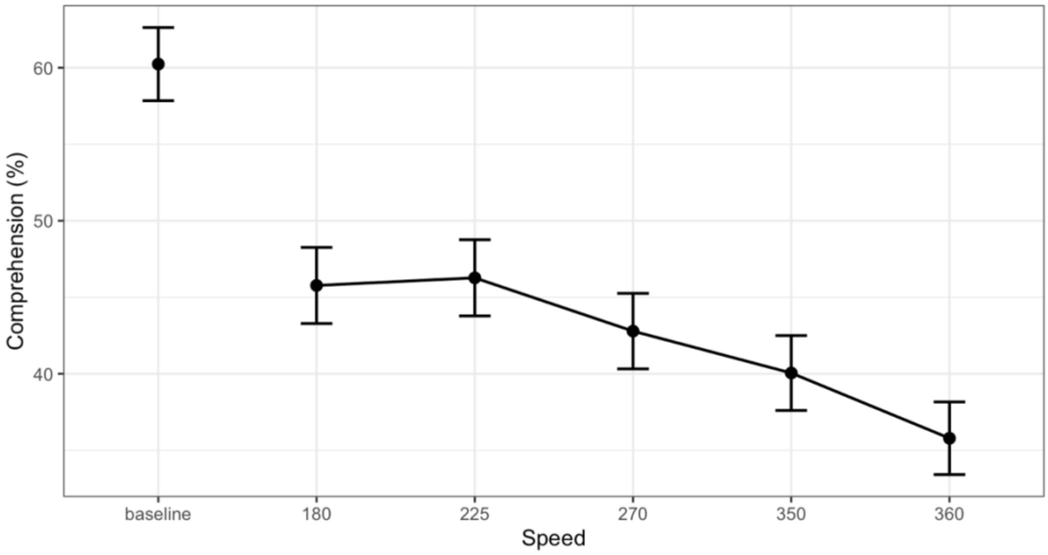
	Speed					
	Baseline *M* (*SD*)	180 wpm *M* (*SD*)	225 wpm *M* (*SD*)	270 wpm *M* (*SD*)	350 wpm *M* (*SD*)	360 wpm *M* (*SD*)
Comprehension (%)	60 (49)	46 (50)	46 (50)	43 (50)	40 (49)	36 (48)
Fixation probability	.72 (.45)	.69 (.46)	.62 (.49)	.58 (.49)	.49 (.50)	.48 (.50)
First fixation duration (ms)	238 (90)	247 (94)	243 (91)	238 (88)	231 (84)	232 (83)
Gaze duration (ms)	270 (125)	280 (130)	273 (123)	265 (117)	253 (108)	253 (107)
Total reading time (ms)	366 (223)	363 (213)	329 (185)	304 (162)	278 (141)	278 (139)
Refixation probability	.14 (.35)	.14 (.35)	.13 (.34)	.12 (.33)	.11 (.31)	.10 (.31)
Regression-in probability	.13 (.34)	.15 (.35)	.13 (.34)	.13 (.33)	.12 (.32)	.10 (.32)

Effects of reading speed on comprehension

Comprehension scores were calculated for each participant at each speed and are presented as a percentage. Figure 8 illustrates the effect of reading speed on comprehension. The results of the linear mixed-effects model (see Appendix C1 for the full model) indicate a significant difference in comprehension between the baseline condition and the 180 wpm condition. However, no significant differences were found between the subsequent speeds in this analysis. To investigate the differences between the manipulated speeds more precisely, a second analysis was conducted with adjusted contrasts. In this analysis, all speeds were compared to the 180 wpm condition. This analysis revealed a significant difference between 180 wpm and 360 wpm (see Appendix C2 for the full model). While the results clearly demonstrate that all speed manipulations reduce comprehension, irrespective of the specific speed, a clear downward trend in comprehension is evident at higher speeds.

Figure 8

Effect of reading speed on text comprehension (Experiment 2)



Note. Error bars represent ±1 SE.

Exploration of individual differences. To account for individual differences, the analyses included both baseline reading rate and word reading efficiency. The mean baseline reading rate was 197 wpm, with a standard deviation of 51 wpm and a range from 91 to 337 wpm. The mean word reading efficiency, based on the combined TOWRE-2 subtest scores (sight word efficiency and phonemic decoding), was 127.91 (SD = 19.29), with a range from 84 to 167.

Contrary to the anticipated outcome, baseline reading rate was found to have no significant effect on comprehension, nor was there any interaction between baseline reading rate and reading speed (see Table 6 for ANOVA-style results and Appendix C3 for full model details). Both faster and slower L2 readers of English exhibited similar declines in comprehension with speed manipulation.

However, word reading efficiency demonstrated a significant main effect, with higher efficiency scores attenuating the adverse impact of speed manipulation across all speed levels (see Table 6 for ANOVA-style results and Appendix C4 for full model details). Figure 9 depicts the relationship between word reading efficiency and comprehension scores across reading speeds. While participants were grouped into high- and low-efficiency categories for illustrative purposes based on median splits, continuous measures were employed in the models to enhance precision.

Although readers with a high word reading efficiency (rather unexpectedly) demonstrated a numerically lower level of text comprehension in the baseline condition, they exhibited significantly higher comprehension levels in the manipulated speed conditions (see Figure 9). An additional analysis limited to the baseline condition revealed no significant effect of word reading efficiency and comprehension, $\chi^2(1) = 0.87$, $p = .36$.

Table 6

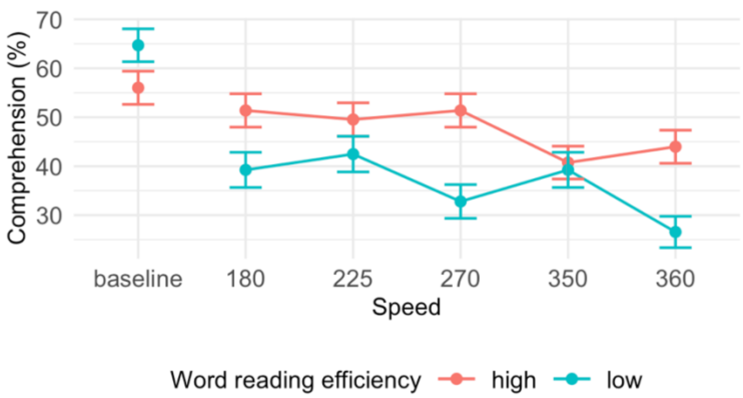
ANOVA-style summary of comprehension as a function of reading speed and baseline reading rate (A) and reading speed and word reading efficiency (B) (Experiment 2)

	Factor	χ^2	*df*	*p*
A	Speed	**14.32**	**4**	**>.001**
	Baseline reading rate	1.84	1	.17
	Speed*Baseline reading rate	5.98	4	.20
B	Speed	**13.79**	**4**	**>.001**
	Word reading efficiency	**10.97**	**1**	**>.001**
	Speed*Word reading efficiency	4.99	4	.29

Note. Values with p < .05 are presented in **bold**.

Figure 9

Effect of reading speed and word reading efficiency on text comprehension



Note. Error bars represent ±1 SE.

Effects of reading speed on eye movements

As presented in Table 5, there is a substantial variability in the patterns of eye movement across the various speed conditions. In particular, early oculomotor measures (first-pass reading measures) are less susceptible to speed-related changes than later measures (see Figure 10). Specifically, the time spent on rereading decreases at higher speeds, thereby contributing to the necessary reduction in total reading time. As reading speed increases, the number of fixations per word decreases, with words being skipped more frequently and instances of multiple fixations on a word becoming less common (see Figure 11).

The results of the GLMM analyses indicate the presence of significant main effects of speed for all eye movement measures (see Appendix C5 – C10). The probability of fixation decreases significantly between baseline and 180 wpm, and this decrease is maintained at each subsequent higher speed, with the largest difference between 270 wpm and 350 wpm (9% of relative change). Significant differences were observed in first fixation duration, gaze duration, and regression-in across all speed comparisons, except for the two highest speeds. These three variables show an increase at slower speeds compared to baseline (longer fixation durations and greater number of regressions), before showing a progressive decrease (see Figure 12). The largest differences were again observed between 270 wpm and 350 wpm, with a small difference of 2% relative change for first fixation duration and a decrease of 5% for gaze duration. No significant differences were observed between baseline, the slowest speed, and the two fastest speeds for total reading time and refixation probability. However, both measures showed a significant decrease in the remaining comparisons, with the largest difference (7% of relative change) between 180 and 225 wpm for total reading time and a 1% difference for refixation probability between subsequent speeds.

Figure 10

First fixation duration, refixation duration and rereading time as a proportion of total reading for the different speed conditions (Experiment 2)

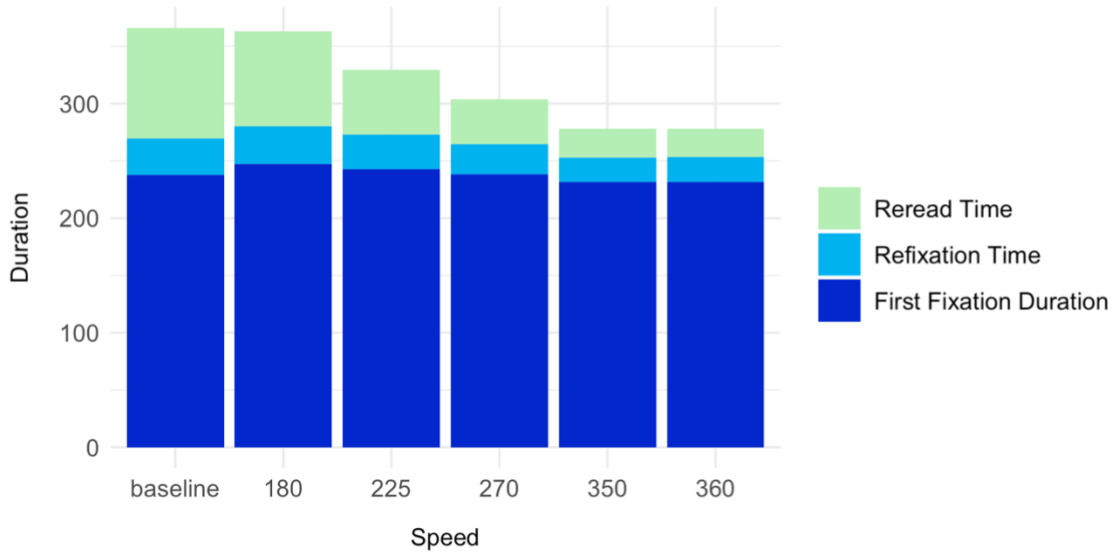


Figure 11

Proportion of fixation count for the different speed conditions (Experiment 2)

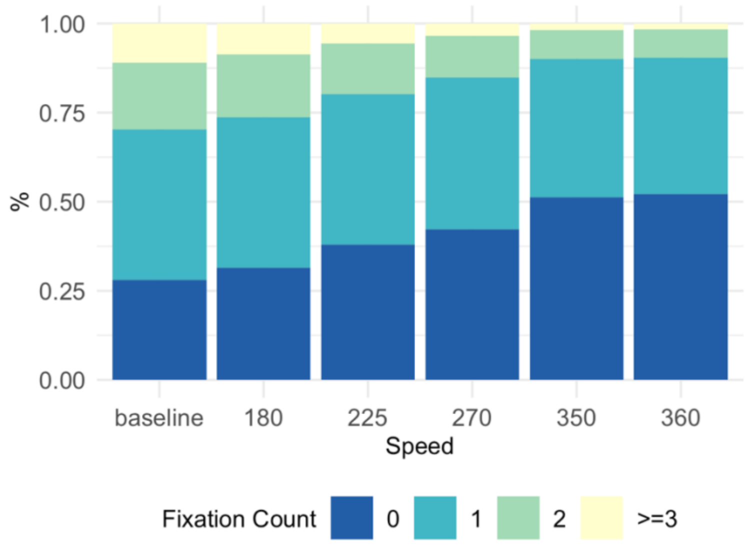
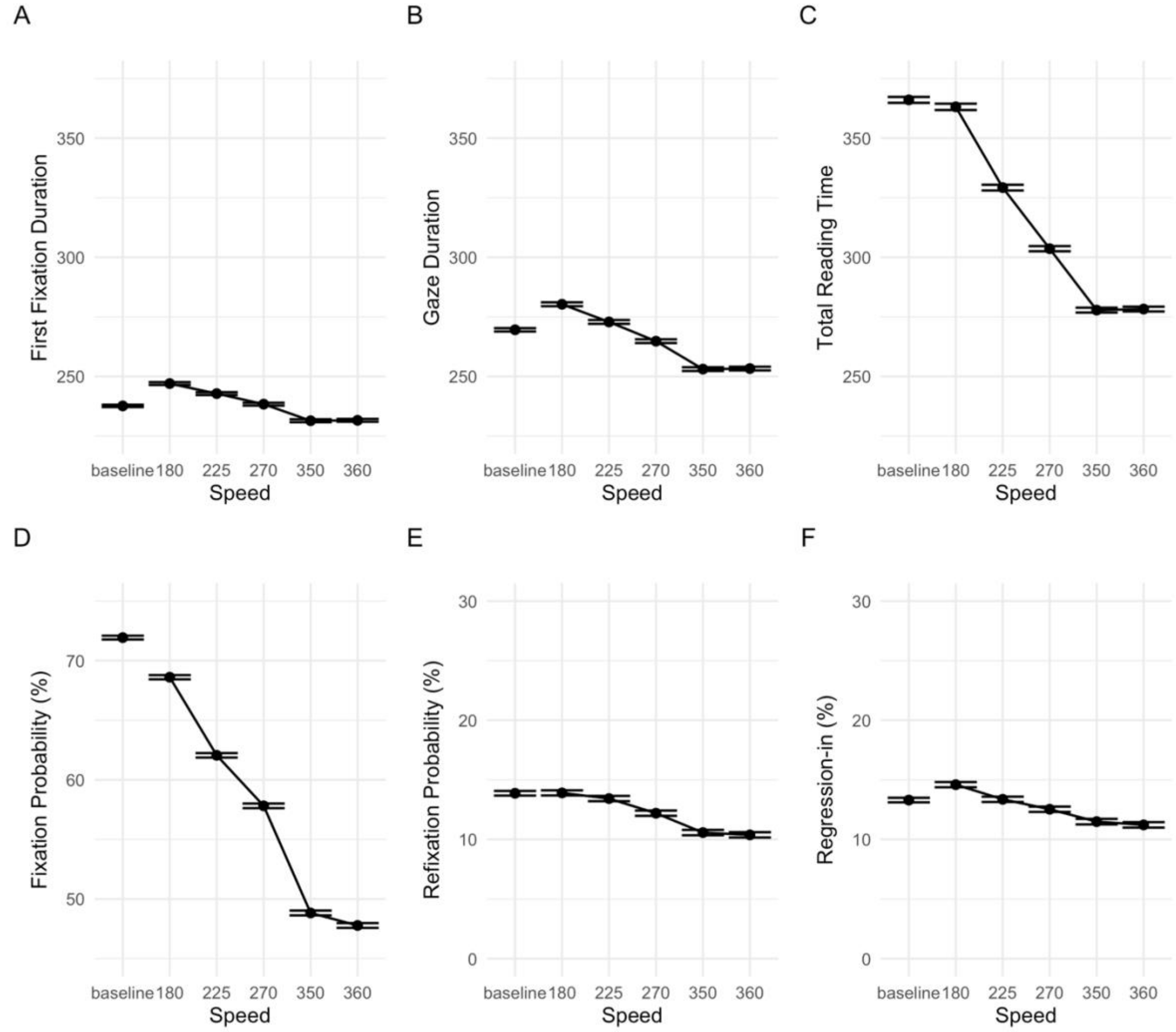


Figure 12

Effects of reading speed on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), and the probability for a regression-in (F) (Experiment 2)



Note. Error bars represent ±1 SE.

Lexical benchmark effects. In line with Experiment 1, word frequency and length were included in the GLMM analyses, with detailed results in Appendix C11 -C16 and an ANOVA-style summary in Table 7.

Word length. The results of the linear mixed models indicated a significant main effect of word length for all oculomotor measures. In particular, longer words were found to elicit longer fixation durations and a higher number of (re)fixations. Furthermore, interactions between word length and reading speed were identified. Figure 13 illustrates all analyzed variables including the aforementioned interaction effects for fixation probability (Figure 13D), first fixation duration (Figure 13A), gaze duration (Figure 13B), and total reading time (Figure 13C). At slower reading speeds, word length exerted a more pronounced influence on refixation probability, gaze duration, and total viewing time. Conversely, the impact of word length on fixation probability and first fixation duration was less pronounced at slower reading speeds. It would seem that the elevated cognitive load associated with processing longer words at slower reading speeds was compensated for by a greater number of refixations, longer gaze durations, and an increased total viewing time. However, at higher speeds, there was a shift in strategy, with an increase in fixation probability for long words and a greater increase in first fixation duration than for short words.

Word frequency. The results also demonstrated a significant main effect of word frequency on all oculomotor measures with the exception of regression-in. The frequency effects remained stable across all speeds, with the exception of gaze duration and total viewing time (see Figure 14B and C). As with the word length effects, these two variables showed stronger effects at lower speeds. Consequently, the influence of word frequency on gaze duration and total reading time decreased with higher speeds.

Table 7

ANOVA-style summary of eye movement measures as a function of reading speed, word length and word frequency (Experiment 2)

Measure	Factor	χ^2	*df*	*p*
Fixation probability (%)	Speed	**9984.09**	**5**	**>.01**
	Word length	**1437.36**	**1**	**>.01**
	Word frequency	**61.36**	**1**	**>.01**
	Speed: Word length	**188.27**	**5**	**>.01**
	Speed: Word frequency	8.77	5	.12
Refixation probability (%)	Speed	**511.09**	**5**	**>.01**
	Word length	**1165.38**	**1**	**>.01**
	Word frequency	**99.57**	**1**	**>.01**
	Speed: Word length	**12.47**	**5**	**.03**
	Speed: Word frequency	6.56	5	.26
First fixation duration (ms)	Speed	**435.94**	**5**	**>.01**
	Word length	**31.77**	**1**	**>.01**
	Word frequency	**7.47**	**1**	**>.01**
	Speed: Word length	**14.50**	**5**	**.01**
	Speed: Word frequency	9.93	5	.08

Measure	Factor	χ^2	*df*	*p*
Gaze duration (ms)	Speed	**1071.8**	**5**	**>.01**
	Word length	**609.23**	**1**	**>.01**
	Word frequency	**90.04**	**1**	**>.01**
	Speed: Word length	50.70	**5**	**>.01**
	Speed: Word frequency	**12.55**	**5**	**.03**
Total reading time (ms)	Speed	**5733.13**	**5**	**>.01**
	Word length	**479.22**	**1**	**>.01**
	Word frequency	**149.54**	**1**	**>.01**
	Speed: Word length	**95.21**	**5**	**>.01**
	Speed: Word frequency	**33.59**	**5**	**>.01**
Regression-in (%)	Speed	**144.23**	**5**	**>.01**
	Word length	0.28	1	.59
	Word frequency	0.41	1	.52
	Speed: Word length	**13.59**	**5**	**.02**
	Speed: Word frequency	4.78	5	.44

Note. Values with p < .05 are presented in **bold**.

Figure 13

Effects of reading speed and word length on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), regression-in (F) (Experiment 2)

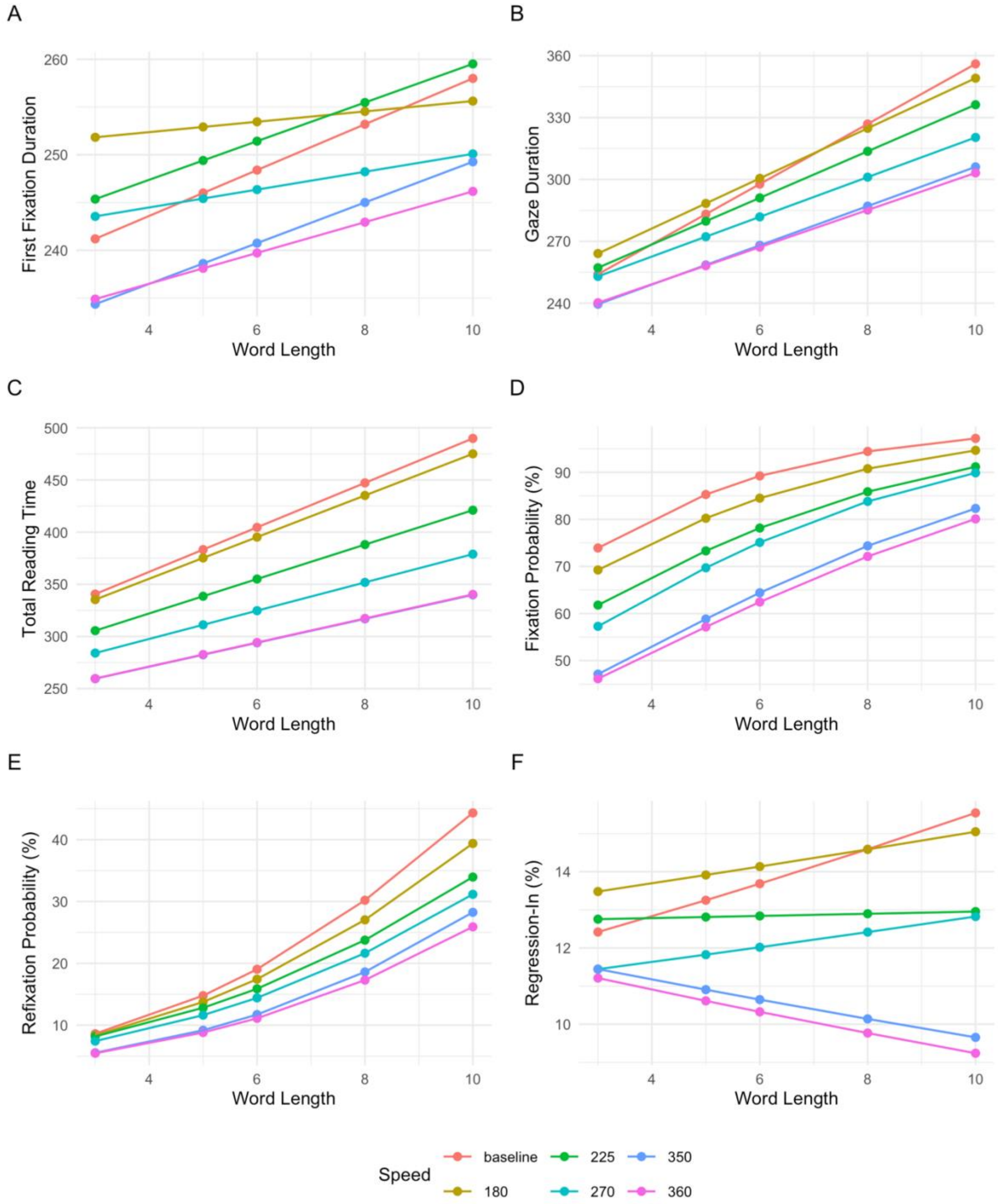
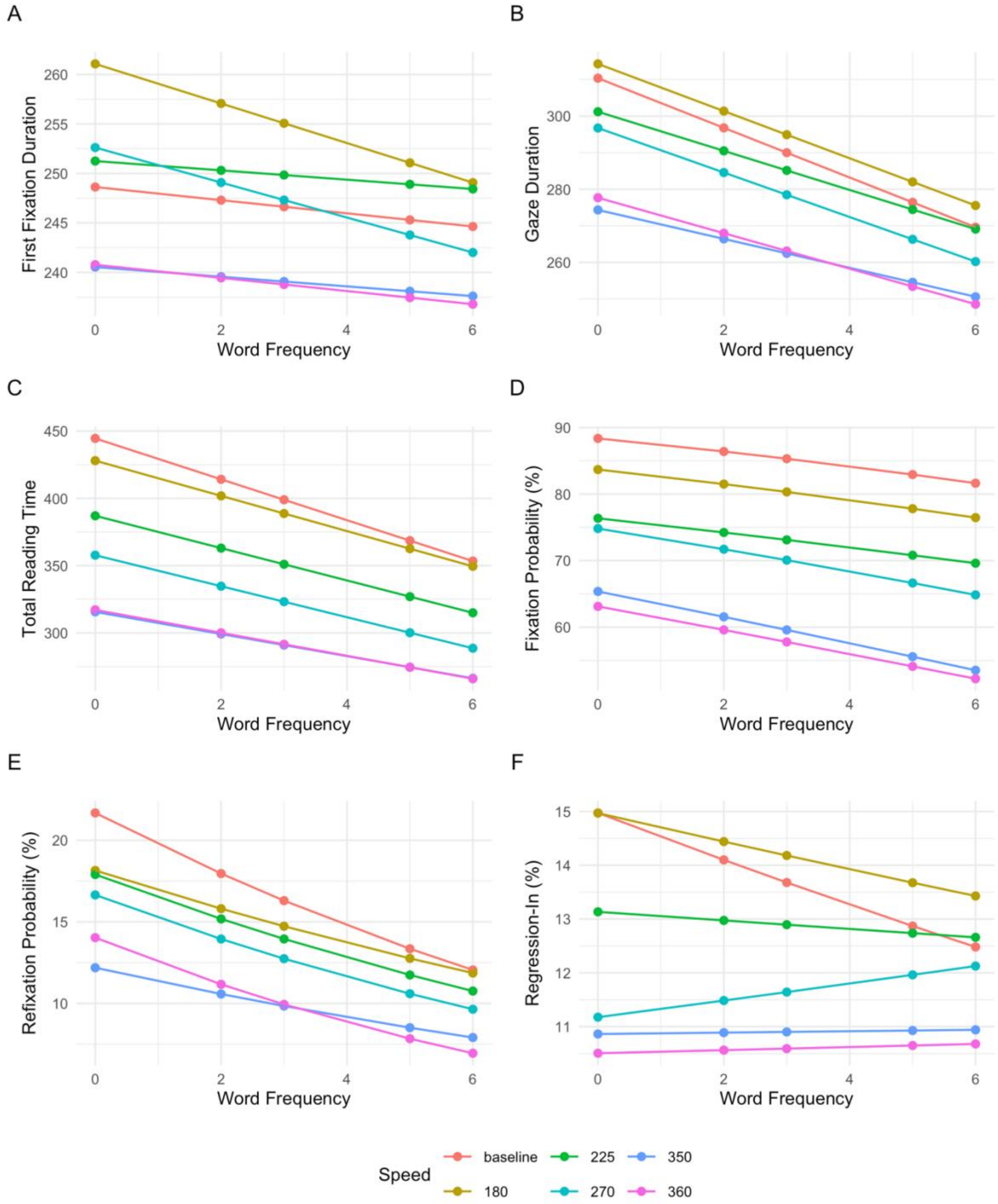


Figure 14

Effects of reading speed and word frequency on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), regression-in (F) (Experiment 2)



Supplementary analyses

Distribution of fixations in the paragraph. As in Experiment 1, it was of additional interest to investigate whether participants experienced difficulties in keeping pace with the line-by-line manipulation at higher reading speeds, leading to reduced fixations on the subsequent sections of paragraphs. To examine whether this tendency occurred in the present L2 sample, the relative position of each word within its paragraph was included as a continuous predictor in the analysis. This allowed for a detailed assessment of whether fixation probabilities declined as word position progressed through the paragraph. For visualization purposes only, paragraphs were divided into four equal sections, and fixation probabilities were averaged across these bins (see Figure 15). In all statistical analyses, word position was treated as a continuous variable (see Table 8 for ANOVA-style results and Appendix C17 for the full model).

The results revealed significant main effects of both reading speed and word position. Fixation probabilities decreased with higher reading speeds and for words appearing later in the paragraph. These effects are consistent with those observed in the L1 sample.

Importantly, a significant interaction between reading speed and word position was found. As shown in Figure 15, this interaction reflects the increasing influence of word position at higher reading speeds. While differences in fixation probability across the paragraph were minimal at 180 wpm, they became more pronounced at higher speeds. This pattern suggests that at elevated speeds, L2 participants were more likely to skip words toward the ends of paragraphs, potentially due to difficulties in adapting to the demands of accelerated reading.

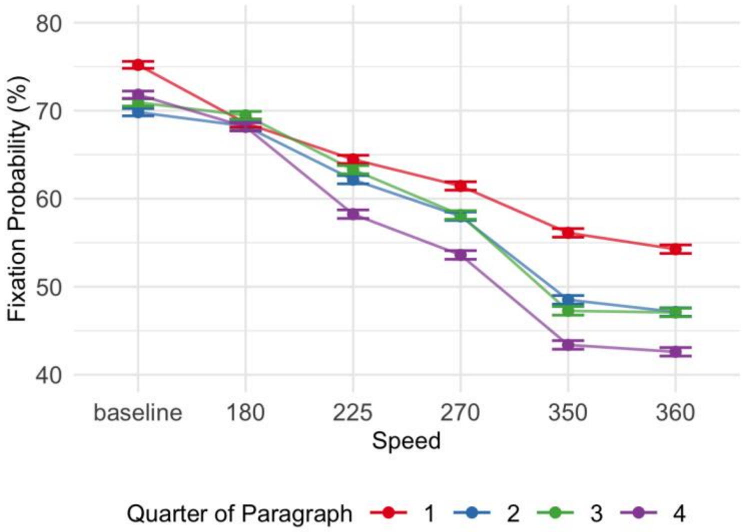
Table 8
ANOVA-style summary of fixation probability as a function of reading speed and word position in the paragraph (Experiment 2)

Factor	χ^2	*df*	*p*
Speed	**56.46**	**5**	**<.001**
Word position in paragraph	**13.06**	**1**	**<.001**
Speed*Word position in paragraph	**3.75**	**5**	**.005**

Note. Values with p < .05 are presented in **bold**.

Figure 15

Effect of reading speed and position in the paragraph (measured in quarters) on fixation probability (Experiment 2)



Note. Error bars represent ±1 SE.

3.4 Discussion

Effects of reading speed on comprehension

The main goal of this study was to ascertain whether proficient L2 readers possess an additional cognitive capacity that allows them to increase their reading rate without compromising comprehension, as found for L1 readers (see Experiment 1 as well as Korinth et al., 2016). The present findings provide a definitive answer to this question: Even though the participants were fluent readers in their non-native language and academically successful university students, they did not demonstrate the capacity to maintain comprehension at elevated reading speeds beyond their natural baseline reading rate.

Participants demonstrated good text comprehension under baseline conditions, but their performance was significantly disrupted when reading speed was manipulated, even at the slowest speed of 180 wpm, which is approximately 0.33 standard deviations below the observed baseline of 197 wpm. Further increases in reading speed led to a stepwise decline in comprehension, with a significant difference observed between the slowest and fastest conditions. Individuals baseline reading speed did not play a significant role in text comprehension, either at baseline or when speed was manipulated. In contrast, word reading efficiency showed a positive effect on text comprehension at accelerated speeds. These findings largely align with the extant literature, which has thus far demonstrated an absence of a significant relationship between reading speed and text comprehension for L2 readers (Wijaya, 2018). Notably, an individual's natural baseline reading rate did not significantly predict the preservation of comprehension at accelerated speeds – a phenomenon that will be discussed in greater detail later. At the same time, word reading efficiency exhibited a positive effect on text comprehension under speed manipulation, although no significant effect was observed on the baseline reading rate. It was expected that there would be a modest positive effect on baseline comprehension (Bernhardt, 2005, 2019; Jeon & Yamashita, 2014). However, this hypothesis was not substantiated by the present data. Previous research has shown that word reading efficiency plays a more substantial role in predicting comprehension for L1 readers than for L2 readers, where the effect tends to be relatively small (Geva, 1997).

Despite the apparent individual differences, second-language readers were basically unable to sustain high levels of text comprehension once reading speed was experimentally increased. This finding suggests that task demands indeed exceeded the limits of their cognitive capacity. This conclusion is in harmony with previous research on L2 listening, where increased speech rates similarly resulted in reduced comprehension (Conrad, 1989; Griffiths, 1990). This appears to suggest that the natural reading rate is in fact identical or close to the optimal reading rate for L2 readers. Faster reading above this optimum leads to lower comprehension because information cannot be processed faster.

What is the locus of this effect? A likely explanation may be the disruption of prelexical and lexical stages of word processing, such as letter discrimination and/or lexical access, while they unfold during the course of information processing. Alternatively, these results could be indicative of an overload during later stages of information integration, e.g., when a coherent representation needs to be formed on the level of sentence comprehension.

It is not a simple task to determine which of these components suffer most when L2 readers are running out of time. The positive correlation observed between assessed word reading efficiency and text comprehension provides evidence for a critical role of efficient lexical processing. Word reading efficiency was associated with improved comprehension across all manipulated speed conditions, suggesting that efficient lexical processing acted as a protective factor against the challenges posed by accelerated reading speeds (see e.g., Reichle, 2021, for a detailed discussion of the primary role of the lexical processing stage during reading).

Contrary to previous research (Bernhardt, 2005, 2019; Jeon & Yamashita, 2014), no positive association between word reading efficiency and text comprehension was observed in the baseline condition. This discrepancy suggests that, in the absence of time constraints, competent L2 readers can achieve a high level of comprehension regardless of their efficiency in word recognition. However, when processing time becomes a critical factor under speed manipulation, individuals with higher word reading efficiency gain a comparative advantage. These readers require fewer temporal resources for lexical access, allowing them to allocate more capacity to higher-order processing, ultimately supporting better comprehension.

Nonetheless, text comprehension generally declined under accelerated reading conditions, albeit to a lesser extent for those with higher word reading efficiency. This finding reinforces the idea that efficient lexical processing is a crucial factor in maintaining comprehension, particularly under increased processing speed (see Bernhardt, 2005, 2019; Jeon & Yamashita, 2014, for a critical discussion). However, based on the evidence presented, it remains unclear whether comprehension difficulties arise due to impaired lexical processing (meaning that lexical access is hampered at higher speeds) or whether lexical access occurs successfully but consumes excessive cognitive resources so that insufficient capacity remains for higher order processing stages. Insights into this question can be gained by examining moment-to-moment processing during reading.

Adaptivity of eye movements as a result of reading speed

Analyses of eye movement data revealed that readers make substantial adjustments to their oculomotor behavior when reading speed is increased. The observed changes were significant across all the eye movement metrics, with the most pronounced effects being a steep decline in the number of times a word was refixated and especially in the time spent rereading words. Looking at the adaptation of eye movements in relation to word length and frequency, it turned out that both lexical benchmark effects remained largely intact even at high speeds. In fact, the word length effect on first fixation duration was even more pronounced at higher speeds, while the subsequent viewing durations (both gaze duration and total viewing time) showed a slight decrease. Apparently, readers are forced to rely on increased initial fixations, when making additional fixations becomes too time-consuming.

Linguistically, this pattern is characterized by a sustained focus on lexical processing (especially of difficult words) combined with a diminishing reliance on later-stage reanalysis. Part of the reason for this strategy may be the fact that it potentially minimizes the need for time-consuming reprocessing. More fundamentally, it may be concluded that successful word recognition is prioritized because it is the necessary precondition to achieve even basic comprehension. In any case, it appears that the efficient lexical access observed in L2 readers consumes a significant proportion of their cognitive capacity (Morishima, 2013; Nisbet et al., 2021), leaving insufficient resources for the subsequent integration of information into a coherent text representation.

To achieve a more complete description of reader's adjustments in response to increased speeds, the relative position of each word within its paragraphs was analyzed as a continuous predictor. The results indicate a consistent decline in fixation probability for words appearing later in the paragraph, particularly at higher reading speeds. This suggests that readers may be increasingly challenged to maintain the pace, hampering the acquisition of information from later parts of the paragraph. Consequently, this dynamic may impede the accessibility of information from the latter segments of the paragraph, potentially hindering the formation of a comprehensive situation model.

Yet, the observed comprehension drop appears to stem from more than just increased reading speed. Although comprehension scores show a consistent downward trend with increasing speed, comprehension was significantly lower when the line-by-line technique was introduced, even at speeds close to or below the mean natural reading rate. Given that the speeds were presented in a randomized order, rather than in ascending order, it can be deduced that this phenomenon cannot be explained by habituation effects. The finding is further supported by the observation that individual baseline reading rate did not significantly predict comprehension under the manipulated conditions. Contrary to the hypothesis that faster baseline readers would sustain their comprehension longer, as they can maintain their natural reading rate and reading behavior at a greater number of the manipulated speeds, the results did not support this prediction. Consequently, factors beyond mere speed must account for the observed decline in comprehension among L2 readers under the line-by-line manipulation.

In addition to the challenges posed by reading speed, the text manipulation may have acted as a *dual-task* situation, thereby imposing further cognitive strain on readers. While they were required to read the text, their decision on when and where to move their eyes next also had to consider the location of the highlighted line at any given moment. For the L2 group, maintaining a consistent reading speed within these boundaries, and therefore ensuring steady and coherent information acquisition, might have been particularly challenging.

This interpretation is consistent with findings from auditory language processing research, indicating that distractions or background noise have a greater impact on L2 listeners compared to L1 controls (Gat & Keith, 1978; for a review of this research, see Lecumberri et al., 2010). The introduction of an additional focus of sustained attention (or source of distraction) has been observed to have a particularly detrimental impact on L2 language processing.

In summary, findings appear to indicate that while effective lexical access remains feasible even at elevated speeds, L2 readers encounter difficulties in sustaining comprehension when reading speed is modulated. Their cognitive resources appear to be fully utilized by prelexical and lexical processes, impeding effective compensation for accelerated reading speeds without a significant decline in comprehension.

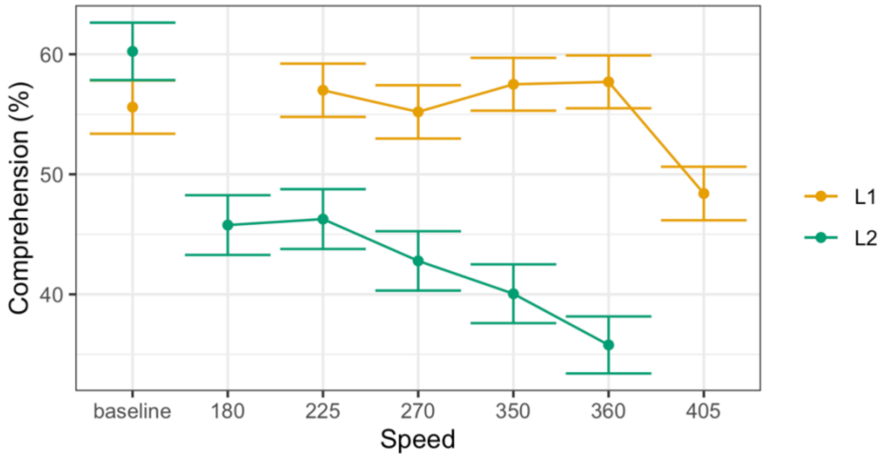
Comparing L1 and L2 Reading Behavior

The methodological similarity between Experiments 1 and 2 allowed to compare the impact of reading speed on L1 and L2 readers. The two experiments revealed clear differences in how L1 and L2 readers adapt to manipulated reading speeds. As could be expected, and consistent with previous research (e.g., Cop et al., 2015), L2 readers exhibit slower mean baseline reading rates (197 wpm, *SD* = 51) compared to L1 readers (273 wpm, *SD* = 71).

Looking at comprehension, it is interesting that second-language participants initially demonstrated high comprehension scores in the natural reading condition, with no significant difference between both groups. Entering the speed task leads to an immediate divergence between both groups (see Figure *16*). While the L1 group is able to maintain their initial level of comprehension over a wide range of increasing speed conditions, the comprehension rate for the L2 group starts at a lower level and soon starts to decline quite dramatically with increasing speed. The differences between groups in the speed condition are all significant (see Appendix D1 and D2, for the full analysis).

A compelling question emerges from these observations: what potential explanations exist for the remarkable discrepancy between the text comprehension of L1 and L2 readers under the speed manipulation? One hypothesis could be that the discrepancy may be attributable to disparate levels of vocabulary knowledge. Achieving a comprehensive understanding of a text necessitates familiarity with the vast majority of its lexical elements (Hsueh-Chao & Nation, 2000). This points to the possibility that L2 readers might have exhibited less successful word recognition, consequently hindering their ability to attain a high level of comprehension. However, this idea loses credibility once the remarkably high levels of text comprehension observed in the baseline condition are considered.

Figure 16
Effect of reading speed on text comprehension (in %) for L1 and L2 readers (Experiments 1 and 2)



Note. Error bars represent ±1 SE. Not all speed conditions are available for both language groups, as 180 wpm were not induced for L1 readers and 405 wpm were not induced for L2 readers.

In contrast to L1 readers, who appear to maintain their comprehension by leveraging more efficient lexical processing (Brysbaert, 2019; Rayner et al., 2016), L2 readers may reach a critical threshold more rapidly due to the increased cognitive load associated with lower proficiency and less automatized word recognition (Godfroid, 2019; Perfetti, 2007). These assumptions are in harmony with research on the auditory processing of language, which similarly demonstrates the existence of residual cognitive capacity in L1 populations. For example, Kuperman et al. (2021) report that native speakers are able to process auditory language input at rates approximately 130% faster than the typical input speed without any deficits in comprehension. In contrast, L2 populations demonstrate a significant decline in comprehension when the input rate is increased, irrespective of whether they are medium or highly proficient speakers (Conrad, 1989). Conrad (1989) suggested that for L2 speakers, the processing capacity is inadequate to establish syntactic expectations when speech is time-compressed. Consequently, they experience difficulties in differentiating between relevant and irrelevant information and in prioritizing content in an effective manner.

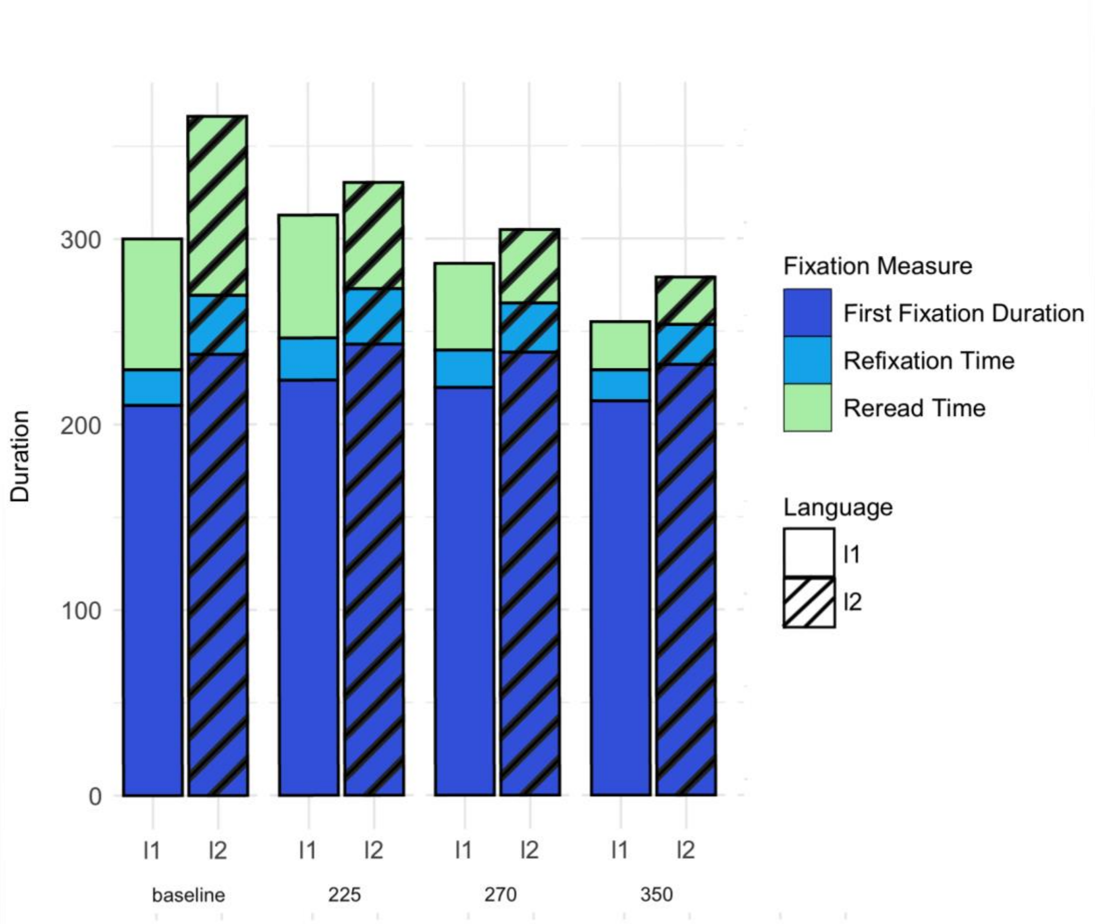
Furthermore, the role of individual factors such as word reading efficiency and baseline reading rate appears to differ between the groups. In the L1 sample, word reading efficiency predicts not only better comprehension under speed manipulation but also higher baseline comprehension. In contrast, for L2 readers, although higher word reading efficiency supports comprehension under accelerated conditions, this advantage does not extend to baseline performance. The absence of a significant relationship between baseline reading rate and comprehension in L2 readers is an additional considerable difference. As discussed above, reading speed does not seem to be the only factor that changes when the line-by-line manipulation is implemented. It is quite likely that the method presented additional challenges to all L2 readers, making baseline reading rate a less critical factor.

Eye movement analyses provide further insight into the differences and similarities between L1 and L2 readers. As reading speed increased, both groups demonstrated reduced fixation probabilities and shorter viewing times, indicating a general adaptation in oculomotor behavior under temporal constraints. At first glance, the adjustments in eye movement patterns appear quite similar between the two groups; however, a closer examination reveals subtle differences. A compact overview is provided in Figure 17, which shows the total viewing time decomposed into first fixation duration, refixation and rereading time for the two groups. As anticipated based on their notably different natural reading speeds, significant differences were observed in all three variables in the baseline condition (see Appendix D4 – D8 for ANOVA-style results and the full models). More intriguing, however, are conditions under which both groups read at an equivalent overall speed, allowing for a direct comparison of how temporal resources are allocated. In all selected conditions (225, 270 and 350 wpm), first fixation durations were consistently shorter for L1 readers than for L2 readers. Both groups exhibited a slight reduction in first fixation duration as reading speed increased, and the non-significant interaction suggests that the magnitude of this decrease is comparable across groups. These findings align with the extant literature, which indicates that lexical access requires more time for L2 readers than for L1 readers (Nisbet et al., 2021; Siegelman et al., 2024).

Refixation time decreased with higher speeds, and the rate of decline 270 to 350 wpm appeared to be slightly pronounced among L2 readers compared to L1 readers. But despite numerical differences, no statistically significant differences in pairwise comparisons emerged between the groups across the various speed levels, indicating that the additional time required for lexical access, as measured by *refixation time*, did not differ substantially. A parallel dynamic was observed in *rereading time*, which decreased in both groups, with a greater reduction from 270 to 350 wpm among L2 readers when compared to their L1 counterparts.

Figure 17

First fixation duration, refixation duration and rereading time as a proportion of total reading time as a function of speed and language



Note. Only reading speeds that were induced in both Experiment 1 and Experiment 2 are presented. The absolute height of the staked bars equals total reading time.

In summary, while both groups demonstrated comparable overall reading speeds, L2 readers exhibited longer total viewing times for the words they fixated. Interestingly, this discrepancy originated predominantly from the initial phase of word processing, as opposed to subsequent reanalysis and integration processes[7]. Both groups showed a tendency to maintain their natural reading patterns during speed manipulations; however, when these patterns could not be sustained due to high speeds, the reduction occurred primarily in reanalysis time rather than in the time allocated for initial lexical processing. This strategy appears effective for L1 readers, as evidenced by their high text comprehension. In contrast, while L2 readers encountered difficulties integrating the processed information, they relied more heavily on reanalysis and requiring additional time to achieve comprehension.

[7] The increased total viewing times observed among L2 readers can be partly attributed to reduced fixation probabilities and a tendency to fixate on a smaller number of words towards the end of paragraphs at higher speeds (see additional analyses reported in chapter 3.3).

For both groups, lexical benchmark effects, such as those of word frequency and word length, remain largely robust across conditions. Although they are slightly modulated by increased reading speed, the differences between L1 and L2 readers are minimal. Both groups exhibit a reduction in reanalysis for more challenging words at higher speeds, while demonstrating a tendency for longer *first fixations* on long or low-frequency words. This finding suggests that the process of lexical access may operate similarly in both groups. The persistence of the main effects at elevated speeds indicates that successful word processing continues, even at high speeds.

Taken together, L1 and L2 readers exhibit remarkably similar oculomotor responses to reading speed manipulations. However, the discrepancy becomes much more pronounced in the ultimate outcome of reading: comprehension. As discussed before, the observed large disparities in text comprehension under increased reading speed between L1 and L2 readers are presumably attributable to heightened variability in higher-order processing rather than to challenges in lexical processing.

4 Experiment 3: Effects of incremental reading speed increase on lexical access and comprehension monitoring

4.1 Introduction

The natural reading rate of a person is a highly individual characteristic influenced by multiple factors. External aspects, such as *text complexity*, reading goals, and task instructions, play a critical role in determining how quickly and effectively a person reads (see chapters 1.2.2.1 and 2.1). Simultaneously, internal factors, including processing speed and working memory capacity, contribute significantly to individual differences in the reading rate (Perfetti & Roth, 1980). While prior research produced (largely correlational) evidence for broad patterns in such influences, there remains a need for a more systematic exploration of the factors that distinguish faster from slower readers (Brysbaert, 2019). Particularly, there is a need to clarify how comprehension and moment-to-moment processing adapt to varying external demands. Building on the findings from Experiments 1 and 2, which examined the effects of reading speed manipulation on comprehension and eye movements, Experiment 3 takes a more individualized approach to address open questions.

In Experiment 1, a fixed-speed approach was employed to systematically vary the speed of reading, demonstrating a remarkable resilience for L1 reader's comprehension, when speed increased. One important aspect in the pattern of results was that participants' natural reading rate significantly impacted their ability to comprehend texts at accelerated speeds. More specifically, high natural reading rates predicted better comprehension for higher manipulated reading speeds. This finding makes perfect sense, given the fact that for the fastest readers in the sample, the fastest experimental speed (405 wpm) approximated their natural reading rate. This leads to the question to what extent the results of Experiment 1 may hold, when, instead of an overall average, the individual reading rate is used as a starting point. Following this logic, numerically identical increases in reading speed are likely to impose very uneven demands, when, as an example, the natural reading speed is 200 wpm for one individual and 350 wpm for another. Consequently, Experiment 3 employed a reading speed manipulation in increments derived as percentages of the individual baseline rate.

Looking at possible outcomes of an experiment with individualized speed increases, one hypothesis may suggest that faster readers possess higher levels of reading competence and flexibility, which may enable them to accommodate increasing reading speeds. Alternatively, it is possible that these individuals are already reading at or close to their maximum capacity, and that accelerating beyond this level could lead to a rather sharp decline in comprehension. Conversely, slower readers may possess untapped reserves that could be utilized in response to increased speed. The individualized approach enables a more nuanced investigation into whether adaptive potential is proportional to baseline rates, and whether slower and faster readers can achieve analogous adjustments when speed increases are tailored to their natural rate.

As evidenced by Experiments 1 and 2, valuable insights into reading processes can be derived from analyzing lexical benchmark effects. These studies demonstrated robust effects of word frequency and word length under varying speed conditions, underscoring the resilience of lexical access even when reading rates were substantially increased. While frequency effects were analyzed based on naturally occurring variations within text materials, this approach, though informative, has inherent limitations. Textual materials naturally vary not only in the lexical properties of interest (e.g., word frequency) but also in other correlated factors, such as word familiarity (frequency of words with the same word length and the same word beginning), word length, and *plausibility*. These co-triggered properties may confound the interpretation of results by introducing variability unrelated to the word frequency or length itself. For instance, high-frequency words tend to be more familiar and shorter, thereby inflating the observed effects (Levshina, 2021). The utilization of tightly controlled sentence and text material with systematically manipulated target words can avoid this problem.

Word frequency effects are a robust phenomenon in reading research, reflecting the efficiency of lexical access. However, these effects are modulated by task demands and cognitive engagement. In tasks with reduced cognitive load – such as visual search or mindless reading – frequency effects on non-target words are diminished (Rayner & Fischer, 1996; Rayner & Raney, 1996; Reichle et al., 2010; Schad et al., 2012), suggesting that lexical processing is less engaged when comprehension is not the primary objective. Conversely, tasks that demand deeper cognitive engagement, such as reading for comprehension or proofreading, amplify frequency effects. For example, Radach et al. (2008) found that frequency effects were stronger when comprehension questions were answered compared to a simpler word verification task. Additionally, proofreading tasks – requiring intense attention to orthographic details – yield even greater frequency effects (Kaakinen & Hyönä, 2010; Schotter et al., 2014).

Studies comparing regular reading with skimming reveal that while first-pass frequency effects remain relatively stable across different reading goals, later measures such as total viewing time and rereading probability are attenuated during skimming (Strukelj & Niehorster, 2018; White et al., 2015). Overall, these findings suggest that although the initial stages of lexical access are quite robust, the subsequent integrative processes are more susceptible to demands imposed by the reading task.

In addition to examining lexical effects, plausibility manipulations have emerged as a valuable approach to investigating real-time semantic processes during reading. Such manipulations provide insight into how readers detect and resolve inconsistencies within a text. For example, Rayner et al. (2004) demonstrated that implausible words – those that are unlikely but not outright incorrect – are associated with prolonged late reading measures, whereas anomalous words, which are clearly inappropriate in context, elicit immediate disruptions that are evident even in first-pass reading (see also Staub et al., 2007; Veldre et al., 2020). Specifically, anomalous words lead to a disruption of lexical processing, while implausible words tend to produce a more gradual recognition of difficulty that necessitates additional cognitive effort for integration into the existing semantic framework.

In recent literature, the detection of semantic inconsistencies has been used as a tool to study the process of comprehension monitoring (see Chapter 1.1.2.1). This higher-order cognitive process involves the active, ongoing evaluation of whether new information coheres with one's existing mental representation of the text, as well as the detection and subsequent repair of any inconsistencies that arise. Comprehension monitoring is critical for maintaining a coherent situation model during reading, ensuring that initial propositions are continuously assessed and, if necessary, reanalyzed or revised to reflect the true meaning of the text (Smith et al., 2021; Vorstius et al., 2013).

Embedding a plausible versus an implausible word within the context of a previously introduced action or situation allows us to infer the underlying comprehension monitoring processes by analyzing moment-to-moment processing dynamics (e.g., Kim et al., 2018). When encountering a word that appears implausible, readers may initially attempt to construct meaning from contextual cues before recognizing the incongruity. This process results in delayed effects, such as increased refixation and overall reading times, as well as higher regression probabilities. These patterns indicate an ongoing reevaluation process, wherein readers reassess the sentence to reconcile the detected semantic mismatch. Consequently, prolonged fixations on implausible words serve as a sensitive indicator of comprehension monitoring (Baker, 1989; Vorstius et al., 2013).

Rather than relying solely on conventional post-reading comprehension questions – which have been shown to influence reading behavior, particularly when presented frequently – comprehension monitoring offers a more direct measure of how semantic inconsistencies are detected and resolved during reading. By analyzing implicit indicators such as regression probability, gaze duration, and total viewing time, a more precise window into ongoing comprehension processes is obtained.

Prior research has demonstrated that readers with greater cognitive capacities, particularly higher working memory (WM) capacity, are more adept at detecting and resolving inconsistencies within a text, owing to their ability to simultaneously maintain and manipulate larger amounts of information (Long & Prat, 2008; Peng et al., 2018). As a fundamental domain-general cognitive resource, working memory plays a critical role in integrating new linguistic input with prior knowledge, thereby enabling the construction of coherent mental representations of the text. In the context of reading, working memory is essential not only for activating lexical representations but also for integrating these representations into higher-level syntactic and semantic structures – a process that becomes particularly demanding when encountering complex or ambiguous material (Traxler et al., 2012).

Individuals with higher working memory capacity tend to exhibit more efficient lexical access, as indicated by shorter fixation durations and fewer regressions (Daneman & Carpenter, 1980; Johann et al., 2020). This efficiency has also been associated with smaller frequency effects, suggesting that high-capacity readers are less challenged by variability in word frequency (Ashby et al., 2005). Beyond lexical access, WM capacity has been demonstrated to influence comprehension monitoring (Komori, 2016; Pérez et al., 2016; Tibken et al., 2024). While in Pérez et al. (2016) inconsistencies in the text were detected regardless of WM capacity, individuals with higher working memory capacity were able to disengage from an initial interpretation more quickly and construct a revised situation model with greater efficiency. This suggests that high-capacity readers may allocate cognitive resources more flexibly, allowing them to adapt to new information with minimal processing delays. In line with these findings, individuals who possess a superior WM capacity generally demonstrate an enhanced ability to manage the demands of dual-tasks, a proficiency that extends to reading comprehension (e.g., Azevedo et al., 2022). By measuring WM capacity alongside individualized speed manipulations, Experiment 3 aims to explore how this cognitive resource interacts with task demands to shape reading behavior and comprehension. It was hypothesized that individuals with higher WM capacities would demonstrate greater resilience to speed increases and would maintain efficient word processing and information integration even under increased demands.

Building on the theoretical foundations and empirical findings of the previous experiments, Experiment 3 implements an individualized reading speed manipulation in which participants read at 100%, 125%, and 150% of their personal baseline speed. In addition to this individualized speed manipulation, the experiment includes tightly controlled lexical manipulations by varying word frequency and plausibility. The latter allows comprehension to be assessed primarily through comprehension monitoring, a method that captures the moment-to-moment processing of semantic inconsistencies. To further increase the information gain on inter-individual differences, the effect of baseline reading speed and working memory capacity on the adaptivity of the reading process was explored.

In summary, this study takes a methodologically refined approach to understanding the interplay between reading efficiency and comprehension under dynamic conditions. The anticipated results are expected to elucidate the mechanisms that allow readers to adapt to external constraints and to inform strategies for improving reading performance in diverse populations.

4.2 Methodology

Participants

The sample size for the experiment was determined using the means and standard deviations from Experiment 1, combined with the frequency effects expected on the basis of White et al. (2015). As White et al. found interactions involving word frequency only in late measures, total reading time was selected as the dependent variable, as interaction effects typically require higher statistical power than main effects (Brysbaert & Stevens, 2018). See supplementary material S3 for the detailed estimates.

Power calculations were conducted using simulation-based methods outlined by Kumle et al. implemented through the mixedpower package (version 0.1.0) in R (Kumle et al., 2021). This approach is suitable for estimating power in mixed-effects models with complex designs. The model incorporated reading speed (baseline, 100%, 125%, 150%), word frequency (high, low), and their interaction as fixed effects, with random effects for subjects and items. The simulation results indicated that a sample size of 35 participants provides sufficient power to detect the main effects of speed and word frequency, as well as their interaction, with a smaller frequency effect expected at the highest reading speed. The power values for the main effects of speed and word frequency were 0.97 and 0.99, respectively, while the power for the interaction was 0.86. This sample size is regarded as adequate in accordance with established benchmarks in the field of psychological research (Cohen, 1988).

The final sample comprised 41 participants, with an average age of 24.78 years (*SD* = 10.18) and German as their first language. Of these, 11 identified as male and 30 as female. The participants were predominantly psychology students from the University of

Wuppertal/Germany, who received course credits in compensation for their participation (66%), while the remaining participants did not receive compensation. It was ascertained that all participants had normal or corrected-to-normal vision.

Materials

The experimental materials comprised 72 items, each consisting of five German sentences (279–423 words) with a mean word length of 6.02 letters. Each item commenced with a neutral introductory sentence, followed by a sentence pair designed to manipulate plausibility and facilitate the measurement of comprehension monitoring. In the second sentence of each pair, a target word (a noun) was introduced, either plausible or implausible relative to an event or action expressed in the previous sentence, with a length ranging from five to ten characters. Target words were controlled for word length, type frequency (frequency of the word form), lemma frequency (frequency of the infinitive), word beginning familiarity (sum of the frequency of all words with the same word length and the same three initial letters), and word beginning regularity (frequency of all words with the same word length and the same three initial letters). All values had been sourced from the dlexdb database (see Appendix E1 and E2 for statistical comparison between the two types of target words).

In the fourth sentence within each five-sentence item, noun frequency was manipulated, with target words ranging in length from six to seven characters. High-frequency lemma occurrences (from the Subtlex database) were set to more than 20 occurrences per million words (mean = 87.96), while low-frequency lemma occurrences were below four (mean = 1.45).

Counting from the beginning of each line, there were always at least two words in front of both target words, so that this word was placed as centrally as possible to avoid longer viewing times due to the word being at the beginning or end of the sentence (e.g., Kuperman et al., 2010). Each item concluded with a neutral closing sentence. An example paragraph is presented in Figure 18 (see Appendix F all test stimuli).

Figure 18

Example paragraph presenting the predictability and frequency manipulation (Experiment 3)

```
Nach mehreren Monaten Arbeit am Stück hatte Hannah bald endlich frei. Im
Sommer flog sie dieses Mal nicht zum Strandurlaub nach Portugal. Leider
wurden ihre Flüge/Wände gestrichen und sie musste zuhause bleiben.
Die landesübliche Nahrung/Schwüle hatte sie körperlich sowieso nie richtig
vertragen. Sie überlegte sich, wie sie ihre freie Zeit sinnvoll nutzen
könnte.
```

Note. The plausibility manipulation is presented in bold font and the frequency manipulation underlined for visualization purposes.

In addition, 16 practice items were created, which approximated the structure of the experimental items. Eight of these were presented prior to the baseline measurement, with the aim of introducing the general setup. The remaining eight were shown before the first line-by-line manipulation, with the objective of familiarizing participants with the speed manipulation.

To ensure attentive reading, 16 comprehension questions were placed throughout the experiment, with four questions per speed condition. The comprehension questions were designed so that in 50% of cases they were surface-level questions directly based on the text, while in the other 50% they were more complex and relied on the construction of a situation model (see Chapter 1.1.2).

The information required for responses was uniformly distributed across different positions across the text (1st, 2nd, 3rd, or 4th quarter), and none of the questions referenced any target words. The questions were structured in an open format, with participants providing oral responses, which were subsequently rated on a point scale from 0 (incorrect), over 1 (partially correct) to 2 (completely correct).

The assessment of working memory capacity was conducted using the Short Test for the Measurement of working memory (KAI-N; Lehrl & Balaha, 2001), which evaluates two core dimensions: processing speed and memory span. The test comprises two tasks:

Processing Speed: Participants are required to read aloud rows of 20 meaningless letters from four cards as quickly as possible. The fastest reading time across the four trials was used to determine the processing speed, measured in bits per second (bit/sec).

Memory Span: This test is comprised of two parts. The examiner will read out sequences of numbers and letters of increasing length in a monotone voice, with an interval of one second between each sequence. Participants are instructed to repeat these sequences verbally. Testing continues until errors are made on two attempts of the same sequence length, with memory span measured in seconds.

The KAI-N integrates these measures by multiplying processing speed and memory span to calculate working memory capacity, expressed in bits. This composite measure represents the participant's maximum conscious information processing ability. The test, developed for efficiency with a completion time of approximately five minutes, ensures minimal fatigue effects and demonstrates satisfactory psychometric properties.

Apparatus

Eye movements were recorded using an SR Research EyeLink 1000 eye tracker, with a sampling rate of 2000 Hz. Participants were positioned at a distance of approximately 80 centimeters from a 21-inch CRT monitor, which had a resolution of 1682 x 1050 pixels and a refresh rate of 120 Hz. To mitigate the impact of head movements, a chin and forehead rest was utilized. At this distance, three characters corresponded to approximately one degree of visual angle.

Procedure

The study, which was approved by the Research Ethics Board of the University of Wuppertal (SK/AE 230616), collected data in 2023.

Following the completion of the demographic questionnaire and the working memory test, participants read 22 paragraphs at their regular pace to establish a baseline reading rate. Utilizing this baseline, their reading speed was then individually augmented, commencing at the regular speed (100%), followed by a 25% increase, and concluding with a 50% increase. Within each designated speed condition, participants were required to read 22 paragraphs.

Reading speed was manipulated using the line-by-line technique, as in Experiments 1 and 2. The duration of each line’s highlight was determined by the number of characters in the line and the average word length in the texts (6.1 letters), ensuring alignment with the target words per minute rates. The incorporation of the 100% speed condition functioned as a control to differentiate changes in reading behavior caused by the technique itself from those induced by increased reading speed. Absent this condition, it would be difficult to ascertain whether the observed effects resulted from the modified reading format itself or the manipulation of speed.

Variables

As in Experiment 1 and 2, a number of dependent variables associated with eye movements during reading were analyzed. For a more detailed description of variables, see Experiment 1 and for a comprehensive overview, see Inhoff & Radach (1998). Measures used in this study included fixation probability, first fixation duration, gaze duration, total viewing time, refixation probability, and regression-in probability.

The primary independent variable was reading speed, which was manipulated across four levels: the natural reading rate, 100%, 125%, and 150% of the individual baseline speed. Additionally, the influence of word frequency was examined, with target words being either high- or low-frequency. A further manipulation involved the plausibility of a second target word, which was either plausible or implausible within the given context. This design enabled an analysis of comprehension monitoring by examining variations in viewing times on the respective target word.

Moreover, the study sought to explore the influence of working memory capacity, as measured by the KAI-N test (Lehrl & Balaha, 2001), on the reading process and the effects of increased reading speed. This additional focus provided insights into individual differences that could moderate the impact of speed manipulations on reading behavior and comprehension.

Statistical considerations

For a comprehensive overview of the statistical considerations pertaining to all experiments, please refer to Chapter 1.4.4.

4.3 Results

Fixations that were shorter than 80 ms or longer than 600 ms were excluded from the analysis, representing 3.01% of the total number of fixations. Additionally, observations with gaze durations exceeding 1,000 ms (0.29%), total reading times above 1,500 ms (0.10%) and more than six fixations on a word (0.16%) were excluded. The remaining data consisted of 151,381 observations, representing 96.46% of the initial dataset.

The analysis is structured into two primary sections. The first one considers the global effects of reading speed on overall text processing, providing insights into changes in general eye movement behavior across speed conditions. Table 9 presents descriptive statistics for all reported eye movement measures under the varying speed conditions, summarizing how speed manipulation influenced the reading process on a general level.

The subsequent section focuses on local effects, analyzing oculomotor behavior with respect to the specific target words manipulated for frequency and plausibility. These analyses provide a more nuanced understanding of how lexical and contextual properties interact with increasing reading speed.

Additionally, exploratory analyses are conducted to evaluate the role of baseline reading speed and working memory capacity in moderating the observed effects. Here, the focus is on how individual differences in participants working memory and the natural reading rate influence both global and local measures of eye movements under varying speed conditions.

To differentiate the effects of the specific levels of speed using general linear mixed-effects models, backward difference contrast coding was employed. In the initial step, the individual baseline reading rate was compared to the 100% condition (using the line highlighting technique at the same speed), followed by a comparison of 100% with 125%, and finally, 125% with 150%.

Table 9

Descriptive statistics of eye movement measures for the overall text (Experiment 3)

	Speed			
	Baseline	100%	125%	150%
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Fixation probability	.75 (.43)	.74 (.44)	.69 (.46)	.63 (.48)
First fixation duration (ms)	201 (74)	214 (84)	209 (81)	204 (76)
Gaze duration (ms)	238 (118)	256 (136)	246 (127)	236 (116)
Total reading time (ms)	313 (201)	314 (193)	281 (163)	259 (142)
Refixation probability	.18 (.40)	.19 (.39)	.17 (.38)	.15 (.36)
Regression-in probability	.20 (.01)	.19 (.02)	.16 (.02)	.13 (.02)

Global analyses for the effect of reading speed on eye movements

The average reading rate at the individual baseline ranged from 131 wpm to 467 wpm with an average speed of 245 (*SD* = 45).

A comprehensive summary of all eye movement measures is presented in Table 9. Figure 19 visualizes the decomposition of total reading time, divided into first fixation duration, refixation time, and rereading time across the four speed conditions. First fixation duration remains relatively stable across the speed range, showing only a slight increase between baseline and the 100% condition. However, it decreases slightly at the higher speeds. A similar pattern is observed for the refixation time, although the most pronounced changes are in the rereading time. The baseline condition demonstrates the longest rereading time, which decreases systematically across the speed increases. The mean number of fixations on a word reveals a decline in fixation frequency with increasing speeds, particularly for fixations of two or more, suggesting a systematic pattern (see Figure 20).

GLMMs confirm that all oculomotor measures were significantly influenced by the reading speed manipulation (see Appendix G1 – G6 for full model specifications and main effects in Table 10 and Table 11). Initially, fixation and gaze durations were the longest in the 100% condition and subsequently decreased systematically with increasing speed. However, these changes were numerically modest; for first fixation duration the difference between each speed condition was approximately 5 ms (or 2% of relative change), with all durations numerically higher than baseline. Gaze duration showed a 10 ms decrease with each speed increment (4% of relative change), reaching a value similar to baseline at 150% speed.

Total reading time did not differ significantly between baseline and the 100% speed condition, but showed a clear and significant reduction at the higher speeds: a decrease of 33 ms between 100% and 125%, and 22 ms between 125% and 150% (11% and 8% of relative change). Fixation probability showed a slight decrease from baseline to 100% (1%), with more pronounced decreases of 5% and 6% for the transitions from 100% to 125% and 150%, respectively. Similarly, refixation probability remained equal between baseline and 100%, but decreased by 2% with each subsequent speed increment.

As a final variable, the probability that the saccade into the word was an inter-word regression (originated from a location to the right of the current word) was examined. The baseline condition showed the highest regression-in rate, which underwent a significant and continuous decrease across the speed conditions. However, the observed differences between the baseline and 100% are relatively minor, with a 1% reduction. A slightly more substantial reduction occurred between the subsequent two speed increases, with a 3% reduction for each increase.

Figure 19

First fixation duration, refixation duration and rereading time as a percentage of the total reading time for the different speed conditions (Experiment 3)

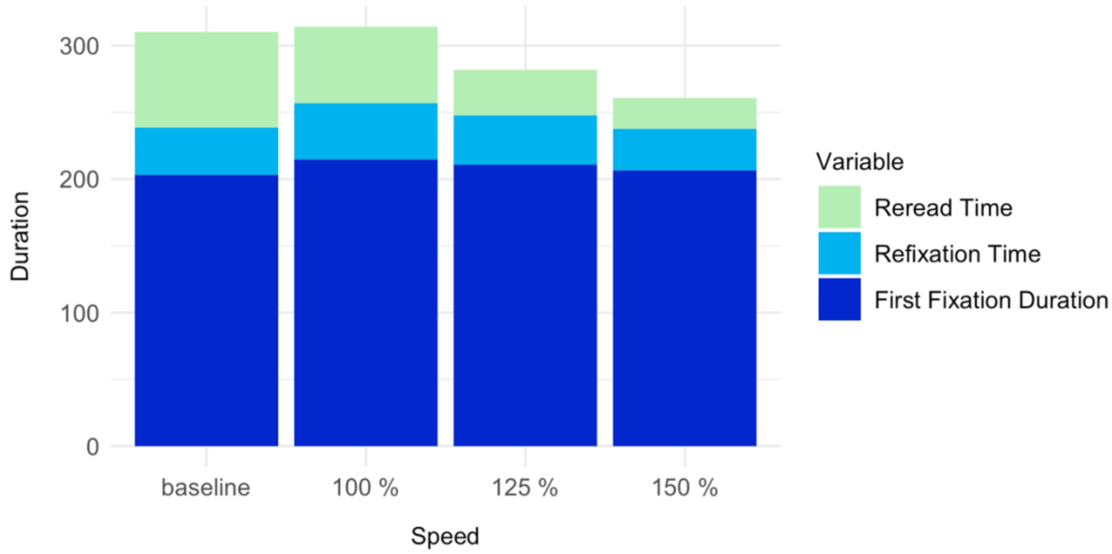
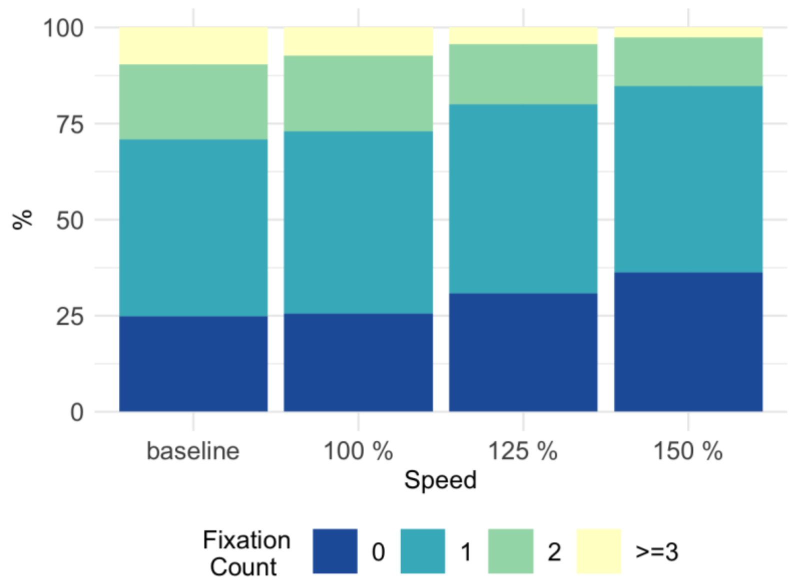


Figure 20

Proportion of fixation count for the different speed conditions (Experiment 3)



Exploration of individual differences. In an effort to ascertain the interdependence of eye movement alterations across subjects at differing speeds, a two-pronged approach was adopted. Firstly, the baseline reading rate was taken into consideration, and secondly, the working memory capacity of the subjects was evaluated. A Pearson correlation analysis revealed a significant positive relationship between reading rate and working memory capacity, $r(39) = .62$, $p < .001$, 95% CI [.616, .623]. This finding suggests the presence of a moderately strong association, indicating that individuals with higher working memory capacity tend to read at a faster pace.

For both factors, a binary variable was created using a median split (faster vs. slower reading rate, and high vs. low working memory capacity). Participants classified as faster readers ($n = 20$) had a mean baseline reading rate of 318 wpm ($SD = 64.2$), whereas slower readers ($n = 21$) had a mean of 196 wpm ($SD = 32.4$). Regarding working memory capacity, participants with higher scores ($n = 21$) achieved an average score of 135 ($SD = 25.4$), while those with lower working memory capacity ($n = 20$) had a mean score of 93 ($SD = 12$).

Baseline reading rate. All oculomotor measures were found to be significantly influenced by the baseline reading rate (see Appendix G7 – G12 for the full models). Faster readers demonstrated shorter viewing times, fewer (re)fixations, and fewer regressions-in. Rather than employing distinct reading strategies, their advantage appears to stem from greater efficiency across all processing stages (see Figure 21 and Table 10 for ANOVA-style results).

Interactions between the baseline reading rate and speed manipulation were observed for refixation probability, gaze duration, total viewing time, and regression-in probability. The interactions for refixation probability revealed a significant difference between the baseline and the 100% condition, indicating that the baseline reading rate had a stronger influence at the 100% condition compared to the baseline condition (see Figure 21 E). For gaze duration, interactions emerged in both the first and third speed contrasts. The discrepancy between faster and slower readers was more pronounced in the 100% condition compared to the baseline condition, whereas in the 150% condition, this discrepancy was slightly reduced compared to the 125% condition (see Figure 21 B). In contrast, for total reading time, the influence of baseline reading rate progressively diminished across all speed contrasts (see Figure 21 C). A further interaction was observed for regression-in probability. At baseline, slower readers numerically made more regressions than faster readers. However, with increased speed, this trend reversed, leading to a significantly stronger reduction in regression-in probability for slower readers compared to faster readers (see 21 F). As a result, in the manipulated speed conditions, slower readers ultimately demonstrated a more and more reduced number of regressions in comparison to their faster counterparts, even though they maintained a slightly higher absolute regression frequency.

Overall, there were significant disparities between faster and slower readers in all eye movement parameters except regression-in (where a similar numerical trend was observed). However, these differences were diminished to some extent at higher speeds. This phenomenon is particularly evident in the stronger adaptation shown by slower readers in the late processing stages.

Table 10

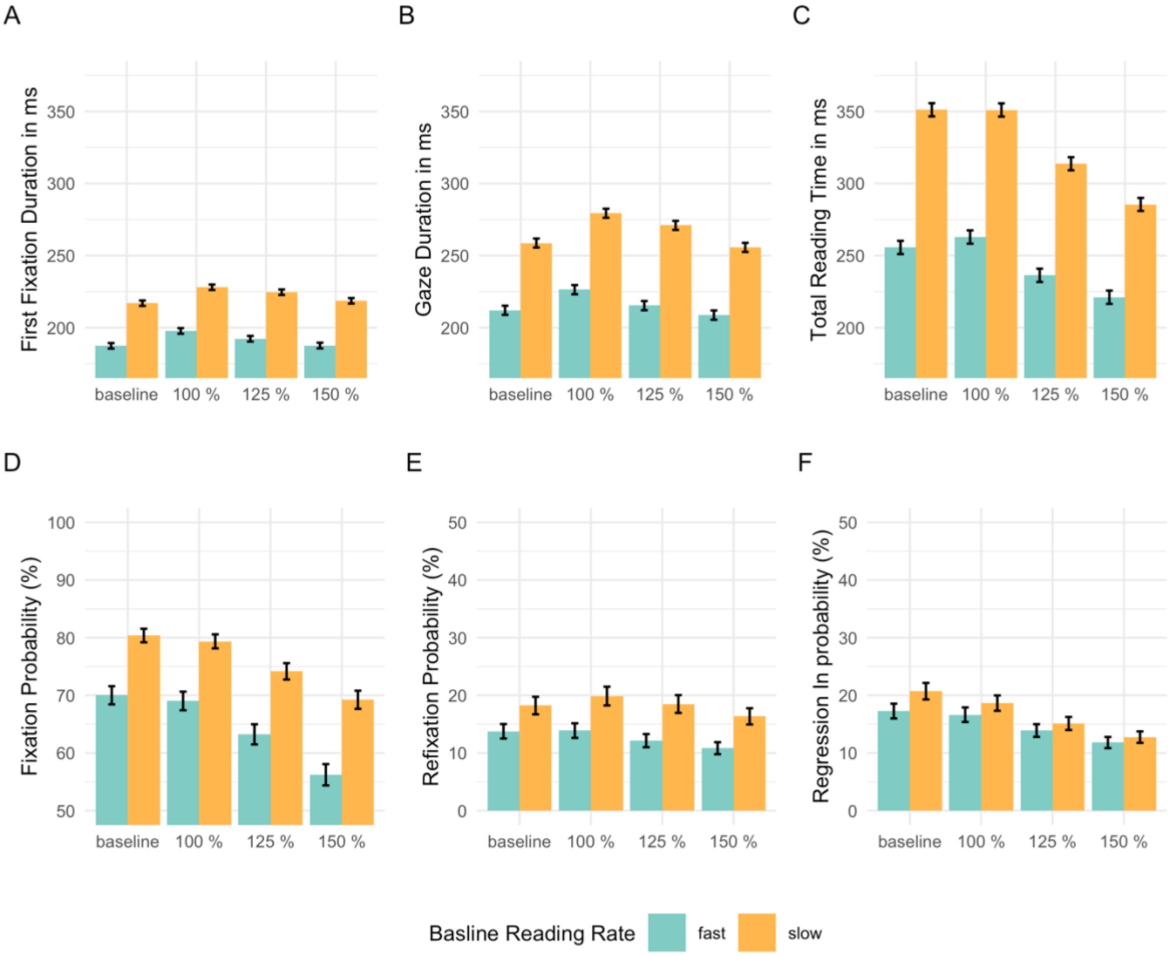
ANOVA-style summary of eye movement measures as a function of reading speed and baseline reading rate (Experiment 3)

Measure	Factor	χ^2	*df*	*p*
Fixation probability (%)	Speed	**721.98**	**3**	**<.001**
	Baseline rate	**28.22**	**1**	**<.001**
	Speed: Baseline rate	3.02	3	.39
Refixation probability (%)	Speed	**46.00**	**3**	**<.001**
	Baseline rate	**8.89**	**1**	**<.001**
	Speed: Baseline rate	**13.51**	3	**<.001**
First fixation duration (ms)	Speed	**179.31**	**3**	**<.001**
	Baseline rate	**29.63**	**1**	**<.001**
	Speed: Baseline rate	1.41	3	.70
Gaze duration (ms)	Speed	**176.06**	**3**	**<.001**
	Baseline rate	**151.64**	**1**	**<.001**
	Speed: Baseline rate	**31.82**	**3**	**<.001**
Total reading time (ms)	Speed	**708.31**	**3**	**<.001**
	Baseline rate	**183.56**	**1**	**<.001**
	Speed: Baseline rate	**155.79**	**3**	**<.001**
Regression-in (%)	Speed	**645.74**	**3**	**<.001**
	Baseline rate	1.60	**1**	.21
	Speed: Baseline rate	**13.02**	**3**	**.005**

Note. Values with p < .05 are presented in **bold**.

Figure 21

Effects of reading speed and baseline reading rate on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), regression-in (F) (Experiment 3)



Note. Error bars represent ±1 SE.

Working memory capacity. The impact of working memory capacity on the examined variables was found to be significant, with the exception of regression-in probability (see Table 11 and Appendix G13 - G18 for the full models). In a manner analogous to the baseline reading rate, all temporal parameters were found to be significantly shorter for participants with high WM capacity. These individuals also exhibited a reduced number of fixations and refixations in comparison to those with lower working memory capacity. Additionally, while the effect did not reach statistical significance, a numerical trend suggests that individuals with higher working memory capacity tended to make fewer regressions across all speed conditions. A visual representation of these effects is provided in Figure *22*. Furthermore, significant interactions between speed manipulation and WM capacity were observed for fixation probability and total reading time (see Figure 22 C and D). The difference in fixation probability between the high and low working memory capacity groups was significantly smaller in the 125% condition compared to the 100% condition. Similarly, for total viewing time the difference between the two groups was more pronounced in the 125% condition than in the 150% condition.

Overall, a trend emerges suggesting that differences between the two groups diminish at higher reading speeds, similar to the pattern observed for the baseline reading rate. Notably, the primary finding underscores the substantial impact of WM capacity on eye movement behavior, suggesting that individuals with higher working memory capacity process texts more efficiently across all conditions.

Table 11

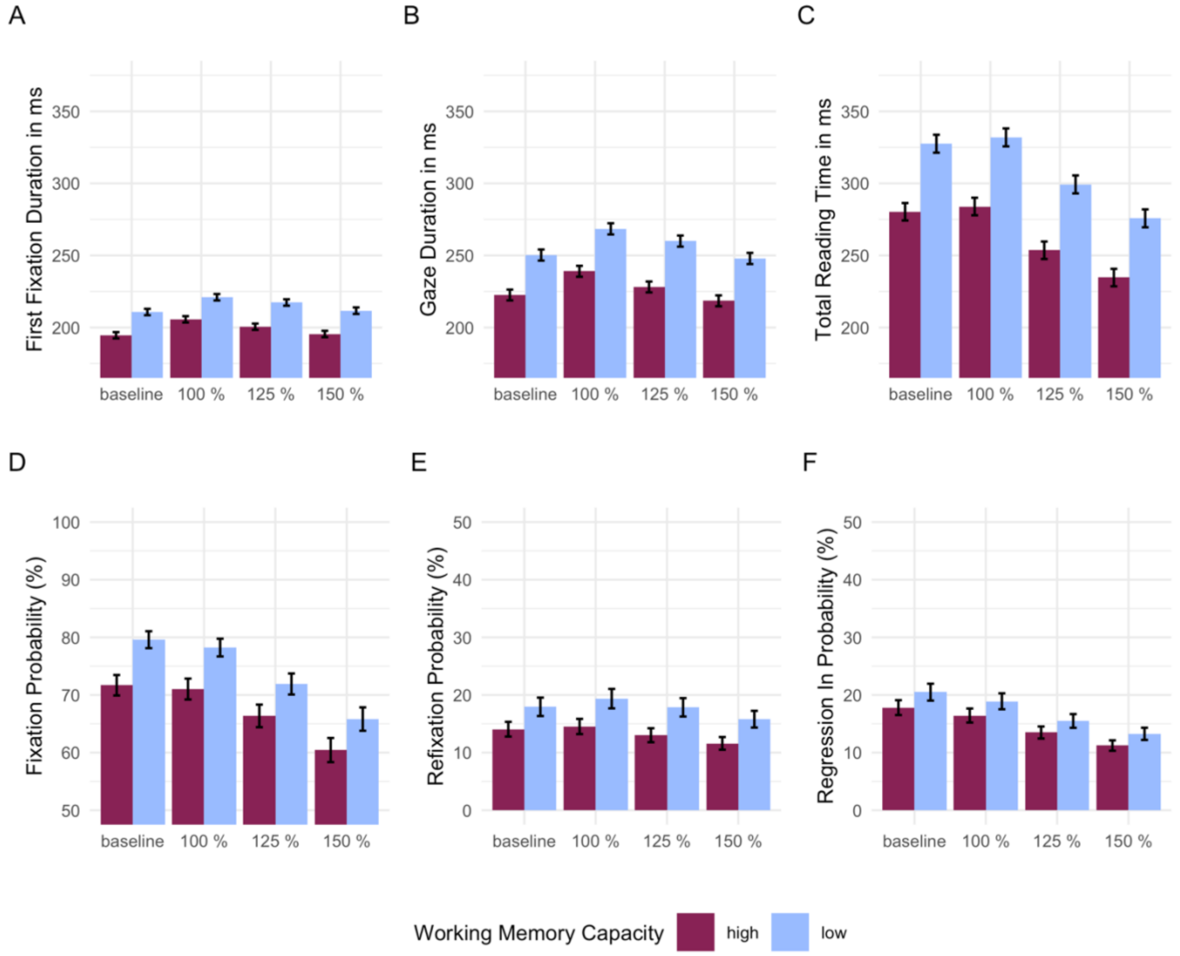
ANOVA-style summary of eye movement measures as a function of reading speed, word length and working memory capacity (Experiment 3)

Measure	Factor	χ^2	*df*	*p*
Fixation probability (%)	Speed	**699.51**	**3**	**<.001**
	Working memory	**7.00**	**1**	**<.001**
	Speed: Working memory	**49.36**	**3**	**<.001**
Refixation probability (%)	Speed	**45.91**	**3**	**<.001**
	Working memory	**5.24**	**1**	**.02**
	Speed: Working memory	3.56	3	.31
First fixation duration (ms)	Speed	**179.32**	**3**	**<.001**
	Working memory	**29.63**	**1**	**<.001**
	Speed: Working memory	1.41	3	.70
Gaze duration (ms)	Speed	**176.83**	**3**	**<.001**
	Working memory	**33.43**	**1**	**<.001**
	Speed: Working memory	4.74	3	.19
Total reading time (ms)	Speed	**705.89**	**3**	**<.001**
	Working memory	**29.74**	**1**	**<.001**
	Speed: Working memory	**8.08**	**3**	**.004**
Regression-in (%)	Speed	**651.44**	**3**	**<.001**
	Working memory	1.95	1	.16
	Speed: Working memory	0.31	3	.96

Note. Values with p < .05 are presented in **bold**.

Figure 22

Effects of reading speed and working memory capacity on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), regression-in (F) (Experiment 3)



Note. Error bars represent ±1 SE.

Local analyses for the effects of reading speed on eye movements

Local analyses were conducted to examine specific word-level processing mechanisms. To this end, the frequency and predictability of manipulated target words were computed to determine the nature of lexical processing and higher-order information integration during reading at increased speeds. These analyses exclude cases in which blinks occurred on the critical word, affecting 8.45% of cases for the frequency targets and 8.21% for the plausibility targets.

Word frequency effects

The full GLMM results detailing the effects of word frequency are presented in Appendix G19 – G24. The ANOVA-style results (see Table 12) indicate a significant main effect of word frequency across all measures, with the exception of regression-in probability. Low-frequency words were fixated and refixated more frequently and resulted in longer viewing times.

Additionally, a main effect of speed was observed for fixation probability, gaze duration, and total reading time. As was reported in the global analyses, higher reading speeds led to lower fixation probabilities, shorter gaze durations and total reading times.

A notable interaction between reading speed and word frequency was identified for total reading time. As demonstrated in Figures 23 C and 24 C, the frequency effect exhibited a slight reduction at higher speeds but remained discernible even at 150% of the natural reading rate. This finding underscores the robustness of lexical processing under accelerated reading conditions. However, under the increasing constraints of faster speed, readers are forced to limit processing time, especially for more difficult words.

Table 12

ANOVA-style summary of eye movement measures as a function of reading speed and word frequency (Experiment 3)

Measure	Factor	χ^2	*df*	*p*
Fixation probability (%)	Speed	**25.61**	**3**	**<.001**
	Frequency	**21.03**	**1**	**<.001**
	Speed: Frequency	1.97	3	.58
Refixation probability (%)	Speed	4.2	3	.24
	Frequency	**16.61**	**1**	**<.001**
	Speed: Frequency	1.49	3	.69
First fixation duration (ms)	Speed	5.07	3	.17
	Frequency	**26.23**	**1**	**<.001**
	Speed: Frequency	1.36	3	.72
Gaze duration (ms)	Speed	**7.96**	**3**	**.04**
	Frequency	**47.34**	**1**	**<.001**
	Speed: Frequency	4.79	3	0.19
Total reading time (ms)	Speed	**44.09**	**3**	**<.001**
	Frequency	**58.41**	**1**	**<.001**

Measure	Factor	χ^2	*df*	*p*
	Speed: Frequency	**11.51**	**3**	**.009**
Regression-in (%)	Speed	**9.12**	**3**	**.03**
	Frequency	2.27	1	.13
	Speed: Frequency	2.54	3	.47

Note. Values with p < .05 are presented in **bold**.

Exploration of individual differences. While the preceding sections were focused on main effects of word frequency, baseline reading rate, and working memory capacity on a global level, the following sections will focus on potential interactive effects. In this context it is of particular interest whether participants with high baseline reading rates and high working memory capacity exhibit larger or smaller overall frequency and predictability effects, especially at increased reading speeds.

Baseline reading rate. Table 13 shows the ANOVA-style results for a model including word frequency and the baseline reading rate as predictors (see Appendix G25 – G30 for the full models). A visual representation of these effects is presented in Figure 23.

Substantial interaction effects were identified for gaze duration, total reading time, and regression-in probability. Specifically, an interaction between word frequency and baseline reading rate was identified for gaze duration, suggesting that individuals with slower reading speeds showed larger frequency effects compared to those with faster reading speeds (see Figure 23 B). However, this effect remained stable across different reading speeds, as evidenced by the non-significant three-way interaction.

For total reading time, three significant interaction effects were observed. Consistent with the findings for gaze duration, the frequency effect was more pronounced for slower readers and was particularly strong at lower reading speeds. Furthermore, a notable three-way interaction indicated that the frequency effect diminished specifically when reading speed increased from 100% to 125% for participants with a lower baseline reading rate (see Figure 23 C). A similar three-way interaction was identified in the regression-in probability analysis. At the baseline level, low-frequency words were more likely to be targeted by regressions for slower readers. However, this effect diminished in the 100% speed condition.

Overall, the frequency effects were consistently observed across all readers and reading speeds, with a slight numerical reduction in the 125% speed condition. Potential explanations for this attenuation are addressed in the discussion. The finding that slower readers exhibited stronger frequency effects, particularly in later processing stages, suggests greater difficulty in processing low-frequency words.

Table 13

ANOVA-style summary of eye movement measures as a function of reading speed word frequency, and baseline reading rate (Experiment 3)

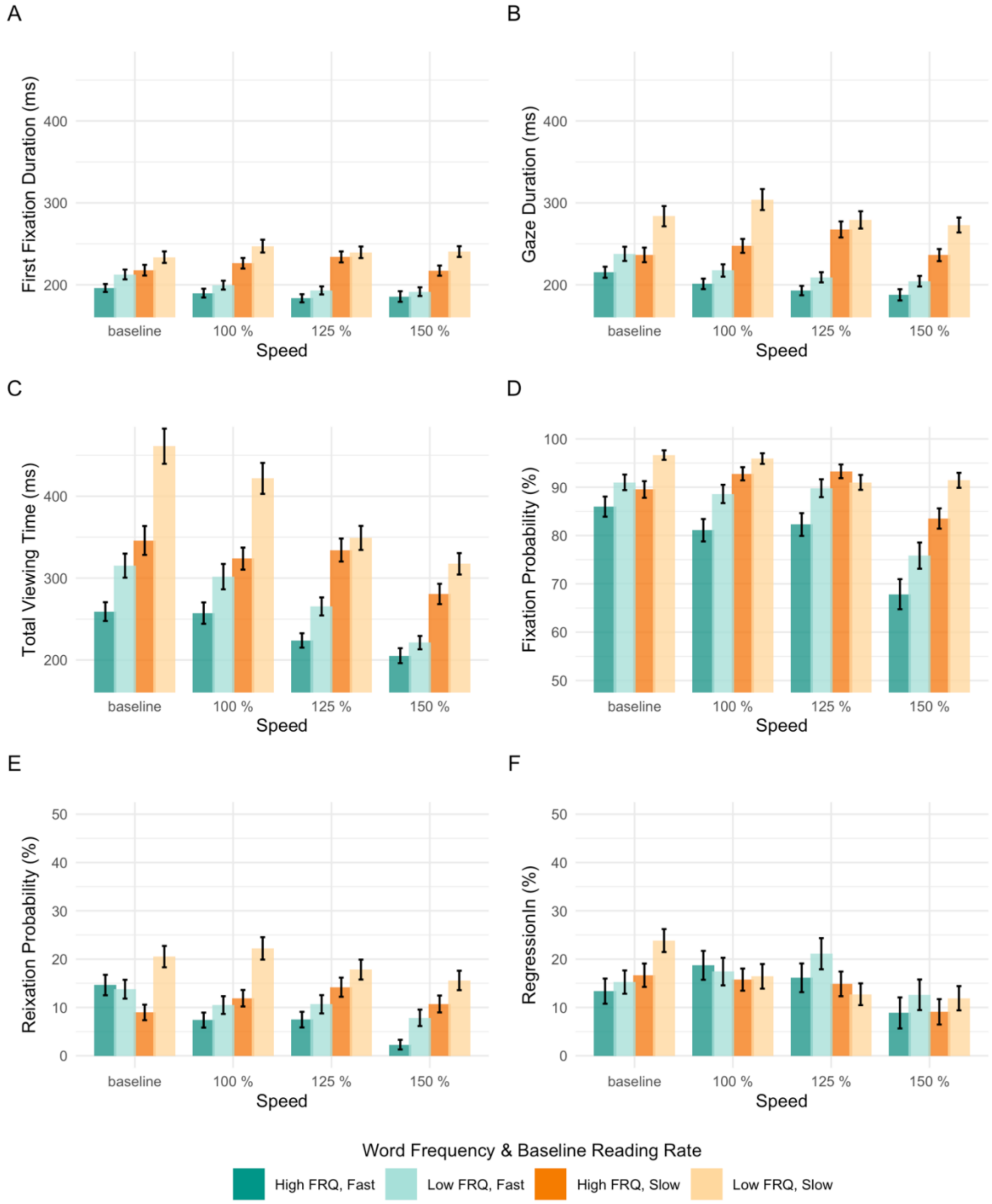
Measure	Factor	χ^2	*df*	*p*
Fixation probability	Speed	**24.37**	**3**	**<.001**
	Frequency	**19.96**	**1**	**<.001**
	Baseline rate	**13.52**	**1**	**<.001**
	Speed: Frequency	2.67	3	.44
	Frequency: Baseline rate	0.09	1	.76
	Speed: Frequency: Baseline rate	9.99	6	.13
Refixation probability	Speed	3.99	3	.26
	Frequency	**14.56**	**1**	**<.001**
	Baseline rate	**4.36**	**1**	**.04**
	Speed: Frequency	1.24	3	.74
	Frequency: Baseline rate	2.19	1	.14
	Speed: Frequency: Baseline rate	8.01	6	.23
First fixation duration	Speed	5.59	3	.13
	Frequency	**26.28**	**1**	**<.001**
	Baseline rate	**5.51**	**1**	**.02**
	Speed: Frequency	1.36	3	.71
	Frequency: Baseline rate	0.21	1	.65
	Speed: Frequency: Baseline rate	6.14	6	.48
Gaze duration	Speed	**7.89**	**3**	**0.05**
	Frequency	**49.63**	**1**	**<.001**
	Baseline rate	**38.79**	1	**<.001**
	Speed: Frequency	5.18	3	.16
	Frequency: Baseline rate	**8.57**	1	**.003**
	Speed: Frequency: Baseline rate	10.07	6	.12

Measure	Factor	χ^2	*df*	*p*
Total reading time	Speed	**44.13**	**3**	**<.001**
	Frequency	**57.63**	**1**	**<.001**
	Baseline rate	**51.72**	**1**	**<.001**
	Speed: Frequency	**9.98**	**3**	**.02**
	Frequency: Baseline rate	**5.53**	**1**	**.02**
	Speed: Frequency: Baseline rate	**14.65**	**6**	**.02**
Regression-in probability	Speed	**9.44**	**3**	**.03**
	Frequency	2.58	1	.11
	Baseline rate	0.10	1	.75
	Speed: Frequency	2.53	3	.47
	Frequency: Baseline rate	0.11	1	.74
	Speed: Frequency: Baseline rate	**13.14**	**6**	**.04**

Note. Values with $p < .05$ are presented in **bold**.

Figure 23

Effects of reading speed, word frequency and working memory capacity on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), regression-in (F) (Experiment 3)



Note. Error bars represent ±1 SE.

Working memory capacity. Building on the previously reported main effects, the focus in this section is on interactions with WM capacity. Significant interactions were observed for fixation probability, refixation probability, gaze duration, and regression-in (see Table 14 for ANOVA-style results and Appendix G31 – G36 for the full models).

For refixation probability and gaze duration, a significant interaction between word frequency and WM capacity emerged (see Figure 24 B and 24 E). In both cases, the frequency effect was more pronounced in the low WM capacity group, indicating greater processing difficulty for low-frequency words in this group.

Fixation probability showed a significant three-way interaction; while a clear plausibility effect is visible for all other speeds (see Figure 24 D), no such effect emerged for participants with low WM capacity in the 125% speed condition.

A three-way interaction was also observed for regression-in probability, with a significant difference between the 100% and 125% speed conditions. In the faster condition, readers with high working memory capacity exhibited stronger word frequency effects. In contrast, for readers with low working memory capacity, low-frequency words demonstrated a numerically reduced likelihood of being the target of a regression.

The findings indicate an association between elevated working memory capacity and reduced reanalysis, particularly in the context of processing complex vocabulary. However, robust frequency effects were observed in both groups and remained largely stable across different reading speeds.

Table 14

ANOVA-style summary of eye movement measures as a function of reading speed, word frequency and working memory capacity

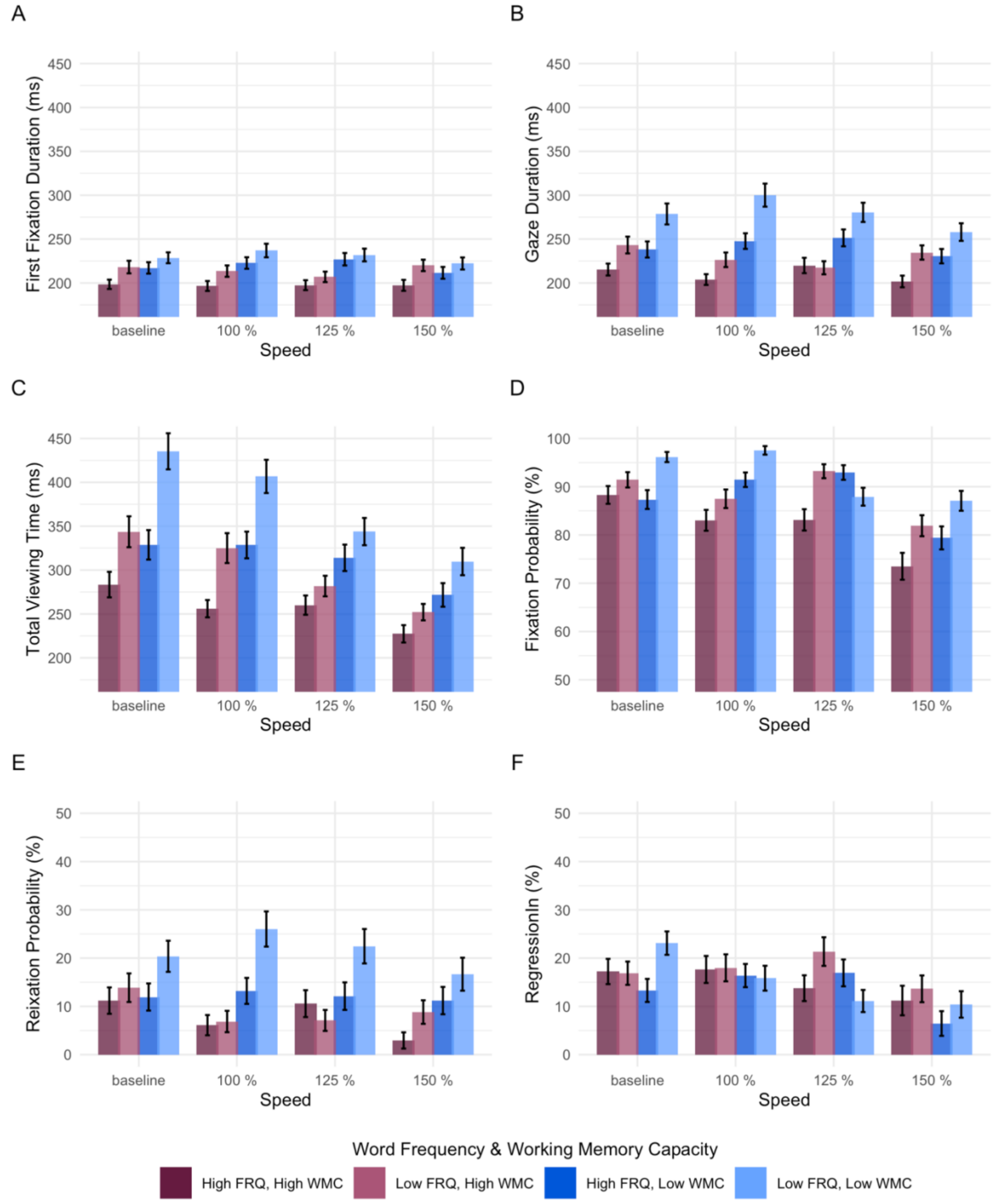
Measure	Factor	χ^2	*df*	*p*
Fixation probability	Speed	**21.94**	**3**	**<.001**
	Frequency	**17.4**	**1**	**<.001**
	Working memory	2.45	1	.12
	Speed: Frequency	2.61	3	.46
	Frequency: Working memory	0.38	1	.54
	Speed: Frequency: Working memory	**23.42**	**6**	**<.001**
Refixation probability	Speed	3.44	3	.33
	Frequency	**15.36**	**1**	**<.001**
	Working memory	**7.59**	**1**	**.006**
	Speed: Frequency	1.31	3	.73
	Frequency: Working memory	**4.82**	**1**	**.03**
	Speed: Frequency: Working memory	10.63	6	.10
First fixation duration (ms)	Speed	5.24	3	.15
	Frequency	**26.32**	**1**	**<.001**
	Working memory	**32.62**	**1**	**<.001**
	Speed: Frequency	1.23	3	.74
	Frequency: Working memory	2.11	1	.15
	Speed: Frequency: Working memory	10.1	6	.12
Gaze duration (ms)	Speed	**7.89**	**3**	**0.05**
	Frequency	**47.23**	**1**	**<.001**
	Working memory	**13.69**	1	**<.001**
	Speed: Frequency	4.59	3	.20
	Frequency: Working memory	**6.43**	1	**.01**
	Speed: Frequency: Working memory	12.17	6	.06

Measure	Factor	χ^2	*df*	*p*
Total reading time (ms)	Speed	**42.66**	**3**	**<.001**
	Frequency	**56.74**	**1**	**<.001**
	Working memory	**18.15**	**1**	**<.001**
	Speed: Frequency	**9.69**	**3**	**.02**
	Frequency: Working memory	3.34	1	.06
	Speed: Frequency: Working memory	8.04	6	.24
Regression-in probability	Speed	**8.93**	**3**	**.03**
	Frequency	2.49	1	.11
	Working memory	0.2	1	.65
	Speed: Frequency	2.53	3	.84
	Frequency: Working memory	0.04	1	.84
	Speed: Frequency: Working memory	**14.48**	**6**	**.02**

Note. Values with p < .05 are presented in **bold**.

Figure 24

Effects of reading speed, Word frequency and working memory capacity on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), regression-in (F) (Experiment 3)



Note. Error bars represent ±1 SE.

Plausibility effects as an indicator of comprehension monitoring

The local analysis of plausibility effects offers insight into semantic processing, particularly the integration of meaning across events or actions described in consecutive sentences. The manipulation of plausibility (relative to an expression in the prior sentence) is intended to yield an index of comprehension monitoring, i.e., the degree to which a consistent representation of meaning is maintained. The full LMM models that substantiate these findings can be located in Appendix G37 - G42, for ANOVA-style results see Table 15.

All measures except refixation probability showed a significant effect of plausibility, with longer viewing times, more fixations, and regressions into the target word. Furthermore, a significant interaction indicated that the longer total reading times for implausible words were especially pronounced in the baseline condition. Higher reading speeds and plausible words were associated with shorter total viewing times, while the plausibility effect was more prominent in the baseline condition compared to the 100% speed manipulation (see Figure 25 C and Figure 26 C).

The analysis of fixation probability revealed significant main effects of both plausibility and reading speed, without a significant interaction. Specifically, words characterized by low plausibility and slower reading speeds exhibited an increased probability for fixation, although the plausibility effect remained statistically consistent across different speed manipulations.

A similar pattern was observed for refixation probability, with plausible words resulting in fewer refixations; however, no significant effect of reading speed on refixation probability was detected. The regression-in probability analysis yielded significant main effects for both variables, with more incoming regressions observed for implausible words and fewer for increased speeds.

An examination of Figure 25 or Figure 26 (comparing the light with the dark bars) reveals an intriguing suppression of plausibility effects in the 100% speed condition. For several parameters the effects are numerically small and only significant for refixation frequency and regression-in. This pattern may indicate an adjustment in processing strategy, with an initial priority on maintaining basic word processing at the prescribed reading speed and a subsequent shift of focus towards higher-order comprehension processes as participants adapt to the altered reading conditions.

Taken together, these findings suggest that plausibility effects remain robust across different reading speeds, with some attenuation in faster reading conditions, particularly in late-stage processing measures such as total viewing time.

Table 15

ANOVA-style summary of eye movement measures as a function of reading speed and plausibility (Experiment 3)

Measure	Factor	χ^2	*df*	*p*
Fixation probability	Speed	**19.6**	**3**	**<.001**
	Plausibility	**3.88**	**1**	**.05**
	Speed: Plausibility	6.07	3	.10
Refixation probability	Speed	1.54	3	.67
	Plausibility	3.20	1	.07
	Speed: Plausibility	6.50	3	.09
First fixation duration	Speed	1.29	3	.73
	Plausibility	**4.82**	**1**	**.03**
	Speed: Plausibility	0.26	3	.97
Gaze duration	Speed	2.79	3	.42
	Plausibility	**6.42**	**1**	**.01**
	Speed: Plausibility	2.95	3	.40
Total reading time	Speed	**27.37**	**3**	**<.001**
	Plausibility	**60.38**	**1**	**<.001**
	Speed: Plausibility	**18.87**	**3**	**<.001**
Regression-in	Speed	**23.13**	**3**	**<.001**
	Plausibility	**25.04**	**1**	**<.001**
	Speed: Plausibility	0.97	3	.81

Note. Values with $p < .05$ are presented in **bold**.

Exploration of individual differences. Given that the main effects of plausibility and speed, along with their respective interactions, have been outlined above, the following sections will direct their attention exclusively to the effects of baseline reading speed and working memory capacity, with a particular emphasis on significant interactions.

Baseline reading rate. In alignment with the findings observed for frequency target words, baseline reading rate showed a significant main effect on the plausibility target for all eye movement measures (see Table 16 for ANOVA-style results and Appendix G43 - G48 for the full models). The visual representation of these effects can be seen in Figure 25.

However, the analysis revealed significant interactions for total viewing time (see Figure 25 C). There was a significant interaction between speed and plausibility, as described in the previous section. In addition, total viewing time showed a significant interaction between plausibility and baseline reading rate, indicating that participants with lower baseline reading rates showed larger plausibility effects. This was especially evident at the 100% condition in comparison to the baseline, where faster readers exhibited a reduced predictability effect, as indicated by a significant three-way interaction. Nevertheless, robust plausibility effects were observed, which remained largely stable across different reading speeds and baseline reading rates. In particular, slower reading was associated with an increased need for reanalysis when encountering implausible words, suggesting a greater effort to integrate them into context. As reading speed increased, the time spent reanalyzing semantic inconsistencies decreased, resulting in shorter but still present reprocessing periods – even at the highest speed condition of 150% for both faster and slower readers.

Table 16

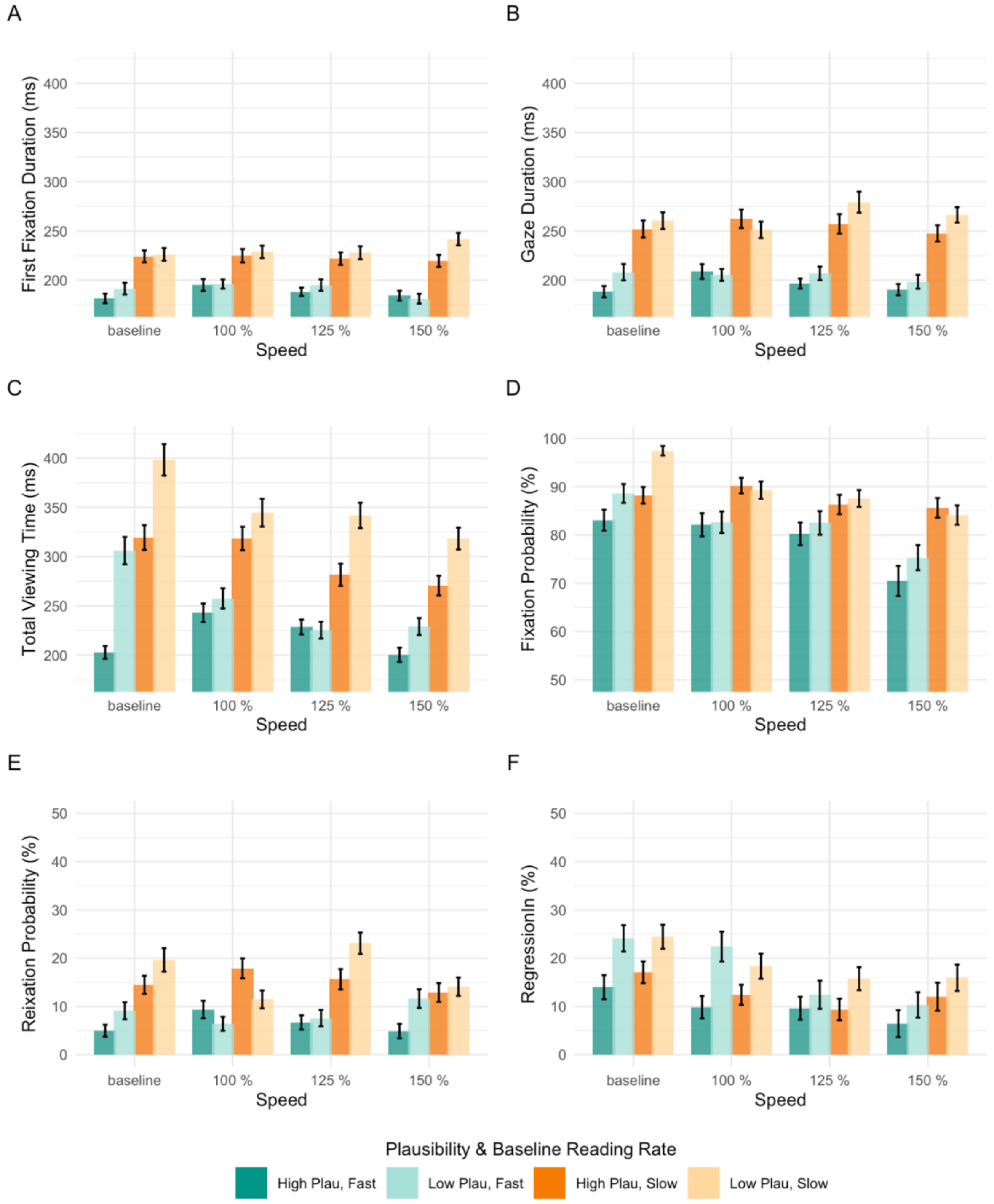
ANOVA-style summary of eye movement measures as a function of reading speed, plausibility and baseline reading rate (Experiment 3)

Measure	Factor	χ^2	*df*	*p*
Fixation probability	Speed	**18.45**	**3**	**<.001**
	Plausibility	3.36	1	.06
	Baseline rate	**7.52**	**1**	**.006**
	Speed: Plausibility	4.94	3	.18
	Plausibility: Baseline rate	0.01	1	.93
	Speed: Plausibility: Baseline rate	5.15	6	.52

Measure	Factor	χ^2	*df*	*p*
Refixation probability	Speed	1.54	3	.67
	Plausibility	3.24	1	.07
	Baseline rate	**10.75**	**1**	**.001**
	Speed: Plausibility	6.39	3	.09
	Plausibility: Baseline rate	0.02	1	.88
	Speed: Plausibility: Baseline rate	6.97	6	.32
First fixation duration	Speed	1.39	3	.71
	Plausibility	**4.85**	**1**	**.03**
	Baseline rate	**48.12**	**1**	**<.001**
	Speed: Plausibility	0.24	3	.97
	Plausibility: Baseline rate	0.90	1	.34
	Speed: Plausibility: Baseline rate	6.38	6	.38
Gaze duration	Speed	2.71	3	.44
	Plausibility	**6.48**	**1**	**.01**
	Baseline rate	**46.47**	1	**<.001**
	Speed: Plausibility	2.96	3	.40
	Plausibility: Baseline rate	1.19	1	.27
	Speed: Plausibility: Baseline rate	2.46	6	.87
Total reading time	Speed	**26.36**	**3**	**<.001**
	Plausibility	**64.31**	**1**	**<.001**
	Baseline rate	**64.87**	**1**	**<.001**
	Speed: Plausibility	**20.63**	**3**	**<.001**
	Plausibility: Baseline rate	**6.91**	**1**	**.008**
	Speed: Plausibility: Baseline rate	**13.63**	**6**	**.03**
Regression-in probability	Speed	**22.25**	**3**	**<.001**
	Plausibility	**25.06**	**1**	**<.001**
	Baseline rate	0.36	1	.55
	Speed: Plausibility	1.05	3	.79
	Plausibility: Baseline rate	0.45	1	.50
	Speed: Plausibility: Baseline rate	4.32	6	.63

Figure 25

Effects of reading speed, plausibility and baseline reading rate on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), and regression-in (F) (Experiment 3)



Note. Error bars represent ±1 SE.

Working memory capacity. Working memory capacity was significantly associated with all eye movement measures examined, except for the probability of regressing into the word (see Figure 26 and previously reported results for global analyses). Additionally, GLMMs revealed significant interactions for refixation probability and total reading time (see Table 17 for ANOVA-style results and Appendix G49 – G54 for the full models).

Total reading time showed only the previously reported interaction between speed and plausibility, with no direct interaction with WM capacity. However, a three-way interaction emerged for refixation probability: individuals with high WM capacity exhibited fewer refixations in the baseline condition compared to the 100% speed condition for plausible words. In addition, they refixated significantly less at 125% speed than at 100% speed (see general plausibility effects).

As discussed above, the 100% speed condition seems to be a somewhat special case in which plausibility effects are far less visible. This phenomenon was particularly pronounced for individuals with high WM capacity, especially when comparing the 100% to the baseline condition. They appeared to execute many additional refixations at 100% speed even for plausible words, resulting in a reduced plausibility effect in the initial word processing stage.

Table 17

ANOVA-style summary of eye movement measures as a function of reading speed, plausibility and working memory capacity (Experiment 3)

Measure	Factor	χ^2	*df*	*p*
Fixation probability	Speed	**17.94**	**3**	**<.001**
	Plausibility	3.36	**1**	.07
	Working memory	**4.73**	**1**	**.03**
	Speed: Plausibility	4.66	3	.20
	Plausibility: Working memory	0.45	1	.50
	Speed: Plausibility: Working memory	13.61	6	.03

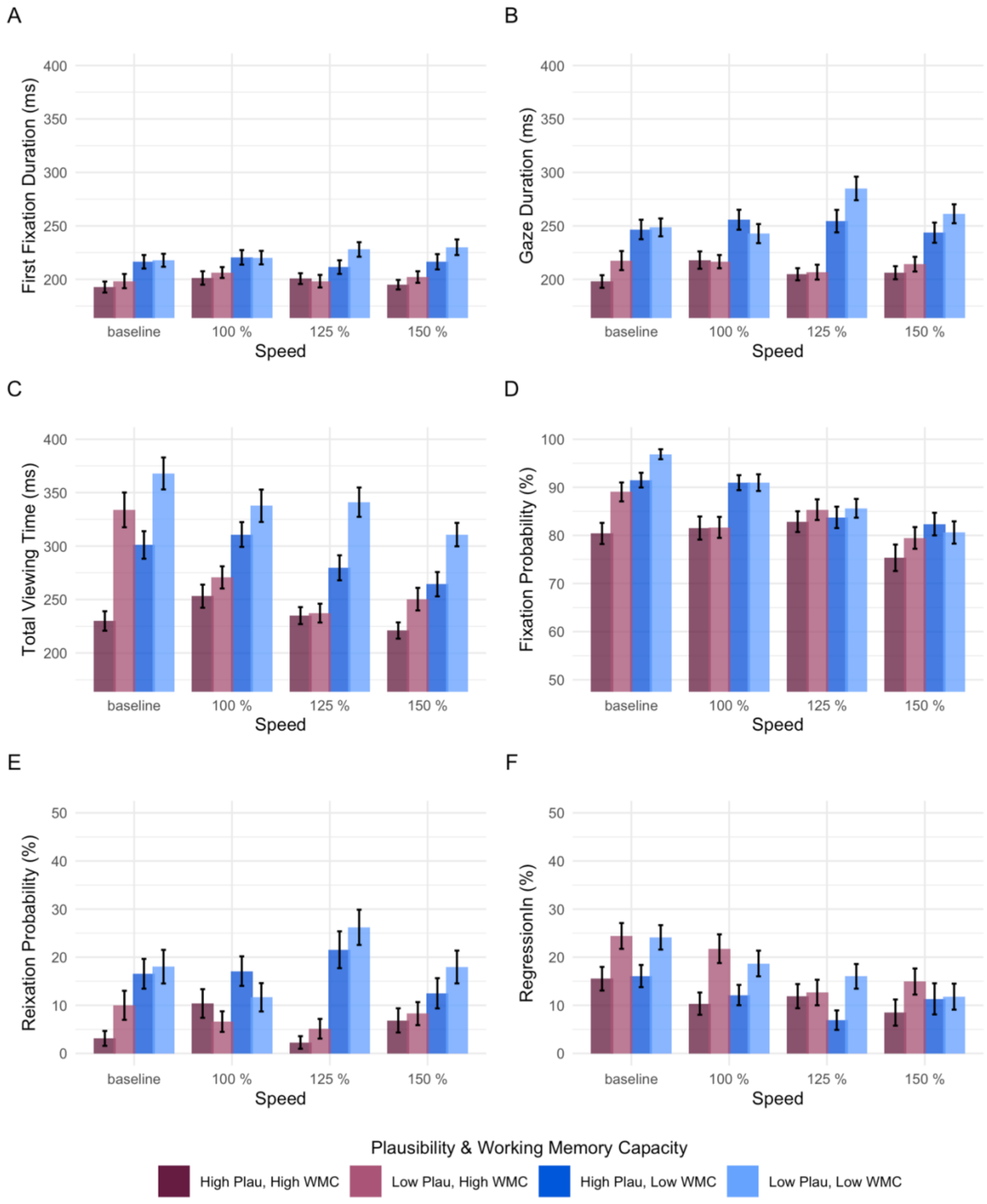
Measure	Factor	χ^2	*df*	*p*
Refixation probability	Speed	1.95	3	.58
	Plausibility	2.14	1	.14
	Working memory	**13.25**	**1**	**<.001**
	Speed: Plausibility	6.15	3	.10
	Plausibility: Working memory	0.32	1	.57
	Speed: Plausibility: Working memory	**14.9**	**6**	**.02**
First fixation duration (ms)	Speed	1.31	3	.73
	Plausibility	**4.84**	**1**	**.03**
	Working memory	**11.07**	**1**	**<.001**
	Speed:Plausibility	0.24	3	.97
	Plausibility:Working memory	0.52	1	.47
	Speed:Plausibility: Working memory	2.92	6	.82
Gaze duration (ms)	Speed	2.69	3	.44
	Plausibility	**6.28**	**1**	**.01**
	Working memory	**14.97**	1	**<.001**
	Speed: Plausibility	2.78	3	.43
	Plausibility: Working memory	0.41	1	.52
	Speed: Plausibility: Working memory	5.91	6	.43
Total reading time (ms)	Speed	**26.00**	**3**	**<.001**
	Plausibility	**60.52**	**1**	**<.001**
	Working memory	**22.58**	**1**	**<.001**
	Speed: Plausibility	**19.07**	**3**	**<.001**
	Plausibility: Working memory	3.66	1	.06
	Speed: Plausibility: Working memory	10.62	6	.10
Regression-in probability	Speed	**22.13**	**3**	**<.001**
	Plausibility	**24.54**	**1**	**<.001**

Measure	Factor	χ^2	*df*	*p*
	Working memory	0.08	1	.77
	Speed: Plausibility	1.02	3	.79
	Plausibility: Working memory	0.04	1	.85
	Speed: Plausibility: Working memory	5.30	6	.51

Note. Values with p < .05 are presented in **bold**.

Figure 26

Effects of reading speed, plausibility and Working memory capacity on first fixation duration (A), gaze duration (B), total reading time (C), fixation probability (D), refixation probability (E), regression-in (F) (Experiment 3)



Note. Error bars represent ±1 SE.

Supplementary analyses

Comprehension. The primary focus of this experiment was on plausibility as an online indicator of comprehension monitoring. During the experiment, comprehension questions were also used to ensure reading for understanding but the number of questions was kept at a minimum. Due to the low number of items, the following results should be regarded with caution, even though they point to some interesting trends. While the numerically highest comprehension scores were observed in the baseline condition (see Table 18), the differences compared to manipulated speeds were not significant. This observation held when comparing individual speed increments but also in pairwise comparisons between each manipulated speed and the baseline (see Appendix G55 and G56). Apparently, skilled readers can maintain a relatively constant level of comprehension within the limits of 150 percent relative to baseline speed.

When individual differences were included in the model, baseline reading rate was not found to be a significant predictor of comprehension. In contrast, working memory capacity demonstrated a clear association with comprehension (see Figure 27), with participants who had higher working memory capacity achieving superior comprehension scores. Although the interaction did not reach statistical significance, the observed trend suggests that the advantage of high working memory capacity becomes particularly pronounced at elevated reading speeds.

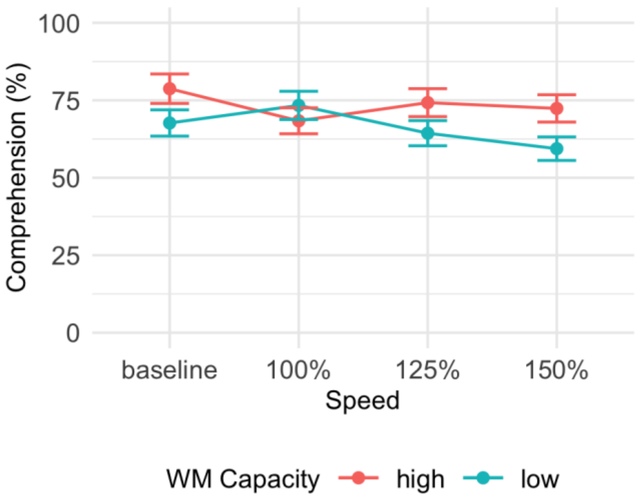
Table 18

Descriptive statistics of comprehension scores (Experiment 3)

Measure	Speed			
	Baseline *M* (*SD*)	100% *M* (*SD*)	125% *M* (*SD*)	150% *M* (*SD*)
Comprehension (in %)	73.2 (21.8)	71.0 (18.2)	70.4 (20.3)	66.2 (19.0)

Figure 27

Effect of reading speed on text comprehension (Experiment 3)



Note. Error bars represent ±1 SE.

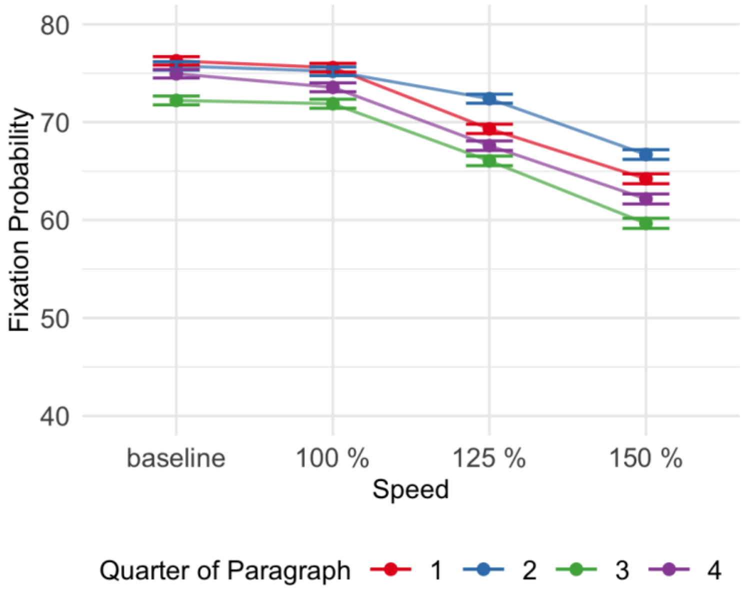
Distribution of fixations in the paragraph. As in Experiments 1 and 2, it was additionally examined whether fixation probability significantly varies with the position of a word within the paragraph and whether this effect interacts with reading speed. Fixation probability was modeled as a function of continuous word position within the paragraph and reading speed (see Table 19 for ANOVA-style results and Appendix G57 for the full model). For visualization purposes, paragraphs were divided into four equal sections, and fixation probabilities were averaged across these bins (see Figure 28).

The results revealed significant main effects of reading speed and word position. As expected, fixation probability decreased with increasing speed. The effect of word position was also significant, but notably small: words occurring later in the paragraph were associated with slightly higher fixation probabilities. Importantly, the trend observed in Experiments 1 and 2 – namely, elevated fixation probability for the initial portion of the paragraph – did not emerge in this experiment (see Figure 28).

No interaction between speed and word position was found, indicating that the influence of word position on fixation probability did not vary systematically across speed conditions. In line with Experiment 1, these results suggest that, even under conditions of speed manipulation, a continuous reading flow was maintained in the present L1 sample.

Figure 28

Effect of reading speed and position within the paragraph (visualized in four sections) on fixation probability (Experiment 3)



Note. Error bars represent ±1 SE.

Table 19

ANOVA-style summary of fixation probability as a function of reading speed and word position in the paragraph (Experiment 3)

Factor	χ^2	*df*	*p*
Speed	**80.09**	**3**	**<.001**
Word position in the paragraph	**2.84**	**1**	**<.001**
Speed*Word position in the paragraph	0.84	3	.24

Note. Values with p < .05 are presented in **bold**.

4.4 Discussion

The present experiment investigated how incremental increases in reading speed – specifically at 100%, 125%, and 150% of each participant's natural baseline – affect both lexical processing and comprehension monitoring. Employing the line-by-line reading paradigm, the study sought to isolate the effects of proportional speed manipulation on global reading behavior as well as on local processing of target words that varied in word frequency and plausibility. Exploratory analyses were also conducted to examine individual differences in the baseline reading rate and working memory capacity.

Effect of reading speed on global moment-to-moment processing

Utilizing a manipulated speed condition that matches each participant's natural reading rate allows for the isolation and observation of potential intrinsic effects of the line-by-line technique. At the global level, the 100% speed condition revealed a subtle shift in reading strategy: first-pass reading times increased slightly, while the number of (re)fixations and regressions decreased. Interestingly, this suggests that the line-by-line method promotes a more linear reading strategy, emphasizing initial word processing and reducing the need for reanalysis.

This finding is further supported by the comparison of frequency and plausibility effects between the baseline and the 100% speed condition. While both effects remained largely consistent under the line-by-line manipulation, the strength of the effects decreased for total reading time. This indicates a reduction not only in global reanalysis but also in cases where participants respond to difficult or contextually challenging words. The line-by-line method appears to encourage a more streamlined reading approach, prioritizing pace maintenance over attempts to re-analyze questionable words or expressions. As the frequency and especially predictability effects become more pronounced again at higher speed conditions, it is plausible to assume that participants initially need time to adapt to the manipulation. This adaptation process may lead to a temporary reduction in top-down influences and a shift toward more automatic processing, which may be less influenced by the specific characteristics of words within the text context.

With each 25% increment in prescribed reading speed, fixation probability and viewing times systematically decreased in the global analyses. However, early processing measures (e.g., first fixation and gaze durations) remained relatively stable, even at 150% of the natural reading rate. Higher reading speeds were achieved by a combination of lower fixation probabilities, fewer refixations on the current word, and – most importantly – less re-reading. On the other hand, the reduction in regressions was smaller than could have been expected, with 13% of saccades still moving against the reading direction at the highest speed. This indicates that readers remained engaged, continued to respond to reading difficulties, and attempted to resolve comprehension challenges (Just & Carpenter, 1987; Reichle et al., 2009).

Further evidence of this conclusion is provided by supplementary analyses, which demonstrate that participants viewed all parts of the paragraph, even at high speeds. While fixation probability decreased overall with increasing speed, this reduction was not more pronounced in specific areas within a page or text, such as the final quarter. Apparently, readers maintained the required pace and continued to fixate words consistently throughout the entire text, within the full range of required speed. Unlike Experiment 1, there was no increased fixation probability in the beginning of a paragraph. Potential explanations for this difference are discussed in Chapter 5.

Effect of reading speed on local moment-to-moment processing

To further investigate the question whether word processing at the local level remains intact, frequency effects were analyzed for carefully selected target words. Low-frequency words consistently elicited significantly longer viewing times and a greater number of (re)fixations compared to high-frequency words. Although the magnitude of the frequency effect diminished for total viewing time at higher speeds, it remained constant for initial fixation duration, indicating that first-pass word processing remained remarkably resilient.

These findings demonstrate that, in contrast to tasks in which comprehension plays a subordinate role (e.g., Reichle et al., 2010; Schad et al., 2012), lexical processing mechanisms remain highly engaged even under increased reading speed demands. However, later processing stages, as indicated by total viewing time, are clearly more compromised by constraints on reading speed. A similar pattern has been observed in skimming, where frequency effects are still evident in early stages of processing but become substantially reduced in later stages (Strukelj & Niehorster, 2018; White et al., 2015). This suggests that, when reading speed demands become critical, core lexical processing is preserved, while sacrificing investment into higher order processing on the sentence or passage level.

To assess whether the monitoring of comprehension – particularly across subsequent sentences – persists at higher speeds, plausibility was manipulated. The difference between plausible and implausible words served as an index of sensitivity for complex semantic relations, reflecting the degree to which a consistent representation of meaning is maintained. Implausible words were associated with prolonged gaze durations and total viewing times, indicating that responses to inconsistencies either took the form of prolonged word viewing or re-inspection. Significant interactions between plausibility and reading speed showed that the plausibility effect was the strongest in the baseline condition and decreased at higher speeds (see the argument above about sacrificing higher order processing). However, even at the highest speed, a significant plausibility effect remained evident.

The observed reduction in total viewing time for implausible words at higher speeds can be interpreted from two complementary perspectives. According to the comprehension monitoring approach, larger processing differences between plausible and implausible words typically indicate successful semantic integration, as readers detect inconsistencies and allocate additional time to resolve them (Baker, 1989; Vorstius et al., 2013). The diminished plausibility effect at higher speeds could be indicative of readers' frequent failure to recognize inconsistencies altogether under time pressure. Considering Kintsch's (1988) construction-integration model, this would imply that while the initial text representation may still be constructed, the increased demands of faster reading prevent the formation of a coherent situation model. Consequently, semantic anomalies may no longer elicit the same level of reprocessing, indicating a breakdown in deeper comprehension.

Alternatively, the reduction in viewing time differences might not stem from a failure to detect inconsistencies but rather from a strategic adjustment in how readers respond to them. Skilled readers have been shown to prioritize key information and bypass less critical details, thereby reducing the need for extensive reanalysis (Ashby et al., 2005). This interpretation is supported by the findings of Pérez et al. (2016), who distinguished between the detection of inconsistencies (evaluation) and their resolution (revision). According to their argument, skilled readers possess a higher degree of flexibility in updating their mental models when confronted with incongruent information, thereby requiring less time for revision. Supporting this efficiency-based account, recent research on scanpath regularity has shown that readers with good comprehension tend to exhibit similar and structured eye movement patterns, characterized by more streamlined reading and fewer regressions (Mézière et al., 2024). In this light, the observed reduction in total viewing time could reflect readers' ability to recognize inconsistencies while allocating fewer resources to their resolution, as these inconsistencies are deemed non-essential for maintaining comprehensive understanding.

These perspectives, while not mutually exclusive, illuminate distinct facets of the reading process under time constraints. The Cognitive Load Theory (Sweller, 2011) offers a unifying explanation: as reading speed increases, cognitive resources are reallocated to maintain efficiency, potentially at the expense of deeper processing. Consequently, the reduction in plausibility effects at higher speeds may reflect both a trade-off between efficiency and depth of processing and an adaptive strategy to prioritize essential information under time constraints.

In addition to employing comprehension monitoring as a primary measure of higher-order processing, comprehension questions were administered intermittently throughout the experiment providing a secondary index of reading for understanding. These questions were deliberately presented infrequently to avoid too much focus on deliberate reading for detail, which could be assumed to artificially boost monitoring (see Radach et al., 2008, for subtle effects of comprehension questions); nonetheless, the resulting comprehension scores offer a reasonable proxy for overall text comprehension. It is important to note that the comprehension questions were intentionally designed not to directly target the manipulated words, thereby avoiding confounding influences on the underlying processing.

Results indicate that reading speed does not significantly affect comprehension, which remains relatively stable even at elevated speeds. In fact, general comprehension remains robust even at 150% of the natural reading speed, despite a reduction in the magnitude of the specific comprehension monitoring effects. Notably, this pattern holds across participants regardless of their individual baseline reading rates – slower and faster readers alike maintain high comprehension accuracy under time pressure. Critically, this dissociation may suggest that the reduced sensitivity of online measures to inconsistencies does not necessarily reflect impaired depth of understanding or a failure to construct a coherent situation model. While the attenuated plausibility effects could indicate that readers engage less in explicit reprocessing of anomalies, they may still register inconsistencies without allocating additional resources to resolve them. Readers may prioritize maintaining textual coherence, possibly by deferring or minimizing the cognitive cost of resolving minor incongruencies when under time pressure.

Individual differences

The present study examined how individual differences in reading speed and working memory capacity influence reading behavior and the adaptation to increased reading rates. In their natural reading, faster and slower readers differ in all eye movement measures, with the most pronounced differences in late processing. In terms of adaptation to higher speeds, relatively moderate differences emerged between the two groups. Slower readers exhibited slightly greater adjustments in gaze duration and total reading time at higher speeds, likely due to the relative nature of the speed increases requiring larger absolute adaptations[8]. At baseline and lower speeds, slower readers engaged in more regressions, but this difference disappeared at 150%, suggesting that both faster and slower readers rely on regressions as a core mechanism for successful reading, even under challenging conditions. Slower readers may use regressions to guarantee confidence in processing, while at higher speeds, the criterion for successful processing may relax, allowing for greater uncertainty.

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[8]To illustrate this point, consider the following example: A reader with a slower reading rate, with a mean total viewing time of 500 ms per word, must reduce their rate by 125 ms to achieve 25% increase in speed. Conversely, a faster reader, whose baseline total viewing time is 300 ms, has to reduce by 75 ms, to reach a 25% increase. While both readers undergo the same relative change, the slow reader's adjustment is more pronounced in absolute terms (125 ms vs. 75 ms).

Individuals reading more slowly also demonstrated stronger frequency effects in both first-pass reading times and total reading time. This finding suggests that these individuals require greater processing effort when encountering difficult words and are more inclined to reanalysis, particularly at lower speeds. In addition, slower readers exhibited a more pronounced plausibility effect even at high speeds. While the time required for lexical access remains similar for both faster and slower readers at accelerated speeds, faster readers have less time available for reanalysis of difficult-to-integrate information. This suggests that slower readers may have a greater potential for speed increases without compromising higher-level comprehension. To further evaluate this assumption, an examination of the participants' comprehension scores was conducted. Surprisingly, there was no significant difference between faster and slower readers – both groups maintained high comprehension accuracy even at 150% speed. These findings align with the earlier interpretation that reduced rereading times for implausible words do not necessarily reflect poorer comprehension. Instead, these results may signify an adaptive processing strategy, whereby readers maintain an understanding that aligns with the demands of the task while efficiently allocating resources in time-constrained conditions.

Working memory capacity emerged as a strong predictor of reading behavior and comprehension, confirming and extending previous findings in the literature. Individuals with higher capacity displayed more efficient processing, characterized by shorter and fewer fixations, consistent with earlier work demonstrating that greater working memory resources facilitate lexical access and text integration (Daneman & Carpenter, 1980; Johann et al., 2020). This supports the established view of working memory as a critical cognitive resource for maintaining and manipulating linguistic information during reading (Long & Prat, 2008; Traxler et al., 2012). While lower WM capacity readers showed greater changes in fixation probability and total reading time, their fundamental adaptation strategies (see above for slower vs. faster readers) differed only slightly from high-capacity readers, suggesting that all readers employ similar adjustments under speed demands.

The substantial correlation between WM capacity and baseline reading rate suggests that participants with lower capacity had to make larger adjustments to meet the imposed speed increases. High WM capacity appears to confer an advantage by enabling faster processing during both early and late stages of reading, aligning with the idea that greater capacity facilitates simultaneous maintenance and manipulation of information (Daneman & Carpenter, 1980; Johann et al., 2020).

In harmony with these findings, WM capacity also influenced frequency and plausibility effects. Individuals with lower capacity showed greater differences in refixation probability and duration between high- and low-frequency words, indicating that lexical access for challenging words required additional time (see also Ashby et al., 2005). A particularly noteworthy pattern manifested at 125% reading speed: lower-capacity readers no longer exhibited an increased response to low-frequency words with refixations; rather, they demonstrated a tendency towards more regressions. This observation may imply that these readers initially experienced difficulties in adapting to the heightened speed demands, prioritizing rapid first-pass reading at the potential expense of successful lexical access. When this initial strategy came to its limits, they subsequently resorted to regressions to reanalyze problematic words.

While individuals with higher working memory capacity demonstrated faster lexical processing, they somewhat surprisingly showed no measurable advantage on comprehension monitoring indicators. It was expected that even with the potentially challenging speed increases, they would find it easier to process complex semantic relations or other aspects of higher-level integration of meaning (Azevedo et al., 2022). Instead, both groups showed similar comprehension monitoring as evidenced by equally increased viewing times for implausible words across all reading speeds.

One notable exception emerged: readers with higher WM capacity showed a reduced plausibility effect in refixation probability at 100% speed compared to baseline, with the reduction diminishing as reading speed increased. This finding aligns with observations reported above on comprehension monitoring in general (see page 119). In the 100% speed condition, participants differentiated less between plausible and implausible words in first-pass processing, exhibiting a more uniform gaze pattern that appeared to be less influenced by top-down processing. Despite the presence of notable yet modest disparities between the working memory groups, the capacity to monitor comprehension was manifest in both groups and sustained even at elevated speeds. In a true dual-task situation, working memory capacity would typically be expected to exert a protective influence on task performance, thereby mitigating any potential decline. Therefore, the results suggest that, at least for generally proficient readers, the line-by-line method may not constitute a real dual-task situation (unlike the L2 sample; see Chapter 3.4).

This presents an interesting contrast to previous research results consistently demonstrating WM capacity advantages in reading processes, particularly for ambiguous text processing (Daneman & Carpenter, 1980; Johann et al., 2020; Komori, 2016; Peng et al., 2018).

While higher working memory capacity predicted better comprehension scores in the current work, no clear working memory capacity advantage in comprehension monitoring was present.

This discrepancy may be attributed to the inherent differences between assessment methods and the underlying mode of processing. Comprehension monitoring measures, as indicated by oculomotor behavior, capture core moment-to-moment processing with arguably lower memory demands. Conversely, comprehension questions require the maintenance and integration of high-level linguistic information over time. This distinction becomes particularly salient when questions are delayed, as memory retention may become more significant than initial processing efficiency. Future research should explicitly examine how temporal factors and memory demands mediate the relationship between working memory and different aspects of comprehension to clarify these dynamics.

Conclusion

Taken together, the results of the study indicate that readers can increase their speed while largely maintaining lexical processing. Later semantic integration, as expressed in terms of comprehension monitoring, is still significantly present when reading at high speeds, but to a reduced extent. As discussed above, this reduction may either indicate that semantic inconsistencies are detected less frequently or less time is allocated to attempt a resolution (compare Pérez et al., 2016). The consistently high comprehension scores, irrespective of the individual's baseline reading speed, lend support to the latter explanation.

Further results suggest that reading speed can be increased largely independent of individual baseline speed, as both slower and faster readers show a comparable capacity for (relative) speed improvement. In contrast, the present work did reveal that high working memory capacity was particularly beneficial for maintaining strong comprehension (scores) even at accelerated speeds, despite minimal differences in word-level processing between the groups.

5 General Discussion

Reading is a complex cognitive skill that requires the coordinated operation of multiple processes, from visual word recognition to higher-order text comprehension. While reading rates naturally vary between individuals and in different situations, the cognitive consequences of these variations remain insufficiently understood. A significant unanswered question in the cognitive science of reading is whether these processes are governed by a speed-accuracy trade-off (SAT), i.e., whether increased reading speed necessarily comes at the expense of reduced comprehension. The SAT framework, which has been firmly established in domains such as perceptual decision making, memory recognition, and motor execution, posits a systematic inverse relationship between processing speed and accuracy (Standage et al., 2014; Wickelgren, 1977). In the domain of reading research, this phenomenon has been examined primarily within the context of isolated word recognition tasks, such as *lexical decision tasks* (Antos, 1979; Rinkenauer et al., 2004).

According to this framework, the phenomenon of accelerated reading is associated with superficial processing, which ultimately impedes comprehension. This perspective was strongly reaffirmed by Rayner et al. (2016) in their critique on speed reading, in which they conclude that accelerated reading disrupts lexical access, interferes with higher-level integration, and reduces inner speech. These processes are considered essential for constructing a coherent mental model of the text. The argument is posited that reading speed can only be increased while maintaining high comprehension by increasing language skills. Otherwise, there would be a cognitive overload.

This dissertation sought to elucidate the impact of systematic changes in reading speed on various levels of processing by conducting a series of three experiments. In these experiments, extensive data were collected on how changes in reading speed affect not only word processing, but also the online monitoring of semantic consistency and overall (offline) text comprehension. This work took into account individual differences in baseline reading speed (Experiments 1, 2, and 3), word reading efficiency (Experiments 1 and 2), as well as working memory capacity (Experiment 3). The results challenge the conventional view by Rayner et al. (2016) by demonstrating that, under certain conditions, readers can increase their speed up to 150% of their natural reading rate without significant loss of online and offline comprehension, suggesting that reading speed above one's natural reading rate and high text comprehension are not necessarily mutually exclusive. The following discussion integrates the results of all experiments to explore the interplay between speed and accuracy in reading and to elucidate the conditions under which the presumed trade-off may be attenuated or absent, ultimately providing insights that may inform both theoretical models and potential applications.

5.1 Summary of the results

To understand the cognitive dynamics of reading at increased speeds, this dissertation examined moment-to-moment processing through analyses of oculomotor behavior. Across all experiments, a global adaptation was evident, characterized by shorter fixations, fewer (re)fixations, and a reduced number of regressions. Notably, these adaptations were primarily observed in the late phase of processing, with a decrease in the extent of rereading at higher speeds. Although the total number of regressions decreased, they were not completely eliminated, suggesting that essential reanalyses were still performed despite the demanding temporal constraints.

Extending these general findings, lexical benchmark effects – especially those related to word frequency and word length – were examined to assess the stability of lexical processing across speed conditions. In Experiments 1 and 2, naturally occurring variations in word frequency and word length were analyzed, resulting in robust effects that persisted across different speed conditions. Longer and low-frequency words were associated with increased viewing times and more (re)fixations. In Experiment 3, the effect of word frequency was experimentally manipulated to provide a systematic evaluation. Results demonstrated prominent frequency effects even at the highest speeds, with low-frequency words eliciting longer viewing times and more fixations. Moreover, a subtle shift in processing strategy was evident in all three experiments at higher speeds: for difficult, low-frequency or long words, the initial processing phase (as indicated by the duration of the first fixation) tended to increase, while subsequent refixations and rereading decreased. This pattern suggests that, under time pressure, readers may prioritize initial word processing for efficient lexical access, thereby reducing resource allocation for additional reprocessing, while still maintaining sensitivity to lexical challenges.

Comprehension monitoring across successive sentences was investigated by embedding semantic inconsistencies – plausible versus implausible target words – into a paragraph (Experiment 3). Results revealed reliable plausibility effects across all speed conditions: implausible words were processed more slowly, suggesting that readers were sensitive to local inconsistencies and engaged in online monitoring of semantic coherence. Although the magnitude of the effect diminished with increasing speed, it remained statistically robust even at 150% of participants' natural reading rates. Consequently, it can be inferred that readers remain fully engaged in the reading process irrespective of the manipulated reading speed (up to 150%), detecting and addressing difficulties at both the word level and in the integration of information.

At the level of global text processing, performance on comprehension questions remained high for native speakers (Experiments 1 and 3) across all speed conditions, including 360 wpm and 150% of natural reading speed. In contrast, proficient second language (L2) readers (Experiment 2) showed significant declines in comprehension as speed increased, even at moderate levels of acceleration. These findings suggest that skilled L1 readers are capable of maintaining a coherent mental representation of a text, even under accelerated conditions. In contrast, L2 readers experience deficits in performance already at mild increases of speed, especially at higher levels of processing.

Finally, the role of individual differences was examined across all experiments, with a focus on effects of natural reading speed (Experiments 1–3), word reading efficiency (Experiments 1 and 2), and working memory capacity (Experiment 3). The results of Experiment 1 indicated that individuals with faster reading speeds exhibited a clear advantage in text comprehension. This finding needs to be seen in conjunction with the fact that fixed speed levels were induced, so that the highest speed condition represented only a slight increase for some participants but a doubling of their baseline speed for others. However, in the L2 sample (Experiment 2), no significant relationship between reading speed and text comprehension was found, despite the use of lower induced speeds to accommodate generally slower L2 reading rates. This marked discrepancy will be examined in greater detail in the subsequent chapter, with additional insights provided in Chapter 3.4.

The third experiment explicitly focused on individual differences in natural reading rate by implementing a paradigm in which speed increase conditions were determined as percentages of each participant's baseline reading rate. Readers with faster baseline rates exhibited more efficient reading behaviors, with the most notable differences in the amount and duration of reanalysis. Frequency effects were more pronounced for slower readers, indicating that they required more time to process difficult words. The adaptation process appeared quite similar between individuals with slower and faster baseline reading speeds, but subtle differences also occurred. However, as reading speed pressure increased, the frequency effects on refixations diminished, rendering the reading behavior of both groups more similar. Remarkably, even at the 150% reading speed condition, both groups showed significant frequency effects, suggesting that lexical access remained robust.

Similar patterns were observed for plausibility effects. Comprehension monitoring appeared to remain intact even in the highest speed conditions, regardless of baseline reading speed. However, for slower readers larger differences between plausible and implausible words were found at higher speeds. While faster readers allocated less time for rereading, even when detecting inconsistencies, slower readers still spent considerable time for reanalysis, even at highly accelerated speeds. At the same time, there were no significant differences in comprehension scores between faster and slower readers, indicating a similar level of general text understanding.

In addition to the natural reading rate, experiments 1 and 2 revealed that word reading efficiency – accessed in a standardized test as the ability to read single words accurately and fluently – strongly predicted reading comprehension. For L1 readers (Experiment 1), word reading efficiency played a particularly prominent role; participants with higher efficiency achieved higher comprehension scores at baseline and accelerated speeds. A similar pattern was observed in L2 readers (Experiment 2), although the effect was not significant at the baseline.

Given the potential for the speed manipulation to emulate a dual-task situation, working memory capacity was hypothesized to significantly predict the ability to cope with accelerated reading speeds in Experiment 3. Indeed, individuals with higher working memory capacities demonstrated more effective reading, characterized by shorter and fewer fixations. However, speed adaptation strategies employed by individuals with higher WM capacity differed only marginally from those with lower capacity. More specifically, with increasing speed demands, lower capacity readers reduced their (initially higher) amount of reanalysis, while maintaining larger frequency and plausibility effects. Along with stronger plausibility effects (suggesting more effort in comprehension monitoring), individuals with lower WM capacity demonstrated poorer text comprehension, as evidenced by their performance on comprehension questions, especially under accelerated reading conditions.

5.2 Linking results

This chapter situates the empirical findings of this dissertation within the broader theoretical discourse on reading adaptability. It examines how moment-to-moment processing and comprehension outcomes are influenced by accelerated reading speeds. Although prior research has debated the idea that increased speed inherently compromises comprehension (Rayner et al., 2016) – a notion aligned with the speed-accuracy trade-off – the present work extends the discussion by examining how readers strategically adapt, rather than assuming uniform trade-offs. The analysis hinges on a critical distinction between superficial skimming, marked by disengagement from text depth, and strategic fast reading, which may preserve comprehension through efficient resource reallocation.

The notion of a speed-accuracy trade-off posits that there is a reciprocal relationship between processing speed and accuracy, whereby the emphasis on one typically comes at the expense of the other. In numerous domains, including motor control and perceptual decision-making, this inverse relationship is so robust that SAT is frequently regarded as a cognitive law (Wickelgren, 1977; Heitz, 2014). Within the domain of reading, this principle would suggest that accelerated reading inevitably leads to diminished comprehension, due to constrained processing capacity. However, empirical findings in more complex cognitive domains suggest that such a trade-off need not always manifest itself in a linear or uniform manner (Domingue et al., 2022; Spieser et al., 2017). Specifically, individual differences in cognitive traits and learning modulate the SAT's dynamics: impulsive individuals, for instance, exhibit superior accuracy under rapid decision-making demands, whereas neurotic individuals show no comparable gains from additional processing time (Dickman & Meyer, 1988; Robinson et al., 2010). Furthermore, while individuals exhibit stable baseline SAT preferences, these are not fixed – strategic adaptations, such as practice-induced efficiency gains, enable readers to recalibrate their speed-accuracy balance (Pacheco et al., 2024). Such findings challenge the assumption of a rigid SAT, emphasizing instead its context-dependence and plasticity. In light of these findings, the prevailing assumption of a fixed trade-off in reading is called into question, pointing to the possibility of a more flexible, context-sensitive model of cognitive resource allocation under time pressure.

The following discussion is structured around two guiding questions. First, how do readers adapt their cognitive and oculomotor behavior in real-time to accommodate speed constraints while maintaining processing depth (Section 5.2.1)? Second, under which conditions can these adaptations fail, and how do individual differences in reading proficiency, language background, or cognitive resources shape the threshold at which comprehension breaks down (Section 5.2.2)?

By reframing the speed-accuracy dynamic as a spectrum of adaptability rather than a uniform trade-off, the chapter contributes to a nuanced understanding of reading flexibility. It shows that skilled readers – especially in their native language – seem to use automated processes and metacognitive awareness to overcome speed challenges, while second-language readers or those with limited cognitive reserves experience earlier comprehension breakdowns.

5.2.1 Moment-to-moment adaption to higher speeds

The findings of the current experiments demonstrate that readers adapt to time pressure through systematic modifications of their moment-to-moment reading behavior. Across all three studies, readers showed clear signs of adjusting in response to externally imposed speed demands. These adaptations were manifest most prominently in late-stage processing measures, such as total viewing time and regression probability, while early processing indicators like first fixation duration were less affected. Strikingly, these adaptive patterns proved remarkably consistent across all three populations, suggesting a universal cognitive strategy for managing speed-related demands during reading. Recent work by Klimovich et al. (2023) on speed reading provides complementary evidence for this pattern: in a comparison of pre- and post-training eye movements, both speed-reading and metacognitive training groups exhibited reduced late processing times and regression rates relative to controls. This aligns very well with the hypothesis that accelerated reading relies on optimizing higher-order processing efficiency rather than altering low-level word processing and/or lexical access.

A particularly noteworthy finding concerns the role of regressive saccades in fast(er) reading. While regressions are critical for resolving ambiguities and integrating complex information (Inhoff et al., 2019), the current studies show that readers can reduce the frequency of inter-word regressions without compromising comprehension. This finding initially seems to contradict Schotter et al. (2014), who experimentally prevented inter-word regressions and observed a significant decrease in comprehension. However, the present study – particularly through the comprehension monitoring paradigm – reveals a critical nuance: while readers maintained a consistent regression baseline (~10% of eye movements) to resolve essential inconsistencies even at high reading speeds, they seem to suppress redundant reinspections. This suggests that regressions are only indispensable when critical for coherence, and strategic reduction within this threshold preserves comprehension – extending the work of Schotter et al. by delineating necessary from dispensable reinspections.

Experiment 3 provided direct evidence for this interpretation, as implausible words consistently elicited prolonged total viewing times even at accelerated reading speeds. This pattern indicates that readers strategically prioritize reanalysis of semantically problematic content while suppressing less critical regressions. Notably, this optimization strategy proved consistent across readers with varying baseline speeds, suggesting it represents a universal feature of skilled reading. These findings collectively demonstrate that efficient reading under time constraints involves not merely reducing regressions, but rather their strategic allocation to maintain text comprehension while maximizing processing speed.

The robustness of lexical benchmark effects, such as word frequency and word length, across varying reading speeds underscores the resilience of lexical processing under temporal constraints. Even at highest speeds, readers continue to allocate more time to low-frequency and longer words, indicating that lexical access remains a priority. However, the current study reveals a strategic shift: at higher speeds, readers increase the duration of initial fixations on challenging words while reducing the need for subsequent refixations. This suggests that readers prioritize efficient lexical access during the initial encounter with a word, minimizing the temporal costs associated with reanalysis.

Building on this, the plausibility manipulation in Experiment 3 provides further evidence of readers' ability to adapt to increased speeds while maintaining comprehension monitoring. The persistent sensitivity to implausible words, even at very high speeds, demonstrates the continued detection of semantic anomalies, aligning with prior research on comprehension monitoring (Baker, 1989; Kim et al., 2018; Vorstius et al., 2013). However, the attenuation of plausibility effects at higher speeds also suggests that readers progressively allocate fewer cognitive resources to resolving inconsistencies. This phenomenon can be related to the influential good-enough processing theory (Christianson et al., 2001; Ferreira et al., 2002)), which posits that readers prioritize constructing a minimally sufficient mental representation to meet task demands. In the present study, the reading task (i.e., reading for comprehension) remained constant across varying speeds. However, the increased temporal demands at higher speeds likely led readers to tolerate minor semantic incongruities rather than exhaustively resolving them.

Taken together, these findings invite comparison to another common mode of fast reading – skimming. Like the present speed manipulation, skimming also produces faster reading without strongly affecting early processing indicators such as first fixation duration, while lexical benchmark effects like word frequency and word length remain largely stable (Strukelj & Niehorster, 2018; White et al., 2015). However, key differences emerge between skimming and the induced reading speed task used in the present work. For one, skimming instructions typically lead to even faster scanning rates – around twice the normal reading speed – compared to the more moderate acceleration imposed in the present experiments (Strukelj & Niehorster, 2018). Additionally, the mechanisms leading to speed gains differ: while the current data suggest that reductions in regressions play a central role in achieving faster reading for comprehension, skimming appears to rely more heavily on reducing the overall number of fixations combined with shorter fixation durations. Quite strikingly, in Strukelj and Niehorster's study, regressions are only slightly reduced during skimming (from 23% to 21%), suggesting a much more unspecific adjustment. Most importantly, comprehension outcomes differ markedly between reading and skimming: whereas comprehension was largely preserved in the current experiments, it typically suffers under skimming conditions. This highlights a crucial distinction: fast reading as induced here reflects a strategic optimization of processing depth under time constraints, whereas skimming appears to reflect a different reading goal – namely, to extract gist information efficiently, even at the cost of detailed comprehension.

While these comparisons focus on general reading strategies, additional differences emerged between the reader populations studied in this dissertation. In all three experiments, a level of analysis was employed where eye movements were compared as participants moved across the lines forming each paragraph. These comparisons yielded three critical insights: First, the L2 readers in Experiment 2 clearly showed an asymmetric distribution of fixations across lines of text. Especially at higher speeds, they tended to show lower fixation probabilities in the final parts of a paragraph. This is similar to results reported by Duggan & Payne (2009) on skimming at speeds as high as 600 wpm, when keeping up became nearly impossible. For the L2 readers, a situation of cognitive overload (see chapter 3.4 for an in-depth discussion) began to emerge at relatively moderate speed increases, with severe escalation at the highest speed. This can be taken to indicate that the seemingly fluent command of a second language may hide a much less automated system of language processing.

Second, for the English native speakers in Experiment 1, a different situation emerged. The distribution of fixations across paragraphs remained constant as the speed of reading increased, with the initial lines of the paragraph being fixated more frequently and fixation frequency then gradually decreasing towards the end. Such an asymmetry in attention allocation has also been reported under normal reading conditions (Strukelj & Niehorster, 2018) and likely reflects a general strategic adaptation aimed at constructing a mental representation of the text. In line with the Construction-Integration Model (Kintsch, 1988), allocating attention to the beginning of a paragraph facilitates the formation of a situational model into which subsequent information can be integrated. The beginning often provides thematically and contextually rich information, which serves as an anchor for comprehension. Moreover, in cohesive narratives like those used in Experiment 1, this strategy is especially useful, as initial sentences often carry key elements for understanding the rest of the text.

This pattern contrasts with that observed in other reading tasks such as skimming or spell checking, where fixation probabilities tend to be more evenly distributed across the text (Strukelj & Niehorster, 2018). Such a relatively uniform fixation pattern suggests a lack of prioritization based on textual structure or meaning, which is consistent with the assumption that readers do not attempt to build a coherent situational model. Rather, as Strukelj and Niehorster argue, skimming resembles a visually guided scanning process, associated with lower semantic integration demands.

Third, the L1 readers in Experiment 3 did not exhibit the typical decline in fixation probability toward the end of paragraphs observed in Experiments 1 and 2. Instead, fixation probabilities remained relatively stable across word positions, with only a small and uniform effect of position. This deviation may be due to the different nature of the text materials. In Experiment 3, readers were presented with isolated paragraphs starting with neutral, context-poor lead-in sentences. In this context, allocating disproportionate attention to the beginning of the paragraph would be less beneficial, as the initial sentences provided little guidance for comprehension. Taken together, these patterns indicate that the distributions of fixations across a paragraph are shaped not only by reading speed or task demands, but also by the nature of the text and the reader's strategic processing goals. In contrast to skimming, regular reading at faster speed appears to retain key features of a strategically controlled process of information acquisition in the service of understanding.

Looking beyond group-level comparisons, individual cognitive resources were found to influence how readers adapted to increased speed. Readers with higher working memory capacity and faster baseline reading rates exhibited more efficient eye movement patterns – shorter fixations and fewer regressions – suggesting an advantage in managing cognitive load (Daneman & Carpenter, 1980; Long & Prat, 2008).

It is noteworthy that both high and low WM capacity readers demonstrated substantial frequency and plausibility effects even at accelerated reading speeds. This finding indicates that lexical access and comprehension monitoring basically remained intact for both groups. However, at higher speeds, word frequency and plausibility effects were more pronounced among readers with lower WM capacity and slower baseline speeds. This may be taken to imply that individuals who read more slowly, engage in more extensive processing or possess a greater capacity for increasing their reading speed.

However, in view of prior studies, establishing a link between low WM capacity and more superficial processing (Swets et al., 2007, 2008; Traxler, 2007), a more probable interpretation is that increased processing times are indicative of a requirement for extended lexical and semantic processing due to limited cognitive capacity. In Experiment 3, where speed was manipulated relative to each participant’s baseline, slower readers – who also tended to have lower WM capacity – were subject to smaller absolute changes (see Chapter 4.4). This may have facilitated the preservation of their capacity to process complex or ambiguous words, despite constrained resources. While both groups monitored for implausibility, only high-capacity readers maintained superior comprehension. Low WM capacity readers appeared to function closer to the threshold of "good enough" understanding, with lexical-level effort not necessarily translating into coherent global representations under time pressure.

Taken together, the results show that fast(er) reading, as induced in the present studies, leads to strategic adaptation rather than more and more shallow processing. While readers reduced investment into late processing and inter-word regressions, they preserved comprehension by reallocating resources to critical content. Importantly, even under high time pressure, participants maintained sensitivity to lexical difficulty and semantic plausibility – markers of deeper processing. Therefore, the present data clearly challenge the claim that depth of processing and comprehension inevitably decline at higher reading speeds (cf. Rayner et al. 2016). The next chapter explores how far this adaptive potential extends and under which conditions comprehension begins to break down.

5.2.2 Reading speed and comprehension

The results obtained in all three experiments offer a multifaceted perspective on the notion of a speed accuracy trade-off in reading. For L1 readers, evidence compatible with an SAT does not emerge until very high speeds are attained. This corresponds with Kuperman et al.'s (2021) observation that L1 listeners can process time-compressed speech at rates significantly above normal speaking pace without experiencing comprehension loss (see also Murphy et al., 2021). In contrast, fluent L2 readers exhibit a clear SAT, as their comprehension declines even at moderate speed increases, reflecting the additional cognitive demands of reading in a non-native language. Experiment 3 further highlights the role of individual differences, such as baseline reading rate and working memory capacity, in determining adaptability to speeded reading. Although lexical access and comprehension monitoring remained largely intact across individual differences, readers with lower working memory capacity even showed stronger plausibility effects at high speeds. Yet, this did not translate into higher comprehension scores, indicating limitations in integrating and maintaining a coherent text representation.

In harmony with the idea that L1 readers may not utilize their full cognitive capacity during normal reading often (Carver, 1982, 1983), the present findings suggest that their natural reading rate is not constrained by hard-wired cognitive limits. Instead, it appears that L1 readers usually operate below their maximum capacity. Consequently, additional cognitive resources can be mobilized when demands increase. This phenomenon can be explained by the interplay of automated processes and strategic resource allocation. Skilled L1 readers have developed highly efficient mechanisms for lexical access and syntactic integration (Perfetti, 2007), which reduce the cognitive load during reading. As a result, they can process texts with relative ease at their natural pace, without fully engaging their cognitive potential[9].

The concept of "good enough" processing further supports this interpretation (Ferreira et al., 2002). According to this theory, readers often prioritize efficiency over exhaustive analysis, extracting sufficient meaning from a text without delving into every detail (see also Sanford & Sturt, 2002). In normal reading conditions, L1 readers may rely on this heuristic approach, which allows them to maintain comprehension while conserving cognitive resources.

However, as reading speed increases, individuals can access their reserve capacity by shifting to more focused and effortful processing strategies. This adaptability has been empirically demonstrated by Klimovich et al. (2023), who found that app-based speed-reading and metacognitive training can increase reading rates by approximately 20% without compromising comprehension. The authors attribute this preservation of understanding to heightened awareness of reading strategies. A parallel phenomenon emerged in Walczyk et al.'s (1999) study, where mild time pressure led to higher comprehension compared to self-paced reading.

When readers decide to engage in faster reading, such a strategic acceleration may foster task engagement, allowing them to allocate mental resources more efficiently and reduce off-task processing. This adaptability underscores the flexibility of skilled readers, who modulate cognitive engagement in accordance with task demands. Seen from this perspective, the natural reading rate may reflect a balance between effort and efficiency rather than a cognitive limit. Prior research has already shown that augmented task demands may facilitate heightened concentration and diminished mind-wandering, thereby enhancing processing efficiency (Seli et al., 2018). From this finding, the conclusion emerges that L1 readers possess the capacity to operate beyond their natural pace without compromising comprehension, provided they sustain goal-directed engagement within cognitive boundaries.

For L2 readers, the picture looks quite different, as increased speed quickly compromises higher-order text comprehension. At baseline, both L1 and L2 readers appear to engage in "good enough" processing, adjusting their strategies to achieve adequate comprehension. However, L2 readers require more time to attain this level of understanding,

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[9] At this point the question may arise why many readers would routinely operate below their optimal level of fluency. A plausible speculation could be that reading is initially taught as reading aloud, with fluency limited by the speed of conversation. It may be that many people are simply not aware that their potential to read faster with good comprehension can reach beyond this limit.

due to their slower lexical access and greater reliance on surface-level features (Bordag et al., 2021; Dirix et al., 2020). When increased speed is required, L2 readers soon encounter a critical threshold where cognitive load exceeds their available capacity. This results in a pronounced speed-accuracy trade-off, where faster reading rates lead to significant declines in efficiency and comprehension.

Several factors may contribute to this phenomenon. First, L2 readers possess a reduced capacity for automatic language processing, necessitating greater cognitive exertion for tasks such as word recognition and semantic integration (Perfetti, 2007; Clahsen & Felser, 2018). As reading speed accelerates, these already challenging processes become too demanding, resulting in insufficient resources for higher-order integration and meaning construction. Secondly, the shallow structure hypothesis (Clahsen & Felser, 2006, 2018) posits that L2 readers engage in less profound syntactic structure processing compared to L1 readers, instead relying on surface-level cues. This shallow processing strategy exhibits diminished effectiveness at higher reading speeds, where the integration of complex syntactic and semantic information becomes critical.

Additionally, the constraints imposed on working memory may play a significant role in this process. As mentioned above, L2 readers experience higher levels of cognitive load due to their limited proficiency and less efficient lexical processing (Godfroid, 2019), which imposes constraints on working memory. As reading speed increases, the demands on working memory may become critical, even up to breakdowns in comprehension. This phenomenon is further compounded by challenges in formulating syntactic expectations and prioritizing salient information in the context of more and more time constraints (Conrad, 1989). Individual differences in proficiency (L2 automatization) may modulate the observed speed-accuracy trade-off. While higher word reading efficiency can mitigate some of the challenges posed by accelerated reading, it does not fully compensate for the increased cognitive load.

In summary, the incapacity of L2 readers to increase reading speed without compromising comprehension signifies their constrained cognitive reserve and elevated reliance on effortful processing, especially at the lexical level. This stands in sharp contrast to L1 readers, who can adapt to higher speeds by reallocating cognitive resources and leveraging automated processes.

When considered as a whole, these findings call into question the assumption that reading above one's natural pace will necessarily lead to more shallow reading and eventually superficial skimming. While it is evident that increased speed alters processing strategies (see chapter 5.2.1), these adaptations do not inevitably compromise comprehension. For L1 readers, global understanding remained largely intact up to 150% of the mean natural and their individual reading rate, indicating that the cognitive system can flexibly adjust to increased demands without a breakdown in meaning construction. Instead of reflecting shallow processing, these adjustments suggest a reallocation of cognitive resources and a shift in strategy toward a more efficient processing of the text.

Conversely, for L2 readers, increases in speed resulted in substantial losses in comprehension, thereby indicating the presence of a pronounced speed-accuracy trade-off. This finding indicates that the distinction between fast reading and skimming is not static but rather contingent on processing efficiency and cognitive resources. The results of the study suggest that reading at a faster pace than one's natural rate can be sustained within the limits of meaningful comprehension, provided that the reader possesses the requisite cognitive flexibility and linguistic proficiency to adapt.

5.3 Theoretical and practical implications

The findings of this dissertation offer important insights for both theoretical models and practical applications. On the theoretical side, the observed adaptations in eye movement behavior under time pressure raise new questions about how flexibly the reading system can operate. Two groups of models are particularly relevant in this context: models of eye movement control, which explain the coordination of visual attention, word processing, and motor behavior, and, on the other hand, psycholinguistic models of reading comprehension, which describe how meaning is constructed across multiple levels of processing. The results challenge both types of frameworks to account for the dynamics of fast reading, including the divergent patterns observed in L1 and L2 readers.

On a practical level, the findings also inform applied approaches to reading. The line-by-line paradigm, as used in this study, offers a new tool for investigating and potentially training adaptive reading behavior. Its potential is critically discussed in relation to existing speed-reading methods and their claims.

5.3.1 Theoretical implications for word processing and eye movement control

In this section, models of eye movement control are considered, including E-Z Reader, SWIFT, Glenmore, and Über-Reader. These models differ in how they conceptualize attention allocation, lexical processing, and saccade programming. Most importantly, the models either suggest a strictly sequential mode of word processing (EZ-Reader, Über-Reader) or emphasize parallel processing of words within the limits of the perceptual span (Glenmore) or an attentional gradient (SWIFT; see Radach et al., 2007b; Reichle et al., 2009 for detailed discussions). In this section, the focus is on the examination of these models with the objective of elucidating the fundamental conclusions derived from the present work. Among the salient findings are the observed adaptations in early processing, wherein first-pass reading measures generally diminished while lexical benchmark effects remained robust. It is also considered whether they account for strategic resource reallocation in late processing evidenced by persistent comprehension monitoring despite reduced reanalyses, and the distinct non-uniform distribution of fixations across paragraphs in L1 and L2 readers.

In the E-Z Reader model, saccade programming is initiated by the completion of the first stage of word recognition (L1), a process in which word familiarity plays a central role. The model posits that low-frequency words inherently prolong L1 duration due to their weaker lexical representations, thereby delaying saccade initiation. In this framework, the observed shortening of early fixations under conditions of accelerated processing without reducing the magnitude of frequency effects needs to be explained. Two adaptations are conceivable: Firstly, L1 processing could be globally accelerated – through heightened attentional allocation or more efficient feature extraction – while preserving the relative differences in processing time between high- and low-frequency words. Secondly, the implementation of a top-down modulator could facilitate the dynamic adjustment of the threshold for L1 completion. However, this would represent a marked deviation from the otherwise modular nature of L1 processing in the model. In both cases, the absolute duration of the L1 stage would be expected to decrease (resulting in shorter fixations), while the proportional influence of word frequency would remain stable (Reichle et al., 2003; 2009).

The SWIFT model provides a potential explanation for the reduction in fixation durations through its stochastic "random timer", which generates saccades independently of ongoing lexical processing. Speeded reading may entail a global acceleration of the timer's baseline rate, resulting in uniformly shortened fixations. The persistence of word frequency and length effects could be preserved through parallel lexical activation: even with a faster timer, rare or long words compete for attentional resources in the perceptual span, delaying saccades when activation thresholds are unmet. This dual mechanism – combining faster default saccades with competitive lexical activation – may ensure efficient oculomotor behavior without sacrificing sensitivity to lexical difficulty (Engbert et al., 2005).

In the Glenmore model, the shortening of initial fixations may be explained by dynamic adjustments in the saliency map activation threshold for saccade initiation. Speeded reading could lower the threshold required to trigger saccades, allowing readers to disengage more rapidly once minimal visuo-lexical activation is achieved. Crucially, the model retains sensitivity to word length and frequency through its interactive activation framework: longer or rarer words generate slower raises of activation levels, delaying saccades even under reduced thresholds. This interaction between adaptive saccade timing and graded lexical activation may provide a theoretical framework to explain both accelerated fixations and preserved lexical effects (Reilly et al., 2006).

Shifting focus to later stages of processing, the data revealed a strategic reduction in total viewing time and regressions. Crucially, the results suggest that readers engage in selective processing adjustments: while regressions and re-reading become less frequent overall, this late processing remains sensitive to lexical challenges and semantic inconsistencies.

Within the E-Z Reader framework, the phenomenon of reduced rereading could be partially explained by an abbreviation of the post-lexical integration stage (L2 or "I" parameter). In situations where time constraints are present, readers may be inclined to reduce syntactic and semantic evaluation for non-critical words, while concurrently ensuring the maintenance of meaning integration for those concepts that are contextually salient (e.g., words that are flagged as semantically inconsistent). However, the model's architecture has a critical limitation: it assumes that integration failures invariably trigger regressions without allowing for the dynamic modulation of the threshold level at which such failures are deemed critical. This rigidity conflicts with the observed selectivity whereby readers suppress regressions for low-priority content. To address this discrepancy, E-Z Reader could adopt a salience-driven integration rule that allocates resources dynamically to high-priority words and suppresses regressions for redundant or predictable content (Reichle et al., 2003; 2009).

SWIFT's parallel activation framework could account for fewer regressions through adaptive inhibition: non-critical words in the perceptual span might be more strongly inhibited under speeded conditions, reducing reactivation. However, the model lacks a mechanism to selectively sustain activation for anomalies or critical terms. To explain the preservation of plausibility effects, SWIFT would need goal-dependent inhibition, where task demands modulate inhibition strength. For example, words violating contextually cued expectations could retain activation, triggering regressions despite global inhibition (Engbert et al., 2005).

In the context of Glenmore, reduced regressions could be attributed to elevated activation thresholds for reprocessing. Under speeded reading, readers might disengage more rapidly from resolved words, minimizing revisits. Yet, the persistence of plausibility-driven regressions implies that semantic saliency modulates these thresholds. To formalize this, Glenmore could integrate a predictive saliency filter, in which activation thresholds are dynamically adjusted based on semantic coherence. In the event of words conflicting with prior context (e.g., semantic inconsistencies), lower reprocessing thresholds would be retained, thereby ensuring targeted regressions even in the presence of time constraints (Reilly et al., 2006).

In addition to the adaptive processing effects at the word level, supplementary analyses revealed text-wide fixation patterns that exceed the explanatory scope of the models mentioned above. The observed patterns are likely tied to the distribution of semantic information (e.g., the introduction of novel concepts versus redundant repetitions) and structural features of the text. The E-Z Reader, SWIFT, and Glenmore models, which primarily operate at the word (and to some extent sentence) level, are unable to account for these effects, as they lack explicit mechanisms to capture sentence and discourse-level structures. To facilitate an understanding of these text-wide patterns, it would be necessary to implement a discourse-analytical module which would couple processing depth to semantic density and visual paragraph cues (e.g., line breaks).

A model that incorporates elements of sentence- and discourse-level processing is the Über-Reader (Veldre et al., 2020). The model is based on the foundational architecture of the E-Z Reader, thereby maintaining serial lexical processing and familiarity-based saccade initiation. Consequently, the word-level effects observed in the present study can be interpreted in the same manner as under the E-Z Reader (see above). However, the Über-Reader model extends this framework to simulate reading behavior beyond the word level. Specifically, it incorporates modules for *syntactic parsing* and semantic integration at the sentence level, as well as a working memory component that enables the maintenance and integration of linguistic representations across multiple words. This facilitates the model's capacity to simulate the impact of syntactic complexity and local coherence on eye movements, and it provides a plausible account for the more efficient reading behavior observed in participants with higher working memory capacity. The current implementation, however, does not yet explicitly model discourse-level structures such as paragraph boundaries or the global organization of semantic content. Such mechanisms would be necessary to explain the observed effects on fixation distributions across paragraphs observed in the present dissertation.

In a similar vein, recent research utilized a social network approach, thereby offering novel perspectives on the processes of moment-to-moment integration during the reading of paragraphs (Catrysse et al., 2025). In this particular instance, the focus is directed towards the structural characteristics of texts and the presence of individual differences, with a particular emphasis on WM capacity. While this approach involves the use of different sentence and participant-level information, the impact of different reading strategies and goals, and most crucially, the resulting reading comprehension, remains to be examined.

To summarize, while it is evident that individual models are capable of accounting for particular aspects of the observed results, none of them fully captures the range of effects reported in this dissertation. In particular, effects that extend beyond word and sentence boundaries, as well as interindividual differences and variations in reading goals, can only be partially addressed in current models of eye movement control during reading. Future modeling efforts should integrate these dimensions more systematically to provide a comprehensive account of reading behavior under varying task demands.

5.3.2 Theoretical implications for high-level processing and comprehension

Moving beyond the level of word processing, the findings of the present dissertation will now be discussed with regard to psycholinguistic models of reading comprehension, including the Construction-Integration model, the Constructionist Theory, the Structure Building Framework, the good-enough processing framework, and the Capacity Theory of Comprehension. This discussion raises questions about how these models account for comprehension under temporally constrained task conditions. Specifically, it is highlighted (1) how limitations in time can restrict the depth of processing at different representational levels; (2) how readers may shift their strategic focus depending on task demands; and (3) how individual factors such as reading efficiency or prior knowledge may modulate the success of comprehension under such conditions.

The Construction-Integration Model (CIM; Kendeou & O'Brien, 2018; Kintsch, 1988, 1998) is widely regarded as one of the most influential theories in the field. It provides a foundational framework for numerous theories of text comprehension and for empirical measures of comprehension. According to the CIM, the process of comprehension comprises two distinct stages. Initially, readers construct propositional representations of the text. Subsequently, these representations are integrated into a coherent mental model through the processes of inference and the application of prior knowledge.

However, the CIM is not equipped with top-down components such as reader's goals, motivational states, or individual reading skills. The present findings suggest that highly skilled L1 readers are able to accelerate the construction of a stable situation model up to a critical speed limit, at which point core processes contributing to comprehension may begin to become unreliable. Nevertheless, it remains opaque how this kind of resilience can be achieved. Even though it is apparent that the CIM offers a powerful theoretical foundation for approaching the problem, its own explanatory capacity is limited in accounting for individual differences or task demands, such as the acceleration of reading speed.

A complementary perspective is offered by the Constructionist Theory (Graesser et al., 1994), which conceptualizes comprehension as a goal-driven, coherence-oriented process. Readers actively seek to form representations that are locally and globally coherent, which aligns with the observed increase in rereading times for implausible words. However, the extent of this elaboration is contingent on the objectives of the reader. While this model introduces a more prominent role for reader intention, it pays less attention to external constraints such as cognitive capacity or task difficulty, which were shown to play a crucial role in the present work.

As was stated in the preceding chapters, the good-enough processing framework is also characterized by a goal-driven perspective (Ferreira et al., 2002). In accordance with this theory, readers adapt the depth of their processing in accordance with situational demands, aiming for sufficient rather than complete understanding. However, the framework is not specifically designed to account for cases in which reduced processing depth does not arise from strategic goal-setting, but from external constraints such as cognitive limitations or time pressure. In the present experiments, comprehension declined for L2 readers even when motivation and skill level were high, suggesting that "good enough" processing may also reflect boundary conditions of processing capacity rather than strategic choice.

This perspective, of comprehension being constrained by factors external to the text, finds a more explicit role in Gernsbacher’s (1990) Structure Building Framework. This model posits that readers continuously build mental structures during comprehension, enhancing relevant information while suppressing irrelevant content. Skilled readers are better at this suppression process, while less skilled readers tend to build more fragmented structures. Applied to fast(er) reading, one could argue that skilled L1 readers prioritize central elements and require less re-integration of earlier structures. However, the model does not specify under which circumstances suppression efficiency might decline in challenging reading situations, such as those involving increased speed or second-language processing.

In addressing this issue, the Capacity Theory of Comprehension (Just & Carpenter, 1992) offers a particularly insightful explanatory framework. This theory posits that comprehension is constrained by the limits of working memory capacity. This model is well-suited to account for the differences in comprehension observed in the present studies as a function of working memory capacity and *language proficiency* (L1 vs. L2). The integration of aspects of this model into other frameworks has the potential to extend existing theories beyond the text level, towards a more reader-centered understanding of comprehension processes under temporal and cognitive constraints.

When considered collectively, the models discussed offer valuable insights into specific high-level aspects of the reading process. The Construction-Integration Model and the Constructionist Theory provide significant accounts of how coherence and inference processes support comprehension. The Good-enough Framework and the Structure Building Framework emphasize adaptive and goal-directed mechanisms, while the Capacity Theory brings essential constraints of working memory and individual differences into focus.

However, it is evident that these models, when considered in isolation, are currently unable to provide a comprehensive explanation of how comprehension is modulated by increased reading speed in interaction with reader characteristics such as language proficiency or cognitive capacity. The present findings highlight the necessity for an integrated account that combines levels of text processing with situational demands and reader-internal constraints. Such an account would not only explain *when* comprehension breaks down but also *how* it can be maintained adaptively through selective processing, strategic inhibition, or enhanced focus on core content.

5.3.3 Practical implications

Beyond their theoretical relevance, the results have practical implications, such as the potential to improve tools and strategies that can enhance reading performance in different populations. Previous experimental approaches to manipulating reading speed have typically followed one of two paths. Either they have relied on task instructions to indirectly manipulate reading speed, or they have employed direct experimental manipulations. Instruction-based methods offer high ecological validity as they allow for natural reading behavior, but also lack experimental control, often resulting in large variability and unclear causal effects. In these cases, the observed speed increase should be seen more as a by-product of the reading strategy than as actually being manipulated (see Chapter 1.2.2). In contrast, direct manipulation techniques such as RSVP (Rapid Serial Visual Presentation; see e.g., Potter, 2018) or the fading method (Korinth et al., 2016) enforce a fixed reading pace, but this comes at the cost of distorting natural reading processes. Both techniques suppress regressions and artificially segment text. These limitations have made it difficult to systematically investigate how readers adapt to increased time pressure in realistic settings.

This dissertation presents a line-by-line method that seeks to overcome the challenges of reading speed and natural reading by combining direct manipulation with the preservation of key aspects of natural reading. This method includes temporal restrictions only at the paragraph level, which allows for unrestricted word-level processing and the ability to perform regressions. Furthermore, this enables a tightly controlled manipulation of reading time while maintaining essential cognitive processes involved in fluent reading.

The findings of the present work offer several implications for applied settings, particularly in the context of reading speed enhancement and training programs. Experiments 1 and 3 demonstrated that moderate speed increases can be achieved by merely introducing external temporal structure (instead of an elaborate training), a finding that may be valuable for the design of reading apps and digital platforms in general. For instance, the line-by-line presentation method, or analogous visual pacing techniques, could be implemented on tablets or e-readers to assist users in maintaining an intended reading speed. Such systems have the potential to facilitate accelerated reading while preserving fundamental components of natural text processing.

The approach lends itself to training-based applications. While the present results do not support the extreme claims made by many commercial speed-reading programs, they do strongly challenge the widespread assumption that any increase in speed inevitably comes at the cost of comprehension (Rayner et al., 2016). The data suggest that, in the absence of targeted or time-intensive training, readers can temporarily read at substantially higher speeds – up to around 150% of their natural rate – without compromising comprehension. However, at a point that lies beyond this range, comprehension begins to deteriorate (e.g., at 405 words per minute in Experiment 1). This pattern suggests a flexible but constrained adaptation potential that could serve as an initial diagnostic indicator for individualized training. Reading training programs may commence with the identification and comprehensive utilization of this individual reserve, prior to the implementation of more intensive training regimen aimed at extending the threshold at which comprehension declines.

It is noteworthy that the mean reading speeds observed in L1 readers under experimental time constraints closely resemble those reported by Klimovich et al. (2023) after participants completed a structured, app-based speed-reading intervention. This parallel suggests that a considerable proportion of the enhancements ascribed to such training may, in reality, be indicative of a more general, underutilized capacity to adapt to elevated speeds.

Current speed-reading training methodologies predominantly emphasize specific techniques, such as chunking, minimizing subvocalization, or suppressing regressions (see Klimovich et al., 2023 and Rayner et al., 2016, for a critical discussion). These techniques may all have their merits, but the present data suggest that investing in such measures might be most useful in the reading speed range beyond the individual reserve capacity. The present findings suggest that, rather than immediately emphasizing technique drills, programs could first utilize externally paced speed increases as a primary training mechanism. This would involve gradually exposing readers to higher speeds while monitoring their comprehension. An interval-based design, which involves alternating between accelerated and unrestricted reading phases, may facilitate the transfer of these adjustments to natural reading contexts. This approach capitalizes on the short-term adaptability observed in the present work and may facilitate progressive recalibration of readers' internal pacing without the necessity of explicit or intensive strategy instruction. The implementation of continuous comprehension checks has the potential to facilitate real-time adjustments and to identify the individual threshold at which speed gains begin to impede understanding. Future research should examine whether the observed short-term effects can be stabilized and expanded through long-term interventions, and whether they can be applied to real-world reading settings (see Chapter 5.5).

While this approach shows promise for native language readers, a key finding of the current work is that second language readers have a limited ability to increase their reading speed without compromising comprehension. This phenomenon can be attributed to the reduced automatic lexical access observed in L2 reading, a process that demands greater cognitive effort. Consequently, interventions designed to support L2 readers should not prioritize reading speed from the outset. Instead, a two-step approach may be more effective: In the initial phase, the training should be oriented towards enhancing vocabulary and automating word recognition, thereby reducing the cognitive demands of lexical processing. Once lexical access becomes more efficient, a second phase could introduce speed-based techniques. This progression has the potential to facilitate enhanced reading fluency in L2 readers without compromising comprehension.

Other groups with comprehension difficulties – such as children or individuals with learning disabilities – may benefit more directly from speed-based interventions. Accelerated reading speeds may help to draw initial attention to the text and support sustained concentration throughout the reading process. By shortening the time during which information must be held in working memory, such methods could reduce cognitive load and make text comprehension easier. These mechanisms may explain why Reading Acceleration Programs have shown positive outcomes in these populations (Korinth & Nagler, 2021).

In addition, these considerations also bear relevance for primary education. In the context of early reading instruction, considerable emphasis is typically placed on accuracy, which refers both to the fast and correct pronunciation of words during oral reading (usually referred to as reading fluency) and to the accurate understanding of their meaning. Reading is usually practiced aloud during the initial years of elementary school, with a strong focus on decoding and articulation (e.g., Kuhn, 2015).

The speed of reading aloud is fundamentally restricted by the time constraints of oral communication. It is probably safe to assume that in most school settings, the higher flexibility of silent reading is not explicitly addressed during reading instruction (see Bredel et al., 2011, for a typical textbook on reading instruction in German). This may lead to the assumption in many readers that oral and silent reading are basically identical, so that the potential of adaptive silent reading is often not fully used or remains unknown.

Following this idea, the present findings emphasize the significance of cultivating metacognitive awareness in young readers, thereby facilitating their comprehension that reading speed is not constant and can be adapted according to the demands of a given task. The employment of pedagogical strategies that emphasize flexible reading, as opposed to a single "correct" pace, has the potential to foster both comprehension and motivation. Instructional tools could include guided speed variations, reflective exercises on reading strategies, or adaptive pacing tools integrated into digital reading environments. The sensibilization of children and educators to the dynamics of reading speed thus represents a practical implication with potential long-term benefits for reading development.

5.4 Strengths and limitations

This dissertation provides valuable insights into the adaptability of reading comprehension and eye movement patterns across varying reading speeds. However, it is important to critically evaluate both the strengths and limitations of the research to contextualize the findings and guide future research.

As mentioned above, a critical strength of this study lies in the development and implementation of the line-by-line technique, a pioneering method that manipulates reading speed while permitting unrestricted eye movements. Nevertheless, the methodology is not without limitations. It cannot be ruled out that the method may have imposed additional cognitive demands beyond the speed aspect. Participants were required to accelerate their reading pace and synchronize their eye movements with the moving line-by-line marker. This dual requirement may have consumed some cognitive resources beyond those needed for faster reading, and could have been perceived as a kind of dual-task situation. However, even though the line-by-line method may introduce additional cognitive demands due to its dynamic pacing, no alternative approach is currently known that offers a comparable level of experimental control while preserving natural eye movement behavior – an essential prerequisite for ensuring the validity of findings on reading speed adaptation.

The methodological setup ensured a high degree of experimental control. By precisely controlling the timing of the line-by-line display, it was possible to isolate the effects of speed variation on eye movement control, word processing and comprehension. This strengthens the internal validity of the findings, as observed differences can be confidently attributed to the experimental manipulation. If indeed some cognitive resources were diverted to maintain performance in the (relatively unobtrusive) dual-task situation, this factor would have potentially reduced effect sizes of experimental manipulation. By this token, the significant results obtained in the three empirical studies can be interpreted confidently. This reasoning also applies in the case of the main null result, the absence of diminished comprehension with speed increase, as dual-task costs should have added to any deterioration of performance.

With respect to external validity, the controlled laboratory setting and the standardized reading format impose limitations on the extent to which findings may be generalized to everyday reading situations. Nonetheless, the line-by-line method can be argued to offer higher ecological validity than more restrictive paradigms, as it preserves key aspects of natural reading. It thus represents a promising compromise by enabling experimental control without completely sacrificing external relevance.

The employment of eye-tracking technology constitutes a notable strength of the present study, as it facilitated a meticulous examination of the moment-to-moment processing during reading. This detailed analytical approach yielded insights that extend beyond mere text comprehension, encompassing the underlying cognitive processes, such as fixation durations and regression patterns. By examining these measures, it was possible to uncover how readers adapt their eye movements and cognitive strategies to increased reading speeds, offering a deeper understanding of the mechanisms underlying reading adaptability. In this context, the study's primary focus on temporal aspects of eye movements ensured the use of variables that are well-established in reading research. These measures offer reliable insights into both early and late processing stages and allow for comparability with previous studies. Spatial parameters (e.g., saccade length, landing positions within words), by contrast, were not explicitly analyzed. Including such variables could have provided further information about low-level visual processing and perceptual span, particularly at higher reading speeds (e.g., Kaakinen, 2012).

A further strength of the study lies in its multifaceted assessment of comprehension, encompassing both offline and online measures. Offline comprehension was evaluated using structured comprehension tests designed to assess understanding at different levels of representation, including the propositional text base and the situation model. This approach ensures a high degree of comparability with both existing and future studies. To gain a more nuanced understanding of the underlying processes, a potential distinction could have been made between scores reflecting superficial and deep comprehension. However, such a separation would have exceeded the available statistical power of the study.

A further procedural factor, namely practice effects and fatigue, should be addressed, particularly with regard to Experiment 3. In Experiments 1 and 2, the randomization of the order in which reading conditions were presented served to minimize potential order-related confounds. However, Experiment 3 employed a stepwise increase in reading speed, allowing participants to gradually adjust to the manipulation and avoid being overwhelmed by the fastest condition from the outset. This design facilitated a form of intended practice effect, thereby enabling progressive adaptation to increased speeds. Nevertheless, it is possible that this approach may result in fatigue during subsequent blocks. It is conceivable that fatigue may have exerted a negative influence on performance at elevated speeds, potentially by diminishing levels of attention or cognitive resources.

Shifting the focus from within-person dynamics to between-person variability, one of this study's primary strengths is its linguistically diverse sample. It includes L1 readers from English and German backgrounds, as well as L2 English speakers. This diversity provides valuable insights into how reading strategies and adaptability vary across different reader profiles. Additionally, the exploration of individual differences, such as working memory capacity and word reading efficiency, addresses a gap in current models of eye movement control and reading comprehension. These models often overlook the role of cognitive variability in reading behavior (see chapter 5.3.1 and 5.3.2). By examining these factors, the dissertation offers a more comprehensive perspective on how readers adapt to increased reading speeds.

However, the selection of experimental samples also has limitations that must be acknowledged. The participant pool consisted mainly of successful students and therefore highly proficient readers. While this group provided valuable data, it restricts the applicability of the findings to populations with lower proficiency levels or less reading experience. The L2 sample consisted of undergraduate students in an English-speaking university and country. This is a relatively heterogeneous group, and further research is needed to determine whether factors such as working memory capacity, lexical access efficiency, and language proficiency, influence reading behavior similarly in other groups of readers. This could include diverse populations, including those with varying language proficiency and exposure levels in L1 and L2, as well as different age groups and levels of overall cognitive performance.

5.5 Future directions

The present work demonstrates readers' capacity to adapt oculomotor behavior to externally imposed temporal constraints, suggesting that natural reading pace represents neither a fixed nor optimal processing threshold. While these findings illuminate adaptive mechanisms in controlled settings, they simultaneously reveal critical knowledge gaps that delineate fertile terrain for future inquiry. Chief among these limitations is the restricted range of induced reading speeds. The natural next step is to extend the range of induced speeds beyond 150 percent to explore at which point the individual reserve capacity reaches its limit. A study with induced speeds up to 200 percent is already underway. In addition, subsequent research endeavors could systematically explore a more fine-grained range of speed increases (e.g., 10% increases) and ascertain each reader's individual time line of speed adaptation.

A further interesting avenue for subsequent research is a combined manipulation not only of reading speed but also text complexity. It is conceivable that the preservation of comprehension at accelerated speeds is most effective for texts of low to moderate complexity. For highly complex materials, even experienced readers may operate near their cognitive capacity at natural reading pace, leaving minimal room for further acceleration without compromising comprehension. This presumed interaction warrants rigorous investigation across distinct linguistic dimensions, including lexical demands (e.g., low-frequency vocabulary, morphologically complex words) and syntactic architecture (e.g., embedded clauses, non-canonical structures). It would be particularly interesting to disentangle these dimensions to unveil their unique contributions to processing bottlenecks. For instance, does speed increases disproportionately impair the integration of semantically dense content or the parsing of intricate syntax? Such experiments would not merely quantify thresholds but reveal compensatory strategies – whether readers sacrifice syntactic precision for conceptual gist or develop heuristic workarounds under speed duress.

Moreover, accelerated reading may universally challenge syntactic processing – even among proficient readers – by forcing strategic trade-offs that compromise grammatical precision. Building on evidence from compressed speech perception (Conrad, 1989), future research should test whether readers prioritize content words over function words during speeded reading, potentially neglecting morphological cues or syntactic dependencies. As an example, temporal constraints could impede the revision of misinterpretations in garden-path sentences (e.g., "The horse raced past the barn fell"), where initial parsing errors require costly reanalysis (Frazier, 1987). Such effects would become evident in reduced regression rates to syntactic violation sites at higher speeds, indicating suppressed error-correction mechanisms. While all readers face these pressures, individual differences in working memory or grammatical sensitivity likely determine adaptation success. Particularly, for L2 readers, inherent syntactic integration difficulties may be exacerbated under speed acceleration, leading to disproportionate comprehension loss despite adequate lexical access. This kind of research may offer the capacity to explicate the manner in which temporal constraints influence linguistic processing hierarchies across proficiency levels.

Levels of “proficiency” themselves comprise multidimensional constructs, defined not merely by global proficiency scores but by distinct constellations of cognitive capacities, linguistic expertise, and strategic competencies. The current findings indicate that working memory capacity and word reading efficiency (as assessed in an external test) are significant factors in this relationship. However, readers vary in numerous ways that extend beyond what can be captured in surface-level skills as determined in a psychometric word reading test. For instance, individuals with poor language comprehension and difficulties in executive functioning may be disproportionately challenged by increased reading speed. This may be the case in particular when the task requires flexible updating, inference generation, or the resolution of inconsistencies. Future studies should therefore more comprehensively examine how a broader set of cognitive resources – including attentional control, executive functioning, and linguistic knowledge – interact to shape reading performance under time pressure. Addressing these questions could not only clarify the cognitive constraints underlying individual adaptation to accelerated reading, but also inform the design of personalized interventions tailored to specific cognitive profiles.

This emphasis on individual cognitive variation naturally prompts technological advancements capable of operationalizing such complexity into practical applications. Adaptive text presentation systems represent a promising frontier in this domain. Rather than relying on static speed increments, these systems would use real-time oculomotor behavior to dynamically adjust exposure parameters. Importantly, their potential goes beyond controlling pace: AI-based systems have the capacity to adapt the linguistic complexity of the text itself, for example by replacing words with higher frequency synonyms, simplifying syntactic constructions, or highlighting key sentence structures, based on the reader's prior oculomotor behavior. When integrated with information about reader-specific traits and skills, such systems could provide precision-adapted reading environments that optimize the balance between speed and comprehension for different populations.

The temporal sustainability of such adaptations, however, remains to be explored. A significant avenue for future research therefore concerns the long-term effects of speeded reading. While the present study focused on immediate comprehension following brief reading sessions, it remains unclear whether elevated reading speeds can support sustained comprehension over longer periods. Addressing this question could provide valuable insights into the cognitive boundaries of reading efficiency and inform the design of training programs that aim to improve reading speed without compromising understanding (see chapter 5.3.3 for a suggestion on how such training courses could be structured).

Finally, while the present experiments were conducted in a controlled laboratory environment, future research should examine how these results can be applied to everyday reading contexts – for example, reading on digital devices, or under suboptimal environmental conditions. Factors such as screen size, font characteristics, or background noise may systematically influence reading speed, eye movement patterns, and comprehension. A better understanding of these contextual effects could inform the development of reading technologies and environments that promote efficient and robust reading performance across diverse real-life situations.

6 Glossary

Glossary of key terms used in the dissertation

Term	Explanation
Baseline reading rate	An individual’s natural reading speed (words per minute, wpm) under normal, unmanipulated conditions.
Cognitive load	The mental effort required to process information (during reading).
Comprehension monitoring	The ability to detect and resolve inconsistencies or ambiguities in a text during reading.
Dual-task (paradigm)	A method where participants perform two concurrent tasks to study cognitive resource allocation.
First fixation duration	The duration of the first fixation on a word during initial reading.
First-pass reading times	The time spent on a word during initial reading (e.g., first fixation duration and gaze duration).
Fixation probability	The likelihood that a word is fixated (not skipped) during reading.
Gaze duration	The total time spent fixating on a word during initial reading (before moving to the next word).
(Inter-word) regressions	Backward eye movements (toward previously read words).
Language proficiency	The degree of mastery in a language, particularly for L2 readers.
Lexical benchmark effects	The influence of word properties (e.g., frequency, length) on processing efficiency.
Lexical decision task	A paradigm where participants judge whether a letter string is a real word.
L1/L2 readers	Native (L1) or second-language (L2) readers.
Natural Reading Rate	Synonym for „baseline reading rate“.
Oculomotor Control	The neural and muscular mechanisms governing eye movements during reading.
Orthographic Processing	The visual recognition of letters and word forms.
Propositional text base	A text representation focused on literal meaning without contextual enrichment.
Reading rate	Synonym for „baseline reading rate“.

Reading speed	The experimentally manipulated pace of text presentation.
Refixation time	Time spent on additional fixations within a word during initial reading.
Regression/ Regressive saccade	Backward eye movement to a prior word or text region.
Rereading time	Time spent revisiting a word after regressions.
Semantic plausibility	The coherence of a word within its contextual meaning (e.g., „drinking coffee“ vs. „drinking bricks“).
Situation model	A mental representation of a text that integrates context, prior knowledge, and inferences.
Skipping	The omission of a word fixation during reading.
Syntactic parsing	The mental process of analyzing sentence structure.
Text complexity	Factors affecting text difficulty (e.g., vocabulary, syntax).
Total reading time	The sum of all fixations on a word, including regressions.
Total viewing time	Synonym for „total reading time“.
Viewing times	General term for fixation durations (e.g., first fixation, total reading time).
Word reading efficiency	The ability to decode words quickly and accurately.
Working memory capacity	The ability to temporarily store and manipulate information during cognitive tasks.

7 References

Aaronson, D., & Ferres, S. (1984). Reading strategies for children and adults: Some empirical evidence. *Journal of Verbal Learning and Verbal Behavior*, *23*(2), 189–220. https://doi.org/10.1016/S0022-5371(84)90137-3

Aaronson, D., & Ferres, S. (1986). Reading strategies for children and adults. A quantitative model. *Psychological Review*, *93*(1), 89–112. https://doi.org/10.1037/0033-295X.93.1.89

Albrengues, C., Lavigne, F., Aguilar, C., Castet, E., & Vitu, F. (2019). Linguistic processes do not beat visuo-motor constraints, but they modulate where the eyes move regardless of word boundaries: Evidence against top-down word-based eye-movement control during reading. *PLoS ONE*, *14*(7), e0219666. https://doi.org/https://doi.org/10.1371/journal.pone.0219666

Allington, R. L., & McGill-Franzen, A. (2014). Comprehension difficulties among struggling readers. In *Handbook of Research on Reading Comprehension* (1st ed., pp. 575–592). Routledge. https://doi.org/10.4324/9781315759609-40

Antos, S. J. (1979). Processing facilitation in a lexical decision task. *Journal of Experimental Psychology: Human Perception and Performance*, *5*(3), 527–545. https://doi.org/10.1037/0096-1523.5.3.527

Appelbaum, M., Cooper, H., Kline, R. B., Mayo-Wilson, E., Nezu, A. M., & Rao, S. M. (2018). Journal article reporting standards for quantitative research in psychology: The APA publications and communications board task force report. *American Psychologist*, *73*(1), 3–25. https://doi.org/10.1037/AMP0000191

Arkoudis, S., Hawthorne, L., Baik, C., Hawthorne, G., O'Loughlin, K., Leach, D., & Bexley, E. (2009). The impact of english language proficiency and workplace readiness on the employment outcomes of tertiary international students (Full Report). *International Migration Research Centre*.

Ashby, J., Rayner, K., & Clifton, C. (2005). Eye movements of highly skilled and average readers: Differential effects of frequency and predictability. *Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, *58*(6), 1065–1086. https://doi.org/10.1080/02724980443000476

Azevedo, B. de, Oliveira, D. A., Finger, I., & Tomitch, L. M. B. (2022). Does working memory capacity predict literal and inferential comprehension of bilinguals' digital reading in a multitasking setting?. *Language Teaching Research Quarterly*, *31*, 136–158. https://doi.org/10.32038/ltrq.2022.31.10

Baker, L. (1989). Metacognition, comprehension monitoring, and the adult reader. *Educational Psychology Review*, *1*(1), 3–38. https://doi.org/10.1007/BF01326548

Balota, D. A., Pollatsek, A., & Rayner, K. (1985). The interaction of contextual constraints and parafoveal visual information in reading. *Cognitive Psychology*, *17*(3), 364–390. https://doi.org/10.1016/0010-0285(85)90013-1

Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, *68*(3), 255–278. https://doi.org/10.1016

Beglar, D., & Hunt, J. A. (2014). Pleasure reading and reading rate gains. *Reading in a Foreign Language*, *26*(1), 29–48. https://doi.org/10125/66684

Bernhardt, E. (2005). Progress and procrastination in second language reading. *Annual Review of Applied Linguistics*, *25*, 133–150. https://doi.org/10.1017/S0267190505000073

Berzak, Y., & Levy, R. (2023). Eye movement traces of linguistic knowledge in native and non-native reading. *Open Mind*, *7*, 179–196. https://doi.org/https://doi.org/10.1162

Biedert, R., Hees, J., Dengel, A., & Buscher, G. (2012). A robust realtime reading-skimming classifier. *Eye Tracking Research and Applications Symposium (ETRA)*, *1*(1), 123–130. https://doi.org/10.1145/2168556.2168575

Binder, K., Pollatsek, A., & Rayner, K. (1999). Extraction of information to the left of the fixated word in reading. *Journal of Experimental Psychology: Human Perception and Performance*, *25*(4), 1162–1172. https://doi.org/10.1037/0096-1523.25.4.1162

Bogacz, R., Wagenmakers, E. J., Forstmann, B. U., & Nieuwenhuis, S. (2010). The neural basis of the speed-accuracy tradeoff. *Trends in Neurosciences*, *33*(1), 10–16. https://doi.org/10.1016/J.TINS.2009.09.002/ASSET/767E1B36-31E4-408C-A349-350024F6033F/MAIN.ASSETS/GR4.SML

Bredel, U., Fuhrhop, N., & Noack, C. (2011). *Wie Kinder lesen und schreiben lernen*. Francke Verlag.

Breznitz, Z. (1987). Increasing first graders' reading accuracy and comprehension by accelerating their reading rates. *Journal of Educational Psychology*, *79*(3), 236–242. https://doi.org/10.1037/0022-0663.79.3.236

Breznitz, Z. (1997). Reading rate acceleration: developmental aspects. *The Journal of Genetic Psychology*, *158*(4), 427–441. https://doi.org/https://doi.org/10.1080/00221329709596680

Breznitz, Z., & Berman, L. (2003). The underlying factors of word reading rate. *Educational Psychology Review*, *15*(3), 247–265. https://doi.org/10.1023/A:1024696101081

Brysbaert, M. (2019). How many words do we read per minute? A review and meta-analysis of reading rate. *Journal of Memory and Language*, *109*. https://doi.org/10.1016/j.jml.2019.104047

Brysbaert, M., & New, B. (2009). Moving beyond Kučera and Francis: A critical evaluation of current word frequency norms and the introduction of a new and improved word frequency measure for American English. *Behavior Research Methods*, *41*(4), 977–990. https://doi.org/10.3758/BRM.41.4.977

Brysbaert, M., & Stevens, M. (2018). Power analysis and effect size in mixed effects models: a tutorial. *Journal of Cognition*, *1*(1), 9. https://doi.org/10.5334/JOC.10

Brysbaert, M., & Vitu, F. (1998). Word Skipping: Implications for Theories of Eye Movement Control in Reading. *Eye Guidance in Reading and Scene Perception*, 125–147. https://doi.org/10.1016/B978-008043361-5/50007-9

Carlson, T. R. (1949). The Relationship between speed and accuracy of comprehension. *The Journal of Educational Research*, *42*(7), 500–512. https://doi.org/https://doi.org/10.1080/00220671.1949.10881714

Carver, R. P. (1977). Toward a theory of reading comprehension and rauding. *Reading Research Quarterly*, *13*(1), 8–63. https://doi.org/10.2307/747588

Carver, R. P. (1982). Optimal rate of reading prose. *Reading Research Quarterly*, *18*(1), 56. https://doi.org/10.2307/747538

Carver, R. P. (1983). Is reading rate constant or flexible? *Reading Research Quarterly*, *18*(2), 190–215. https://doi.org/10.2307/747517

Catrysse, L., van Daal, T., Jarodzka, H., Kaakinen, J. K., Donche, V., & Gijbels, D. (2025). How Eye Read: A Social Network Approach. *Educational Psychology Review*, *37*(1), 1–24. https://doi.org/https://doi.org/10.1007/s10648-025-10000-y

Chen, C. (2010). On reading test and its validity. *Asian Social Science*, *6*(12), 192–194. https://doi.org/10.5539/ass.v6n12p192

Chen, H., De Boeck, P., Grady, M., Yang, C.-L., & Waldschmidt, D. (2018). Curvilinear dependency of response accuracy on response time in cognitive tests. *Intelligence*, *69*, 16–23. https://doi.org/https://doi.org/10.1016/j.intell.2018.04.001

Chittka, L., Skorupski, P., & Raine, N. E. (2009). Speed-accuracy tradeoffs in animal decision making. *Trends in Ecology and Evolution*, *24*(7), 400–407. https://doi.org/10.1016/J.TREE.2009.02.010

Christianson, K., Hollingworth, A., Halliwell, J. F., & Ferreira, F. (2001). Thematic Roles Assigned along the Garden Path Linger. *Cognitive Psychology*, *42*(4), 368–407. https://doi.org/10.1006/COGP.2001.0752

Clahsen, H., & Felser, C. (2006). Continuity and shallow structures in language processing. *Applied Psycholinguistics*, *27*(1), 107–126. https://doi.org/10.1017/S0142716406060206

Clahsen, H., & Felser, C. (2018). SOME NOTES ON THE SHALLOW STRUCTURE HYPOTHESIS. *Studies in Second Language Acquisition*, *40*(3), 693–706. https://doi.org/10.1017/S0272263117000250

Cohen J. (1988). The effect size: r. In *Statistical Power Analysis for the Behavioral Sciences* (2nd ed., pp. 77–83). Lawrence Erlbaum Associates. https://cir.nii.ac.jp/crid/1572261550809239040

Collins, W. M., & Daniel, F. (2018). The impact of reading at rapid rates on inference generation. *Journal of Research in Reading*, *41*(3), 564–581. https://doi.org/10.1111/1467-9817.12125

Conrad, L. (1989). The effects of time-compressed speech on native and efl listening comprehension. *Studies in Second Language Acquisition*, *11*(1), 1–16. https://doi.org/10.1017/S0272263100007804

Cop, U., Drieghe, D., & Duyck, W. (2015). Eye movement patterns in natural reading: A comparison of monolingual and bilingual reading of a novel. *PLoS ONE*, *10*(8), e0134008. https://doi.org/10.1371/JOURNAL.PONE.0134008

Daneman, M., & Carpenter, P. A. (1980). Individual differences in working memory and reading. *Journal of Verbal Learning and Verbal Behavior*, *19*(4), 450–466. https://doi.org/10.1016/S0022-5371(80)90312-6

Dickman, S. J., & Meyer, D. E. (1988). Impulsivity and speed-accuracy tradeoffs in information processing. *Journal of Personality and Social Psychology*, *54*(2), 274–290. https://doi.org/10.1037/0022-3514.54.2.274

Dirix, N., Vander Beken, H., De Bruyne, E., Brysbaert, M., & Duyck, W. (2019). Reading text when studying in a second language: An eye-tracking study. *Reading Research Quarterly*, *55*(3), 371–397. https://doi.org/https://doi.org/10.1002/rrq.277

Domingue, B. W., Kanopka, K., Stenhaug, B., Sulik, M. J., Beverly, T., Brinkhuis, M., Circi, R., Faul, J., Liao, D., McCandliss, B., Obradović, J., Piech, C., Porter, T., Consortium, P. i. L., Soland, J., Weeks, J., Wise, S. L., & Yeatman, J. (2022). Speed–accuracy trade-off? Not so fast: Marginal changes in speed have inconsistent relationships with accuracy in real-world settings. *Journal of Educational and Behavioral Statistics*, *47*(4), 576–602. https://doi.org/10.3102/10769986221099906

Donkin, C., Little, D. R., & Houpt, J. W. (2014). Assessing the speed-accuracy trade-off effect on the capacity of information processing. *Journal of Experimental Psychology: Human Perception and Performance*, *40*(3), 1183–1202. https://doi.org/10.1037/a0035947

Dosher, B. A., McElree, B., Hood, R. M., & Rosedale, G. (1989). Retrieval dynamics of priming in recognition memory: Bias and discrimination analysis. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*(5), 868–886. https://doi.org/10.1037/0278-7393.15.5.868

Drieghe, D., Brysbaert, M., Desmet, T., & De Baecke, C. (2004). Word skipping in reading: On the interplay of linguistic and visual factors. *European Journal of*

Cognitive Psychology, *16*(1–2), 79–103. https://doi.org/10.1080/09541440340000141

Duggan, G. B., & Payne, S. J. (2009). Text skimming: The process and effectiveness of foraging through text under time pressure. *Journal of Experimental Psychology: Applied*, *15*(3), 228–242. https://doi.org/10.1037/A0016995

Duggan, G. B., & Payne, S. J. (2011). Skim reading by satisficing: Evidence from eye tracking. *Conference on Human Factors in Computing Systems - Proceedings*, 1141–1150. https://doi.org/https://doi.org/10.1145/1978942.1979114

Elbro, C., & Buch-Iversen, I. (2013). Activation of background knowledge for inference making: Effects on reading comprehension. *Scientific Studies of Reading*, *17*(6), 435–452. https://doi.org/10.1080/10888438.2013.774005

Elliott-Faust, D. J., & Pressley, M. (1986). How to teach comparison processing to increase children's short- and long-term listening comprehension monitoring. *Journal of Educational Psychology*, *78*(1), 27–33. https://doi.org/10.1037/0022-0663.78.1.27

Engbert, R., Nuthmann, A., Richter, E. M., & Kliegl, R. (2005). Swift: A dynamical model of saccade generation during reading. *Psychological Review*, *112*(4), 777–813. https://doi.org/10.1037/0033-295X.112.4.777

Epstein, M. L., Lazarus, A. D., Calvano, T. B., Matthews, K. A., Hendel, R. A., Epstein, B. B., & Brosvic, G. M. (2002). Immediate feedback assessment technique promotes learning and corrects inaccurate first responses. *The Psychological Record*, *52*(2), 187–201. https://doi.org/10.1007/BF03395423

Ferreira, F., Bailey, K. G. D., & Ferraro, V. (2002). Good-enough representations in language comprehension. *Current Directions in Psychological Science*, *11*(1), 11–15. https://doi.org/10.1111/1467-8721.00158

Fitts, P. M. (1954). The information capacity of the human motor system in controlling the amplitude of movement. *Journal of Experimental Psychology*, *47*(6), 381–391. https://doi.org/https://doi.org/10.1037/h0055392

Forster, K. I., & Chambers, S. M. (1973). Lexical access and naming time. *Journal of Verbal Learning and Verbal Behavior*, *12*(6), 627–635. https://doi.org/10.1016/S0022-5371(73)80042-8

Forstmann, B. U., Dutilh, G., Brown, S., Neumann, J., Von Cramon, D. Y., Ridderinkhof, K. R., & Wagenmakers, E. J. (2008). Striatum and pre-SMA facilitate decision-making under time pressure. *Proceedings of the National Academy of Sciences of the United States of America*, *105*(45), 17538–17542. https://doi.org/https://doi.org/10.1073/pnas.0805903105

Fraser, C. A. (2007). Reading rate in L1 mandarin chinese and L2 english across five reading tasks. *The Modern Language Journal*, *91*(3), 372–394. https://doi.org/10.1111/J.1540-4781.2007.00587.X

Frazier, L., & Rayner, K. (1982). Making and correcting errors during sentence comprehension: Eye movements in the analysis of structurally ambiguous sentences. *Cognitive Psychology*, *14*(2), 178–210. https://doi.org/10.1016/0010-0285(82)90008-1

Garner, R., & Reis, R. (1981). Monitoring and resolving comprehension obstacles: An investigation of spontaneous text lookbacks among upper-grade good and poor comprehenders. *Reading Research Quarterly*, *16*(4), 569. https://doi.org/10.2307/747316

Gernsbacher, M. A. (1997). Attentuating interference during comprehension: The role of suppression. *Psychology of Learning and Motivation*, *37*, 85–104. https://doi.org/10.1016/S0079-7421(08)60500-9

Geva, E., Wade-Woolley, L., & Shany, M. (1997). Development of reading efficiency in first and second language. *Scientific Studies of Reading*, *1*(2), 119–144. https://doi.org/10.1207/S1532799XSSR0102_2

Godfroid, A. (2019). Eye tracking in second language acquisition and bilingualism: A research synthesis and methodological guide. In *Eye Tracking In Second Language Acquisition And Bilingualism: A Research Synthesis and Methodological Guide* (1st ed.). Taylor and Francis. https://doi.org/10.4324/9781315775616

Grainger, J. (2018). Orthographic processing: A 'mid-level' vision of reading: The 44th Sir Frederic Bartlett Lecture. *Quarterly Journal of Experimental Psychology*, *71*(2), 335–359. https://doi.org/10.1080/17470218.2017.1314515

Griffiths, R. (1990). Speech rate and NNS comprehension: A preliminary study in time-benefit analysis. *Language Learning*, *40*(3), 311–336. https://doi.org/10.1111/J.1467-1770.1990.TB00666.X

Hausfeld, S. (1981). Speeded reading and listening comprehension for easy and difficult materials. *Journal of Educational Psychology*, *73*(3), 312–319. https://doi.org/10.1037/0022-0663.73.3.312

Heitz, R. P. (2014). The speed-accuracy tradeoff: History, physiology, methodology, and behavior. *Frontiers in Neuroscience*, *8*, 150–170. https://doi.org/10.3389

Hintzman, D. L., & Caulton, D. A. (1997). Recognition memory and modality judgments: A comparison of retrieval dynamics. *Journal of Memory and Language*, *37*(1), 1–23. https://doi.org/10.1006/JMLA.1997.2511

Hsueh-Chao, M. H., & Nation, P. (2000). Unknown vocabulary density and reading comprehension. *Reading in a Foreign Language*, *13*(1), 403–430. https://doi.org/https://doi.org/10125/66973

Hudson, R. F., Lane, H. B., & Pullen, P. C. (2005). Reading fluency assessment and instruction: What, why, and how? *The Reading Teacher*, *58*(8), 702–714. https://doi.org/10.1598/RT.58.8.1

Inhoff, A. W., Kim, A., & Radach, R. (2019). Regressions during reading. *Vision*, *3*(3), 35–49. https://doi.org/10.3390/VISION3030035

Inhoff, A. W., & Radach, R. (1998). Definition and computation of oculomotor measures in the study of cognitive processes. *Eye Guidance in Reading and Scene Perception*, 29–53. https://doi.org/10.1016/B978-008043361-5/50003-1

Inhoff, A. W., & Rayner, K. (1986). Parafoveal word processing during eye fixations in reading: Effects of word frequency. *Perception & Psychophysics*, *40*(6), 431–439. https://doi.org/10.3758/BF03208203

Ivanoff, J., Branning, P., & Marois, R. (2008). fMRI evidence for a dual process account of the speed-accuracy tradeoff in decision-making. *PLoS ONE*, *3*(7), e2635. https://doi.org/https://doi.org/10.1371/JOURNAL.PONE.0002635

Jeon, E. H., & Yamashita, J. (2014). L2 reading comprehension and its correlates: A meta-analysis. *Language Learning*, *64*(1), 160–212. https://doi.org/https://doi.org/10.1111/lang.12034

Johann, V., Könen, T., & Karbach, J. (2020). The unique contribution of working memory, inhibition, cognitive flexibility, and intelligence to reading comprehension and reading speed. *Child Neuropsychology*, *26*(3), 324–344. https://doi.org/10.1080/09297049.2019.1649381

Johnson-Laird, P. N. (1983). *Mental models : Towards a cognitive science of language, inference, and consciousness*. Harvard University Press.

Juhasz, B. J., & Rayner, K. (2003). Investigating the effects of a set of intercorrelated variables on eye fixation durations in reading. *Journal of Experimental Psychology:*

Learning Memory and Cognition, *29*(6), 1312–1318. https://doi.org/10.1037/0278-7393.29.6.1312

Juola, J. F., Ward, N. J., & McNamara, T. (1982). Visual search and reading of rapid serial presentations of letter strings, words, and text. *Journal of Experimental Psychology: General*, *111*(2), 208–227. https://doi.org/10.1037/0096-3445.111.2.208

Just, M. A., & Carpenter, P. A. (1987). *The psychology of reading and language comprehension.* Allyn & Bacon.

Kaakinen, J. K., & Hyönä, J. (2010). Task effects on eye movements during reading. *Journal of Experimental Psychology: Learning, Memory and Cognition*, *36*(6), 1561–1566. https://doi.org/10.1037/A0020693

Kendeou, P., & O'Brien, E. J. (2018). Reading comprehension theories. In P. van den Broek, P. Afflerbach, & E. F. Rapp (Eds.), *The Routledge Handbook of Discourse Processes* (pp. 7–21). Routledge. https://doi.org/https://doi.org/10.4324/9781315687384-2

Kim, Y. S. G., Vorstius, C., & Radach, R. (2018). Does Online Comprehension Monitoring Make a Unique Contribution to Reading Comprehension in Beginning Readers? Evidence from eye movements. *Scientific Studies of Reading*, *22*(5), 367–383. https://doi.org/10.1080/10888438.2018.1457680

Kintsch, W. (1988). The Role of Knowledge in Discourse Comprehension: A Construction-Integration Model. *Psychological Review*, *95*(2), 163–182. https://doi.org/10.1037/0033-295X.95.2.163

Kintsch, W. (1998). *Comprehension: A paradigm for cognition.* Cambridge University Press. https://doi.org/https://doi.org/10.1017/CBO9780511809114

Kliegl, R., Grabner, E., Rolfs, M., & Engbert, R. (2004). Length, frequency, and predictability effects of words on eye movements in reading. *European Journal of*

Cognitive Psychology, *16*(1–2), 262–284. https://doi.org/10.1080/09541440340000213

Klimovich, M., Tiffin-Richards, S. P., & Richter, T. (2023). Does speed-reading training work, and if so, why? Effects of speed-reading training and metacognitive training on reading speed, comprehension and eye movements. *Journal of Research in Reading*, *46*(2), 123–142. https://doi.org/10.1111/1467-9817.12417

Kobayashi, M. (2002). Method effects on reading comprehension test performance: text organization and response format. *Language Testing*, *19*(2), 193–220. https://doi.org/https://doi.org/10.1191/0265532202lt227oa

Koda, K. (2005). Learning to read across writing systems: Transfer, metalinguistic awareness, and second-language reading development. *Second Language Writing Systems*, 311–334. https://doi.org/10.21832/9781853597954-014/HTML

Komori, M. (2016). Effects of working memory capacity on metacognitive monitoring: A study of group differences using a listening span test. *Frontiers in Psychology*, *7*, 172995. https://doi.org/10.3389/FPSYG.2016.00285/BIBTEX

Korinth, S. P., Dimigen, O., & Sommer, W. (2016). Reading training by means of disappearing text: effects on reading performance and eye movements. *Reading and Writing*, *22*(4), 289–307.

Korinth, S. P., & Nagler, T. (2021). Improving reading rates and comprehension? Benefits and limitations of the reading acceleration approach. *Language and Linguistics Compass*, *15*(3). https://doi.org/10.1111/LNC3.12408

Kuhn, M. R. , L. L. (n.d.). Developing fluent readers : teaching fluency as a foundational skill. *(No Title)*. Retrieved May 28, 2025, from https://cir.nii.ac.jp/crid/1130000797408173824

Kumle, L., Võ, M. L. H., & Draschkow, D. (2021). Estimating power in (generalized) linear mixed models: An open introduction and tutorial in R. *Behavior Research Methods*, *53*(6), 2528–2543. https://doi.org/10.3758/S13428-021-01546-0/figures/8

Kuperman, V. (2022). A cross-linguistic study of spatial parameters of eye-movement control during reading. *Journal of Experimental Psychology: Human Perception and Performance*, *48*(11), 1213–1228. https://psycnet.apa.org/fulltext/2022-95105-001.html

Kuperman, V. (2024). Intersample variance of second-language readers should not be overlooked. *Bilingualism: Language and Cognition*, 1–7. https://doi.org/10.1017/S1366728924000932

Kuperman, V., Dambacher, M., Nuthmann, A., & Kliegl, R. (2010). The effect of word position on eye-movements in sentence and paragraph reading. *Quarterly Journal of Experimental Psychology*, *63*(9), 1838–1857. https://doi.org/10.1080/17470211003602412

Kuperman, V., Drieghe, D., Keuleers, E., & Brysbaert, M. (2013). How strongly do word reading times and lexical decision times correlate? Combining data from eye movement corpora and megastudies. *Quarterly Journal of Experimental Psychology*, *66*(3), 563–580. https://doi.org/10.1080/17470218.2012.658820/

Kuperman, V., Kyröläinen, A. J., Porretta, V., Brysbaert, M., & Yang, S. (2021). A Lingering Question Addressed: Reading Rate and Most Efficient Listening Rate Are Highly Similar. *Journal of Experimental Psychology: Human Perception and Performance*, *47*(8), 1103–1112. https://doi.org/10.1037/XHP0000932

Kuperman, V., Siegelman, N., Schroeder, S., Acartürk, C., Alexeeva, S., Amenta, S., Bertram, R., Bonandrini, R., Brysbaert, M., Chernova, D., Da Fonseca, S. M., Dirix, N., Duyck, W., Fella, A., Frost, R., Gattei, C. A., Kalaitzi, A., Lõo, K., Marelli, M., … Usal, K. A. (2023). Text reading in English as a second language: Evidence from the Multilingual Eye-Movements Corpus. *Studies in Second Language Acquisition*, *45*(1), 3–37. https://doi.org/10.1017/S0272263121000954

Langer, J. A. (1984). Examining Background Knowledge and Text Comprehension. *Reading Research Quarterly*, *19*(4), 468. https://doi.org/10.2307/747918

Laycock, F. (1955). Significant characteristics of college students with varying flexibility in reading rate. *Journal of Experimental Education*, *23*(4), 311–319. https://doi.org/10.1080/00220973.1955.11010519

Lehrl, S., & Balaha, L. (2001). Kurztest zur Messung des Arbeitsgedächtnisses (KAI-N). *Vless*.

Lo, S., & Andrews, S. (2015). To transform or not to transform: using generalized linear mixed models to analyse reaction time data. *Frontiers in Psychology*, *6*, 1–16. https://doi.org/10.3389/FPSYG.2015.01171/

Lovett, M. W. (1987). A developmental approach to reading disability: accuracy and speed criteria of normal and deficient reading skill. *Child Development*, *58*(1), 234–245. https://doi.org/https://doi.org/10.2307/1130305

Luke, S. G., & Henderson, J. M. (2013). Oculomotor and cognitive control of eye movements in reading: Evidence from mindless reading. *Attention, Perception, and Psychophysics*, *75*(6), 1230–1242. https://doi.org/https://doi.org/10.3758/s13414-013-0482-5

Mackenzie, I. S. (2017). Fitts' Law. In I. S. MacKenzie (Ed.), *The Wiley Handbook of Human Computer Interaction Set* (Vol. 1, pp. 347–370). John Wiley & Sons, Ltd. https://doi.org/https://doi.org/10.1002/9781118976005.ch14

Magliano, J. P., Little, L. P., & Fracesser, A. C. (1993). The impact of comprehension instruction on the calibration of comprehension. *Reading Research and Instruction*, *32*(3), 49–63. https://doi.org/https://doi.org/10.1080/19388079309558124

Marian, V., Blumenfeld, H. K., & Kaushanskaya, M. (2007). The language experience and proficiency questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language and Hearing Research*, *50*(4), 940–967. https://doi.org/https://doi.org/10.1044/1092-4388(2007/067)

Markman, E. M., & Gorin, L. (1981). Children's ability to adjust their standards for evaluating comprehension. *Journal of Educational Psychology*, *73*(3), 320–325. https://doi.org/https://doi.org/10.1037/0022-0663.73.3.320

Marmolejo-Ramos, F., Juan, M. R. E., Gygax, P., Madden, C. J., & Roa, S. M. (2009). Reading between the lines: The activation of background knowledge during text comprehension. *Pragmatics & Cognition*, *17*(1), 77–107. https://doi.org/https://doi.org/10.1075/pc.17.1.03mar

McConkie, G. W., Kerr, P. W., & Dyre, B. P. (1994). What are "normal" eye movements during reading: Toward a mathematical description. In J. Ygge & G. Lennerstrand (Eds.), *Eye movements in reading* (pp. 315–327). Elsevier Science Inc.

McConkie, G. W., & Rayner, K. (1975). Identifying the span of the effective stimulus in reading. *Perception & Psychophysics*, *17*, 578–586.

McConkie, G. W., & Zola, D. (1984). Eye movement control during reading: The effect of word units. In Prinz W & Sanders A F (Eds.), *Cognition and motor processes* (pp. 63–74). Springer. https://doi.org/https://doi.org/10.1007/978-3-642-69382-3_5

Mckee, S. (2012a). Reading Comprehension, What We Know: A Review of Research 1995 to 2011. *Language Testing in Asia*, *2*(1), 1–14. https://doi.org/10.1186/2229-0443-2-1-45/METRICS

Mckee, S. (2012b). Reading comprehension, what we know: A review of research 1995 to 2011. *Language Testing in Asia*, *2*(1), 1–14. https://doi.org/10.1186/2229-0443-2-1-45

McNamara, D. S., & Others, A. (1996). Are good texts always better? Interactions of text coherence, background knowledge, and levels of understanding in learning from text. *Cognition and Instruction*, *14*(1), 1–43.

Mézière, D. C., Yu, L., McArthur, G., Reichle, E. D., & von der Malsburg, T. (2024). Scanpath regularity as an index of reading comprehension. *Scientific Studies of Reading*, *28*(1), 79–100. https://doi.org/10.1080/10888438.2023.2232063

Moll, K., Wallner, R., & Landerl, K. (2012). Kognitive Korrelate der Lese-, Leserechtschreib- und der Rechtschreibstörung. *Http://Dx.Doi.Org/10.1024/2235-0977/A000002*, *1*(1), 7–19. https://doi.org/10.1024/2235-0977/A000002

Morishima, Y. (2013). Allocation of limited cognitive resources during text comprehension in a second language. *Discourse Processes*, *50*(8), 577–597. https://doi.org/10.1080/0163853X.2013.846964

Murphy, D. H., Hoover, K. M., Agadzhanyan, K., Kuehn, J. C., & Castel, A. D. (2021). Learning in double time: The effect of lecture video speed on immediate and delayed comprehension. *Applied Cognitive Psychology*, *36*(1), 69–82. https://doi.org/10.1002/ACP.3899

Nahatame, S. (2023). Predicting processing effort during L1 and L2 reading: The relationship between text linguistic features and eye movements. *Bilingualism: Language and Cognition*, *26*(4), 724–737. https://doi.org/10.1017/S136672892200089X

Nguyen, K. V., Binder, K. S., Nemier, C., & Ardoin, S. P. (2014). Gotcha! Catching kids during mindless reading. *Scientific Studies of Reading*, *18*(4), 274–290. https://doi.org/10.1080/10888438.2013.876424

Nisbet, K., Bertram, R., Erlinghagen, C., Pieczykolan, A., & Kuperman, V. (2021). Quantifying the difference in reading fluency between L1 and L2 readers of

English. *Studies in Second Language Acquisition*, *44*(2), 407–434. https://doi.org/10.1017/S0272263121000279

Oliveira, D. G., Mecca, T. P., Botelho, P., Ivan, S., Pinto, S., & Macedo, E. C. (2013). Text complexity and eye movements measures in adults readers. *Psicologia: Teoria e Prática*, *15*(3), 163–174. https://editorarevistas.mackenzie.br/index.php/ptp/article/view/5389

Pacheco, M., Lafe, C. W., Chen, C.-H., & Hsieh, T.-Y. (2024). Consistent individual tendencies in motor speed-accuracy trade-off. *Motor Control*, *28*(2), 158–173. https://doi.org/10.31234/OSF.IO/BZ8UH

Parshina, O., Laurinavichyute, A. K., & Sekerina, I. A. (2021). Eye-movement benchmarks in Heritage Language reading. *Bilingualism: Language and Cognition*, *24*(1), 69–82. https://doi.org/10.1017/S136672892000019X

Paxton, M. (2000). A Linguistic Perspective on Multiple Choice Questioning. *Assessment and Evaluation in Higher Education*, *25*(2), 109–119. https://doi.org/10.1080/713611429

Pecorari, D., & Malmström, H. (2018). At the Crossroads of TESOL and English Medium Instruction. *TESOL Quarterly*, *52*(3), 497. https://doi.org/10.1002/TESQ.470

Peng, P., Barnes, M., Wang, C., Wang, W., Li, S., Swanson, H. L., Dardick, W., & Tao, S. (2018). A Meta-Analysis on the Relation Between Reading and Working Memory. *Association*, *144*(1), 48–76. https://doi.org/10.1037/bul0000124.supp

Pérez, A., Joseph, H. S. S. L., Bajo, T., & Nation, K. (2016). Evaluation and revision of inferential comprehension in narrative texts: an eye movement study. *Language, Cognition and Neuroscience*, *31*(4), 549–566. https://doi.org/10.1080/23273798.2015.1115883

Perfetti, C. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, *11*(4), 357–383. https://doi.org/10.1080/10888430701530730

Perfetti, C. A. (1985). Reading skills. *Psychiatry*, *50*, 1125–1129.

Perfetti, C. A., & Roth, S. (1980). Some of the interactive processes in reading and their role in reading skill. In *Interactive Processes in Reading* (pp. 269–297). Taylor and Francis. https://doi.org/10.4324/9781315108506-11

Perri, R. L., Berchicci, M., Spinelli, D., & Di Russo, F. (2014). Individual differences in response speed and accuracy are associated to specific brain activities of two interacting systems. *Frontiers in Behavioral Neuroscience*, *8*(JULY). https://doi.org/10.3389/FNBEH.2014.00251/PDF

Pickering, M. J., & Frisson, S. (2001). Processing Ambiguous Verbs: Evidence from Eye Movements. *Journal of Experimental Psychology: Learning Memory and Cognition*, *27*(2), 556–573. https://doi.org/10.1037/0278-7393.27.2.556

Pollatsek, A., Reichle, E. D., & Rayner, K. (2003). Modeling eye movements in reading: Extensions of the E–Z reader model. In Hyönä J, Radach R, & Deubel H (Eds.), *The Mind's Eye: Cognitive and Applied Aspects of Eye Movement Research* (pp. 361–390). Elsevier. https://doi.org/10.1016/B978-044451020-4/50021-9

Potter, M. C. (2018). Rapid Serial Visual Presentation (RSVP). *New Methods in Reading Comprehension Research*, 91–118. https://doi.org/10.4324/9780429505379-5

Radach, R., Günther, T., & Huestegge, L. (2012). Blickbewegungen beim Lesen, Leseentwicklung und Legasthenie. *Lernen Und Lernstörungen*, *1*(3), 185–204. https://doi.org/10.1024/2235-0977/a000019

Radach, R., & Hofmann, M. (2016). Graphematische Verarbeitung beim Lesen von Wörtern. In B. Schröder (Ed.), *Handbuch Laut, Gebärde, Buchstabe* (pp. 455–3). De Gruyter. https://doi.org/https://doi.org/10.1515/9783110295993

Radach, R., Huestegge, L., & Reilly, R. (2008). The role of global top-down factors in local eye-movement control in reading. *Psychological Research*, *72*(6), 675–688. https://doi.org/10.1007/S00426-008-0173-3/

Radach, R., & Kempe, V. (1993). An individual analysis of initial fixation positions in reading. In G. d'Ydewalle & J. Van Rensberg (Eds.), *Perception and cognition: Advances in eye movement research* (pp. 213–225). Elsevier. https://psycnet.apa.org/record/1993-97786-018

Radach, R., & Kennedy, A. (2004). Theoretical perspectives on eye movements in reading: Past controversies, current issues, and an agenda for future research. *European Journal of Cognitive Psychology*, *16*(1–2), 3–26. https://doi.org/10.1080/09541440340000295

Radach, R., Reilly, R., & Inhoff, A. (2007a). Models of oculomotor control in reading: Toward a theoretical foundation of current debates. *Eye Movements: A Window on Mind and Brain*, 237–269. https://doi.org/10.1016/B978-008044980-7/50013-6

Radach, R., Reilly, R., & Inhoff, A. (2007b). Models of oculomotor control in reading: Toward a theoretical foundation of current debates. In R. P. G. van Gompel, M. H. Fischer, W. S. Murray, & R. L. Hill (Eds.), *Eye Movements: A Window on Mind and Brain* (pp. 237–269). Elsevier Inc. https://doi.org/10.1016/B978-008044980-7/50013-6

Rank, M., & Di Luca, M. (2015). Speed-accuracy tradeoff in force perception. *Journal of Experimental Psychology: Human Perception and Performance*, *41*(3), 738–746. https://doi.org/10.1037/A0038974

Ratcliff, R., & Smith, P. L. (2004). A comparison of sequential sampling models for two-choice reaction time. *Psychological Review*, *111*(2), 333–367. https://doi.org/10.1037/0033-295X.111.2.333

Ratcliff, R., & Starns, J. J. (2013). Modeling confidence judgments, response times, and multiple choices in decision making: recognition memory and motion discrimination. *Psychological Review*, *120*(3), 697–719. https://doi.org/10.1037/A0033152

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin*, *124*(3), 372–422. https://doi.org/10.1037/0033-2909.124.3.372

Rayner, K., Chace, K. H., Slattery, T. J., & Ashby, J. (2006). Eye movements as reflections of comprehension processes in reading. *Scientific Studies of Reading*, *10*(3), 241–255. https://doi.org/https://doi.org/10.1207/s1532799xssr1003_3

Rayner, K., & Fischer, M. H. (1996). Mindless reading revisited: Eye movements during reading and scanning are different. *Perception and Psychophysics*, *58*(5), 734–747. https://doi.org/10.3758/BF03213106

Rayner, K., Kambe, G., & Duffy, S. A. (2000). The effect of clause wrap-up on eye movements during reading. *The Quarterly Journal of Experimental Psychology: Section A*, *53*(4), 1061–1080. https://doi.org/10.1080/713755934

Rayner, K., & McConkie, G. W. (1976). What guides a reader's eye movements? *Vision Research*, *16*(8), 829–837. https://doi.org/10.1016/0042-6989(76)90143-7

Rayner, K., Pollatsek, A., Ashby, J., & Clifton, C. (2012). Psychology of reading, second edition. In *Psychology of Reading, Second Edition*. Taylor and Francis. https://doi.org/10.4324/9780203155158

Rayner, K., & Raney, G. E. (1996). Eye movement control in reading and visual search: Effects of word frequency. *Psychonomic Bulletin and Review*, *3*(2), 245–248. https://doi.org/10.3758/BF03212426/METRICS

Rayner, K., Schotter, E. R., Masson, M. E. J., Potter, M. C., & Treiman, R. (2016). So much to read, so little time: How do we read, and can speed reading help?

Psychological Science in the Public Interest, *17*(1), 4–34. https://doi.org/10.1177/1529100615623267

Rayner, K., Sereno, S. C., & Raney, G. E. (1996). Eye movement control in reading: A comparison of two types of models. *Journal of Experimental Psychology: Human Perception and Performance*, *22*(5), 1188–1200. https://doi.org/https://doi.org/10.1037/0096-1523.22.5.1188

Rayner, K., Warren, T., Juhasz, B. J., & Liversedge, S. P. (2004). The effect of plausibility on eye movements in reading. *Journal of Experimental Psychology: Learning Memory and Cognition*, *30*(6), 1290–1301. https://doi.org/10.1037/0278-7393.30.6.1290

Rayner, K., & Well, A. D. (1996). Effects of contextual constraint on eye movements in reading: A further examination. *Psychonomic Bulletin and Review*, *3*(4), 504–509. https://doi.org/10.3758/BF03214555/

Reichle, E. D., Liversedge, S. P., Pollatsek, A., & Rayner, K. (2009). Encoding multiple words simultaneously in reading is implausible. *Trends in Cognitive Sciences*, *13*(3), 115–119. https://doi.org/10.1016/J.TICS.2008.12.002

Reichle, E. D., Pollatsek, A., Fisher, D. L., & Rayner, K. (1998). Toward a model of eye movement control in reading. *Psychological Review*, *105*(1), 125–157. https://doi.org/https://doi.org/10.1037/0033-295x.105.1.125

Reichle, E. D., Rayner, K., & Pollatsek, A. (2003). The E-Z reader model of eye-movement control in reading: Comparisons to other models. *Behavioral and Brain Sciences*, *26*(4), 445–476. https://doi.org/10.1017/S0140525X03000104

Reichle, E. D., Reineberg, A. E., & Schooler, J. W. (2010). Eye movements during mindless reading. *Psychological Science*, *21*(9), 1300–1310. https://doi.org/10.1177/0956797610378686

Reichle, E., Warren, T., & McConnell, K. (2009). Using E-Z reader to model the effects of higher level language processing on eye movements during reading. *Psychonomic Bulletin and Review*, *16*(1), 1–21. https://doi.org/10.3758/PBR.16.1.1

Reilly, R. G., & Radach, R. (2006). Some empirical tests of an interactive activation model of eye movement control in reading. *Cognitive Systems Research*, *7*(1), 34–55. https://doi.org/10.1016/J.COGSYS.2005.07.006

Rickheit, G., Herrmann, T., & Deutsch, W. (2003). *Psycholinguistics: Ein internationales Handbuch.* De Gruyter Mouton. https://doi.org/https://doi.org/10.1515/9783110114249

Rinkenauer, G., Osman, A., Ulrich, R., Müler-Gethmann, H., & Mattes, S. (2004). On the locus of speed-accuracy trade-off in reaction time: Inferences from the lateralized readiness potential. *Journal of Experimental Psychology: General*, *133*(2), 261–282. https://doi.org/10.1037/0096-3445.133.2.261

Robinson, M. D., Moeller, S. K., & Fetterman, A. K. (2010). Neuroticism and responsiveness to error feedback: adaptive self-regulation versus affective reactivity. *Journal of Personality*, *78*(5), 1469–1496. https://doi.org/https://doi.org/10.1111/j.1467-6494.2010.00658.x

Rubin, G. S., & Turano, K. (1992). Reading without saccadic eye movements. *Vision Research*, *32*(5), 895–902. https://doi.org/10.1016/0042-6989(92)90032-E

Sanford, A. J., & Sturt, P. (2002). Depth of processing in language comprehension: Not noticing the evidence. *Trends in Cognitive Sciences*, *6*(9), 382–386. https://doi.org/https://doi.org/10.1080/01690960143000354

Scaltritti, M., Greatti, E., & Sulpizio, S. (2024). Decisional components of motor responses are not related to online response control: Evidence from lexical decision and speed-accuracy tradeoff manipulations. *Memory & Cognition*. https://doi.org/10.3758/S13421-024-01619-3

Schad, D. J., Nuthmann, A., & Engbert, R. (2012). Your mind wanders weakly, your mind wanders deeply: Objective measures reveal mindless reading at different levels. *Cognition*, *125*(2), 179–194. https://doi.org/10.1016/J.COGNITION.2012.07.004

Schilling, H. E. H., Rayner, K., & Chumbley, J. I. (1998). Comparing naming, lexical decision, and eye fixation times: Word frequency effects and individual differences. *Memory & Cognition*, *26*(6), 1270–1281. https://doi.org/10.3758/BF03201199

Schotter, E. R., Bicknell, K., Howard, I., Levy, R., & Rayner, K. (2014). Task effects reveal cognitive flexibility responding to frequency and predictability: Evidence from eye movements in reading and proofreading. *Cognition*, *131*(1), 1–27. https://doi.org/10.1016/J.COGNITION.2013.11.018

Schotter, E. R., Tran, R., & Rayner, K. (2014). Don’t believe what you read (only once): Comprehension is supported by regressions during reading. *Psychological Science*, *25*(6), 1218–1226. https://doi.org/https://doi.org/10.1177/0956797614531148

Seli, P., Beaty, R. E., Cheyne, J. A., Smilek, D., Oakman, J., & Schacter, D. L. (2018). How pervasive is mind wandering, really?,. *Consciousness and Cognition*, *66*, 74–78. https://doi.org/10.1016/J.CONCOG.2018.10.002

Siegelman, N., Elgort, I., Brysbaert, M., Agrawal, N., Amenta, S., Arsenijević Mijalković, J., Chang, C. S., Chernova, D., Chetail, F., Clarke, A. J. B., Content, A., Crepaldi, D., Davaabold, N., Delgersuren, S., Deutsch, A., Dibrova, V., Drieghe, D., Filipović Đurđević, D., Finch, B., … Kuperman, V. (2024). Rethinking First Language–Second Language Similarities and Differences in English Proficiency: Insights From the ENglish Reading Online (ENRO) Project. *Language Learning*, *74*(1), 249–294. https://doi.org/10.1111/LANG.12586

Smith, R., Snow, P., Serry, T., & Hammond, L. (2021). The role of background knowledge in reading comprehension: A critical review. *Reading Psychology*, *42*(3), 214–240. https://doi.org/10.1080/02702711.2021.1888348

Sommers, M. S., Hale, S., Myerson, J., Rose, N., Tye-Murray, N., & Spehar, B. (2011). Listening comprehension across the adult lifespan. *Ear and Hearing*, *32*(6), 775–781. https://doi.org/10.1097/AUD.0B013E3182234CF6

Spieser, L., Servant, M., Hasbroucq, T., & Burle, B. (2017). Beyond decision! Motor contribution to speed–accuracy trade-off in decision-making. *Psychonomic Bulletin and Review*, *24*(3), 950–956. https://doi.org/10.3758/S13423-016-1172-9

Standage, D., Blohm, G., & Dorris, M. C. (2014). On the neural implementation of the speed-accuracy trade-off. *Frontiers in Neuroscience*, *8*(8 JUL), 88630. https://doi.org/10.3389/FNINS.2014.00236/BIBTEX

Starr, M. S., & Rayner, K. (2001). Eye movements during reading: some current controversies. *Trends in Cognitive Sciences*, *5*(4), 156–163. https://doi.org/10.1016/S1364-6613(00)01619-3

Staub, A. (2015). The Effect of Lexical Predictability on Eye Movements in Reading: Critical Review and Theoretical Interpretation. *Language and Linguistics Compass*, *9*(8), 311–327. https://doi.org/10.1111/LNC3.12151

Staub, A., Rayner, K., Pollatsek, A., Hyönä, J., & Majewski, H. (2007). The time course of plausibility effects on eye movements in reading: evidence from noun-noun compounds. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *33*(6), 1162–1169. https://doi.org/10.1037/0278-7393.33.6.1162

Steindorf, L., & Rummel, J. (2020). Do your eyes give you away? A validation study of eye-movement measures used as indicators for mindless reading. *Behavior Research Methods*, *52*(1), 162–176. https://doi.org/10.3758/S13428-019-01214-4

Strukelj, A., & Niehorster, D. C. (2018). One page of text: Eye movements during regular and thorough reading, skimming, and spell checking. *Journal of Eye Movement Research*, *11*(1), 1–22. https://doi.org/10.16910/jemr.11.1.1

Sweller, J. (2011). Cognitive load theory. *Psychology of Learning and Motivation*, *55*, 37–76. https://doi.org/10.1016/B978-0-12-387691-1.00002-8

Tarar, J. M., Meisinger, E. B., & Dickens, R. H. (2015). Test review: test of word reading efficiency–second edition (TOWRE-2) by Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. *Canadian Journal of School Psychology*, *30*(4), 320–326. https://doi.org/10.1177/0829573515594334

Thalberg, S. P. (1967). Reading rate and immediate versus delayed retention. *Journal of Educational Psychology*, *58*(6), 373–378. https://doi.org/10.1037/H0025190

Tibken, C., Richter, T., & Wannagat, W. (2024). Metacognitive comprehension monitoring: Cognitive abilities explain performance differences between younger and older adults. *Scientific Studies of Reading*, *28*(3), 284–302. https://doi.org/10.1080/10888438.2023.2261572

Tighe, E. L., Kaldes, G., Talwar, A., Crossley, S. A., Greenberg, D., & Skalicky, S. (2023). Do struggling adult readers monitor their reading? Understanding the role of online and offline comprehension monitoring processes during reading. *Journal of Learning Disabilities*, *56*(1), 25–42. https://doi.org/10.1177/00222194221081473/FORMAT/EPUB

Tye-Murray, N., Sommers, M., Spehar, B., Myerson, J., Hale, S., & Rose, N. S. (2008). Auditory-visual discourse comprehension by older and young adults in favorable and unfavorable conditions. *International Journal of Audiology*, *47*(2), 31–37. https://doi.org/10.1080/14992020802301662

Vacca, R. T., Vacca, J. A. L., Mraz, M., & Williams-Duncan, O. M. (2021). Content area reading: Literacy and learning across the curriculum. *Curriculum and Teaching Dialogue*, *23*(1–2), 317–321.

Van der Schoot, M., Horsley, T. M., & van Lieshout, E. C. D. M. (2010). The effects of instruction on situation model construction: An eye fixation study on text comprehension in primary school children. *Educational Psychology*, *30*(7), 817–835. https://doi.org/10.1080/01443410.2010.510600

Van Dijk, T. A., & Kintsch, W. (1983). Strategies of Discourse Comprehension. In *ACADEMIC PRESS*.

Van Veen, V., Krug, M. K., & Carter, C. S. (2008). The neural and computational basis of controlled speed-accuracy tradeoff during task performance. *Journal of Cognitive Neuroscience*, *20*(11), 1952–1965. https://doi.org/10.1162/JOCN.2008.20146

Veldre, A., Reichle, E. D., Wong, R., & Andrews, S. (2020). The effect of contextual plausibility on word skipping during reading. *Cognition*, *197*, 104184. https://doi.org/10.1016/J.COGNITION.2020.104184

Veldre, A., Yu liliyu, L., Andrews, S., & Reichle, E. D. (2020). Towards a complete model of reading: Simulating lexical decision, word naming, and sentence reading with über-reader. *Proceedings of the Annual Meeting of the Cognitive Science Society*, *42*(0).

Vitu, F. (1991). The existence of a center of gravity effect during reading. *Vision Research*, *31*(7–8), 1289–1313. https://doi.org/10.1016/0042-6989(91)90052-7

Vitu, F., McConkie, G. W., Kerr, P., & O'Regan, J. K. (2001a). Fixation location effects on fixation durations during reading: an inverted optimal viewing position effect. *Vision Research*, *41*(25–26), 3513–3533. https://doi.org/10.1016/S0042-6989(01)00166-3

Vorstius, C., Radach, R., Mayer, M. B., & Lonigan, C. J. (2013). Monitoring local comprehension monitoring in sentence reading. *School Psychology Review*, *42*(2), 191–206. https://doi.org/https://doi.org/10.1080/02796015.2013.12087484

Wade, N. J., Tatler, B. W., & Heller, D. (2003). Dodge-ing the issue: Dodge, javal, hering, and the measurement of saccades in eye-movement research. *Perception*, *32*(7), 793–804. https://doi.org/http://dx.doi.org/10.1068/P3470

Walczyk, J. J., Kelly, K. E., Meche, S. D., & Braud, H. (1999). Time limitations enhance reading comprehension. *Contemporary Educational Psychology*, *24*(2), 156–165.

White, S. J., & Liversedge, S. P. (2006). Linguistic and nonlinguistic influences on the eyes' landing positions during reading. *Quarterly Journal of Experimental Psychology*, *59*(4), 760–782. https://doi.org/10.1080/02724980543000024

White, S. J., Warrington, K. L., McGowan, V. A., & Paterson, K. B. (2015). Eye movements during reading and topic scanning: Effects of word frequency. *Journal of Experimental Psychology: Human Perception and Performance*, *41*(1), 233–248. https://doi.org/10.1037/XHP0000020

Whitford, V., & Titone, D. (2015). Second-language experience modulates eye movements during first- and second-language sentence reading: Evidence from a gaze-contingent moving window paradigm. *Journal of Experimental Psychology: Learning Memory and Cognition*, *41*(4), 1118–1129. https://doi.org/10.1037/xlm0000093

Wickelgren, W. A. (1977). Speed-accuracy tradeoff and information processing dynamics. *Acta Psychologica*, *41*(1), 67–85. https://doi.org/10.1016/0001-6918(77)90012-9

Wijaya, M. (2018). Reading speed level and comprehension in second language reading. *Pedagogy : Journal of English Language Teaching*, *6*(1), 77–86. https://doi.org/https://doi.org/10.32332/pedagogy.v6i1.1087

Wotschack, C., & Kliegl, R. (2013). Reading strategy modulates parafoveal-on-foveal effects in sentence reading. *Quarterly Journal of Experimental Psychology*, *66*(3), 548–562. https://doi.org/10.1080/17470218.2011.625094

Zawoyski, A. M., & Ardoin, S. P. (2019). Using eye-tracking technology to examine the impact of question format on reading behavior in elementary students. *School Psychology Review*, *48*(4), 320–332. https://doi.org/10.17105/SPR-2018-0014.V48-4

Zola, D. (1984). Redundancy and word perception during reading. *Perception & Psychophysics*, *36*(3), 277–284. https://doi.org/10.3758/BF03206369

Zwaan, R. A., Langston, M. C., & Graesser, A. C. (1995). The construction of situation models in narrative comprehension: an event-indexing model. *Psychological Science*, *6*(5), 292–297. https://doi.org/https://doi.org/10.1111/j.1467-9280.1995.tb0051

Appendix

Appendix A

Text stimuli & language questionnaire Experiment 1 & 2

A1
Text stimuli for Experiment 1 and Experiment 2

Font and line breaks are used as presented in both experiments.

Instruction prior to the experiment:

```
In this experiment, you will be presented with various texts. Please read
them carefully.
Before each text is presented, a dot will be displayed in the upper left
corner of each page. Please look at the dot until the text starts.
After reading, you will see questions related to the text. Please answer
them using the keyboard.
Please press the space bar to start the experiment.
```

Instruction prior to the line-by-line technique:

```
In this experiment, you will be presented with various texts. Please read
them carefully.
You will be guided through the text line by line by highlighting the text
to be read in black. The remaining text will be displayed in gray.
Please make sure to always read only the black text. Follow this marking
line by line through the text and adjust your speed accordingly.
Before each text is presented, a dot will be displayed in the upper left
corner of each page. Please look at the dot until the text starts.
After reading, you will see questions related to the text. Please answer
them using the keyboard.
Please press the space bar to start the experiment.
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Text 1

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I had a foreign student who lived in Vietnam. She now lives in Virginia, just outside of Washington.
She came over, at the time, when the North Vietnamese were invading. She had been tipped off by our
embassy. She was working for our embassy as an interpreter, and she'd been tipped off that they
expected this invasion and that if she wanted to, she could take two of her family, two children in
her family, not her own 'cause she wasn't married then, and they'd give her space on a helicopter.

So she took two children from her oldest brother. They are over there. They were about fifteen and
thirteen, and she escaped to the United States. But before she left, she sent me a letter, and she
said, "We think we're going to be invaded and we don't think we're going to be able to stop it, but
here is a list of my family. I have told them all when they get out. They're all going to try to get
out except for my sister," one sister, didn't speak English.

She didn want to get out, so all the rest of them were going to try to get out. Her brother had been
the head of the police on the Mekong River, the military police, so he had a boat, a ship, and he
had that boat hidden. All the family knew where to go to get on that boat, but she took the two
children and she sent in her letter to me with this list, and she says, "My brother So-and-So, his
wife So-and-So, children So-and-So," and they were all given my name and address and telephone
number and told to call me as soon as they got onto American soil, or where they could safely make a
call to me.

So I had all these reverse the charges calls, in the middle of the night, most of them, because it
would be daytime where they were. One night, I got a call from an American sergeant in, where was
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it, in Thailand, I think he said, and he said, "there's a Vietnamese man here who says he knows you." and, of course, I had met them. But, of course, I didn't know, couldn't know them by name, because their names were so different. "And he knows you, and I want to know if he knows you and his name is So-and-So." Well, I had the list right there.

So I had all these reverse the charges calls, in the middle of the night, most of them, because it would be daytime where they were. One night, I got a call from an American sergeant in, where was it, in Thailand, I think he said, and he said, "there's a Vietnamese man here who says he knows you." and, of course, I had met them. But, of course, I didn't know, couldn't know them by name, because their names were so different. "And he knows you, and I want to know if he knows you and his name is So-and-So." Well, I had the list right there.

Well, finally I got a call from our student, and she said she was in Indiana, I think. I've sort of forgotten. She was in a refugee camp. She said, "I have two boys with me," and she said, "We're going to be allowed to go soon." But she said, "I don't know what to do with them because I'm going to Washington and look up some of the people I know and see if I can get a job and an apartment in Washington, where I know people." See, she'd met these people in the embassy and been their interpreter. So I said, "Well, bring them here," and she said, "May I?" And I said, "Of course, you can," so she brought the two boys here.

Questions Text 1

Why did the speaker's foreign student know to leave her country?

She was tipped off by the US Embassy.
The American sergeant tipped them off.
The speaker contacted her and warned her.
Her brother was in the military police.

Where did the exchange student finally call the speaker from?

A refugee camp in Indiana.
The embassy in Washington, DC.
A refugee camp in the state of Washington.
The American ambassador called on her behalf.

The student most likely contacted the speaker about her family's migration because:

The speaker was the only American the student knew.
The student knew of the speaker's influence with US Immigration.
The student thought that the speaker would be sympathetic and trustworthy.
The speaker had information for the student about US Immigration Laws.

Based on what you heard, what is most likely a future action taken by the speaker?

Set up a refugee relief organization.
Leave for Vietnam to help the rest of the exchange student's family.
Advise the Vietnamese family about how to deal with US Immigration.
Teach the Vietnamese boys English.

Because of her previous job at the American embassy, the exchange student:

Was able to talk her way out of the refugee camp.
Had contacts in Washington, DC, who could help her find a job and an apartment.
Was able to explain to the American sergeant why she was allowed to immigrate.
Had known exactly when to warn her cousins to leave Vietnam.

Which is the most accurate account of events?

The speaker went to Vietnam to meet the exchange student's family and decided to help them immigrate to the US.
The exchange student was tipped off about the invasion and asked the speaker for assistance in her escape.
The exchange student escaped on an American embassy helicopter and gave her family the speaker's phone number to help them relocate.
The exchange student called from a refugee camp and asked the speaker to help her and her family get out of Vietnam.

Text 2

Both my parents were born in Russia. I was born in Waterbury, Connecticut. They came here when they were very young. My Dad walked across half of Europe, at the age of fifteen, to get out of Russia. And worked in the vineyards in Germany and France to save money and came to this country as a boy of seventeen. And he and my mother, who was underage, worked in factories in Waterbury, which was the brass center of the world and also the clock industry of the world at that time.

And after they worked for twelve hours they would run home and have a sandwich and then run downtown to study English because the worst insult in those days was to call somebody a greenhorn. And they didn't want to be considered greenhorns. So, my mother spoke English perfectly, but had difficulty with one word. She could not say arthritis. And that always came out "arthur-itis." And my Dad had trouble transposing v's and w's. He would say he put on a west, and went vest, which was his only problem. And my Dad's adventures in going from Russia to Cherbourg, France, to get out of Europe are worthy of a novel.

Well, he got in a second class coach and in the Russian trains the baggage was underneath the seats. There was a sliding door. You open it up. So, he crawled in. There was a lady in the compartment. He told her what he was gonna do. And the reason he was doing this was that he had gone to a small town. He lived on a farm. The farm was on the line of Napoleon's retreat from Moscow in the War of 1812. And in the spring plowing they would dig up artifacts from the French Army and from the French Armory Train. They had buttons, pieces of weapons and uniforms, tattered flags and things.

And when they came to this country, they had this stuffed in a cardboard box on the boat. Also included was the family Bible with a listing of the births of everybody, and who got married and all the family history. And, unfortunately, somebody stole it. So we lost the whole history of our family. But my dad, himself, told me the story of how he came to this country. And he was in this town and they didn't have paved roads in those days. What they had were dirt roads and when it rained it got very muddy. The streets got muddy.

So they built, instead of sidewalks, they had, like, boardwalks about eighteen inches high. So the gentry in their finery could walk without getting mud on their boots. And he came by a Cossack officer wearing a white uniform who took a swing at him with a riding crop because he was a farm boy and he was wearing farm clothes. He knocked him into the street and my Dad said he looked up and he said, "I'm not gonna stay in a country that treats their people like this," and made up his mind that he was going with fifteen, about the equivalent of fifteen dollars that the family gave him. Got on this train, crawled underneath the seat and the woman fed him.

When they came to the Polish border--the customs was very lax in those days. You could walk across. So he walked across. Got a job in Poland. He slept in barns. Worked his way into the wine country in Germany, where he worked for a year. Saved his money and he drove the wagons with the big barrels of grapes. That was his job. He was a husky kid. And that was his job, and then he did the same thing. He worked his way towards France. Got to France and when he had money for his passage, he got on the boat and came to Waterbury, Connecticut.

Questions Text 2

Which characteristic of the speaker’s father is being conveyed?

His physical endurance.
His financial responsibility.
His sneaky nature.
His hard-work and perseverance.

Why did the speaker’s father decide to leave Russia?

He had saved enough money to be able to run away.
He wanted to find work in the French and German vineyards.
He refused to live in a country that did not treat its own people with respect.
The French military artifacts that he dug up inspired him to go to France.

Why does the speaker mention the family Bible?

To create sympathy for the family’s misfortune.
To explain the importance of the speaker’s father’s migration story.
To portray the family’s convictions.
To explain what the speaker’s father carried in his travels.

How old was the speaker’s father when he arrived in America?
12 years old.
15 years old.
17 years old.
20 years old.

What was the progression of the speaker’s father’s travels?

Russia, France, United States.
Russia, Poland, France, United States.
Russia, France, Germany, United States.
Russia, Poland, Germany, France, United States.

The speaker says that his father’s adventures getting out of Europe are worthy of:

A movie.
A novel.
Respect.
Admiration.

Text 3

I'm of Armenian extraction and both my parents were born in the country of Turkey. I don't want to go deeply into the history of what happened there, but Armenians are Christians and the Turks are Muslims, well, inevitably, problems arose. My father came from one of the smaller towns in the center of Turkey, I think it was called 'Gurun.' My mother came from what was then Constantinople, which is now Istanbul. There were massive persecutions and deportations against the Christians by the Turks happening under Sultan Abdul Hamid about 1890 or so. At that particular time, some of my father's relatives were killed, but others got the message and were able to make it to the Port of Constantinople, where they immigrated to the United States.

They being my father, one brother and my grandfather, but another brother was killed. They immigrated to the United States and to Massachusetts. My mother, who was in Constantinople during all this knew nothing about the persecutions that were going on in the villages and smaller cities throughout the country. This can be compared to what recently went on in what was Yugoslavia. So my father got his start in business in Massachusetts and later went back to Turkey to get his bride - my mother. They came over here about 1909 or so.

My father, at that time, was in a rather interesting business. He was an importer, but he was 'wiped out' in one disastrous undertaking. He imported a shipment of raw Filbert nuts that had to be processed by heat to prevent spoilage When the ship arrived in Boston, the longshoremen who loaded and unloaded the ships started a strike which lasted for three weeks. My father told me that the nuts rotted in the shell, and "wiped him out' as an importer. So then he went strictly into what he had been doing right along, the restaurant business, which he mostly successfully continued up to his retirement.

He came to America first and then returned to Turkey. I believe that their marriage was arranged - a common practice at that time. At that time, the United States was accepting all sorts of immigrants, and there was no restrictions against anyone from Turkey. I assume, at that time as well. that the US government knew about the persecutions and were allowing these people to come in without any restrictions. My mother's mother came accompanied by my mother's two sisters but I don't know exactly when they immigrated. My father's father, my grandfather, was also here but I never knew him.

So, my father was in the hotel restaurant business. He had a summer resort in the Catskill Mountains of New York, and he had a place up in New Hampshire. I'll never forget that one, because I was a little tot, and somehow, I don't know how it was, I must have tried to pick up a lobster, and the lobster clamped its claw on my finger - screamed 'bloody murder'! I'll never forget that and my father chopped the claw off trying to get my finger loose. Through all of that I was screaming, screaming, screaming. That stuck in my mind.

He also had a restaurant in Boston. As far as his restaurants go, they kept getting bigger and bigger. Eventually, when he was approaching retirement, he rented a large cafeteria in Ocean Grove (N.J.) for a couple of years and ran that during the summertime. Apparently, it was a very lucrative undertaking, because he could live the whole year alone from the money he made in just two-and-a-half to three months each summer. That was his final occupation.

Questions Text 3

What event ended the speaker’s father’s importing business?

A strike by the longshoremen.
The Depression.
Someone sent him a shipment of spoiled nuts.
He heard there was more money to be made in the restaurant business.

What was the significance of the Catskills Mountains to the speaker’s father?

His second home was located there.
He owned a summer resort there.
It was where he dreamed of spending his summer vacations.
It was where he learned to make lobster rolls.

Why did the speaker’s father leave Turkey?

He was a Christian, and Christians were being persecuted.
He followed his father and brothers to join them in the family business.
He was deported by the Turkish government.
He had heard that the importing business was booming in the United States.

Why did the speaker tell the story about the lobster?

In order to provide an example of how protective his father was of his children
When he recalled that his father had a restaurant in New Hampshire, the story immediately came to mi nd
In order to illustrate the hazards associated with having your children help out in the kitchenWhen he began to reminisce about Maine, he immediately recalled the first time he had lobster

Why did the speaker’s father switch to the restaurant business when his importing business failed?

Unlike most business efforts, it wouldn’t require a large financial investment.
He had heard there were good opportunities in the restaurant business.
He hoped to take advantage of his new bride’s excellent cooking skills.
He was already familiar with the restaurant business.

Where is it most likely that the speaker was born?

Constantinople, Turkey.

Gurun, Armenia.
Ocean Grove, NJ.
Boston, MA.

Text 4

When I was in the Air Force during the Korean War, during the Cold War many days, you would run into the president of the United States, the vice president of the United States. I saw Truman. I saw Eisenhower, and I saw Nixon as vice president. My claim to fame with Vice President Nixon was on the flight line. You know the ceremonies you see at the White House now, when they greet with the cannons like that? Well, they used to do this at Washington National, because the planes would land, and they would put a cordon around the plane.

Nixon was down there to greet the person. He was vice president at that time. He was inside the cordon. Now, actually, I could get inside that cordon, if there was some real reason, but, basically, there was no reason for me to be inside. All of a sudden, this sergeant walked up to me, and Nixon was standing there, and the sergeant said, "Don't look now, sir, but the vice president is down there to greet this dignitary, but his fly is unzipped." I said, "I am not going down and telling the vice president of the United States his fly is open.

He was standing there with his overcoat, and his hands were around the overcoat into his pockets of his pants, so that kind of spread it open a little bit more. The sergeant passed it onto me, I passed
it onto, I forget, one of the State Department officials, something, and you could watch this chain of command, and it was hysterical. It went up the regular chain of command, through the cordon, and all of a sudden, someone, I don't know, the Secret Service man, or whatever it was, they walked over to Nixon and told him, and he was very cool. All he did was he took his hands out of his pockets and buttoned his topcoat, and that was it. But it was comical to watch that.

Then another incident I had was with, do you know the name C. Merriman Smith? I never worked with worse people in my life than the press corps or the photographers for the White House. The colonel called me in one day, and he said, "These parking places out here are reserved for the press corps, but they don't park in the lines. They park wherever they feel like it. From now on, they'll be in their lines." So the next time they had one of these big deals coming in, the corps was all there, and so forth, and I went down to check up. There's this car like parked across, whatever way they wanted to be parked.

So I said to the sergeant, "Whoever that is, that car will be moved." He comes back, he said, "C. Merriman Smith's car," and I said, "Okay, C. Merriman Smith, he's got to move it." He said, "Well, he is the president of the White House press corps," at that time. He was the guy that stood up and said, "Mr. President," and all that. So I said, "I don't care. See that colonel sitting in there? He wants the cars in the lines. The colonel wants it." I said, "Bring him back."
"The guy goes, wearing a .45, and he brought C. Merriman Smith babbling mad, "You can't do this to me. Do you know who I am? I'm C. Merriman Smith." I said, "Sir, I'm sorry. I don't basically care who you are." I said, "See the man in there? He's my colonel. He wants you moved. You'll either move it, or you'll be towed off the base." He eventually got in, and he moved it.

Questions Text 4

What would the speaker probably say about his placement in the military?

It was very mundane work.
It was an entertaining position to take.
It was constantly emotional
It was hard-work

Who were the worst people that the speaker ever worked with?

Members of the Secret Service.
Foreign Dignitaries.
Members of the White House press corps.
It was very mundane work.

What is the speaker's "claim to fame"?

He actually met Richard Nixon.
He ordered C. Merriman Smith to move his car.
He was part of the chain of command that informed Nixon of his unzipped fly.
He was inside the cordon when Nixon was greeting the dignitaries.

Which current or future president did the speaker NOT see during his time in the Air Force?

Harry Truman.
Dwight Eisenhower.
Richard Nixon.
Lyndon Johnson

What do the speaker's interactions with C. Merriman Smith and Richard Nixon have to do with each other in this narrative?

They are examples of what the speaker disliked about his job.
Both involve very embarrassing situations involving important men.

Both interactions occurred during the same political event.
The interactions have little in common other than that they involved important men.

According to the speaker, what was the sequence in which the men passed the message on to Nixon?

State Department official, Secret Service agent, the speaker, Colonel, the Vice President, Nixon.

Secret Service agent, Colonel, the speaker, Nixon.
The speaker, Sergeant, State Department official, Colonel, Secret Service agent, Nixon.
Sergeant, the speaker, State Department official, Secret Service agent, Nixon.

Text 5

There was a fire. It's a quickie story: We're getting married, and we got a lot of presents in advance, and my wife had bought extra clothing, so-called trousseau, and she lived with her mother in a small apartment over a store in downtown. And then we went off on our honeymoon to Mexico. We were very fancy. You know, I was considered to be quite wealthy at that time. I wasn't, but everybody thought I was, which is almost as good as being wealthy. So while we're away, there's a fire in the store down below.

So my cousins, my older cousin particularly kinda, well, I hadn't mentioned that. My father died when I was a senior in high school. So, you know, after that, we were three young people. We weren't really children anymore, but we were sort of, you know, people looked at us like orphans. And we stayed together, and we ran everything by ourselves. But we were old enough to do that, but people don't think you're old enough to do anything when you're in the child category. You know, like my 38-year old daughter is still a child and my 33 year-old son is still a child. It doesn't change. My son works with me, and he's the third generation in our business. But I call him the kid when I talk to a salesperson, I say "Yeah, the kid wants to do this or wants to do that." He's only 33.

So the fire was really disastrous, but it was a blessing in disguise. We were really a small shop, we weren't a real store store. And we were known from around a bit. But we didn't have big, glorious magnetism of any sort, because we didn't advertise. My father, you know, didn't know how to make up ads. He would have learned, but he didn't think it was important, I guess, at that time. But then we had this fire. So very quickly, we got a much larger store, happened to belong to Melvin Silverman's parents. You see, these names keep coming back in.

And we rented it temporarily. We moved by truck all the goods from this burnt-out store and we had a carpenter make quick tables, you know, just wood running on saw horses all over the place. And we took everything and stretched it all out. And we worked, I mean even as kids, we were there and we got some of our classmates to help us. And we were working on Sunday, December the 7th, and we were ready to open for our big fire sale. And we even had, my aunt came down, my mother didn't come down, well, my father was home sick all those years. He was captured in the house for four years before he died, because he had a heart condition.

And they didn't know what to do in those days, so you just stayed home. We were on a second floor, also, so he couldn't walk up and down the steps. They never understood that exercise would have been good, you know. They just didn't have the knowledge that we have today. So he just kind of wasted away and died, which wasn't as terrible to me as it might sound, because I had a chance to get to know my father, because he was home all the time, we used to go and we'd sit and talk, you know. He would be in bed or in the wheelchair and we'd kibitz around and talk. You know, most people didn't spend that much time with their parents, because they were busy working.

Questions Text 5

Where was the speaker when the fire in his store occurred?

In his apartment above the store.
In the store.
Away on a business trip.
Away on his honeymoon.

Why didn´t the speaker ´s father help everyone get ready for the big fire sale?

He was injured in the fire, and was home recuperating.
Physical limitations due to a heart condition prevented him from helping out.
He was too distraught about the impact of the fire on his business.
He did not think much could be salvaged and thought it was a waste of time.

What would the speaker probably say about the fire and his father ´s heart condition?

"The fire was harder to deal with than my father ´s health problems."
"My father ´s health problems were harder to deal with than the fire."
"Both situations sound bad, but something good came out of each."
"The fire led to a closer relationship with my dad."

According to the speaker, someone can be a member of the "child" category,

If she is young and incapable of doing an adult job properly.
If she is young, regardless of her ability.
If she is incompetent, regardless of her age.
Regardless of her age or ability.

Appendix

How old is the speaker ´s daughter?

48
43
38
33

The very next thing the speaker would probably talk about if he continued is:

How the big sale went.
His relationship with other family members besides his father.
What his job is now.
His thoughts on how the fire affected him

Text 6

Well, Pop came over about 1908. Pop was, for a peasant village guy, he was ahead of his time. For instance, he had the first store-bought suit and shoes in the village. After he got out of the military, he bought a suit and shoes and i understand that the village bullies beat him up because they thought he was stuck up or too good for 'em. They [his relatives] also told me he did something else; the floors of these peasant homes were simply rough planks. Pop got the idea of Getting some paint and painting the floors of their house, which he did, and that was resented by the other villagers because they thought that the family was getting uppity. So, a number of things apparently balled up, personal and family and the national politics and the church, which caused them to
decide, "The hell with it," and go someplace else".

He came to the US and was a worker. He had only four years of elementary school. Incidentally, this is fascinating, probably the most fascinating thing about my dad was that he only went four years to school, and one of the biggest surprises I got was when I was studying geometry in high school and was doing my homework and he happened to look over my shoulder and says, "What are you doing?" I knew Pop had only four years of school so I said, "Ahhh, this is geometry," and my feeling was "Pop, you wouldn't know anything about this, you know? I'm a junior in high school and you only had four years, and you wouldn't know anything about this.

Pop says, "Well, what's the question?" I outlined the question for him and Pop proceeded to solve it. He hadn't been to school for decades, and I said, "Holy mackerel, what do we got here?" He knew what geometry was and he solved the problem about as fast as I could. Then I asked Pop, "What kind of math were you taught?" They weren't taught arithmetic, geometry, trigonometry and all that; they were simply taught math, they weren't told that is was geometry or algebra. You understand what they did? They were taught math, and in the four years of school they had taken him on up into geometry.

He was into high school coursework. I was doing some English reading one day and Pop says, "What are you reading?" I said "Well, Charles Dickens, he's an English author." And Pop says, "Yeah, I said Well, Charles Dickens, he's an English author." And Pop says, Yeah, I know." He had read more Dickens than I have to this day. I'm putting the emphasis on the schooling that he got. He was far more educated in four years of elementary school than many of our kids today through high school. I'm not kidding! He learned English, to read, write, and speak it, on his own.

Mom never did learn it, to read, write, or speak English. She spoke Russian, so I had to speak Russian at home, you probably pick up a tinge of an accent. I spoke Russian before I went to When I went to elementary school in Baptistown, New Jersey, we had no kindergarten so I entered first grade,
and I didn't know how to speak English.

Questions Text 6

The passage you just heard was actually part of an interview.
What question was the speaker most likely responding to?

„Would you please describe your father ´s education?"
„When and why did your father leave his native village?"
„What was your relationship with your parents like?"
„What did people think of your father?"

Why did the villagers dislike the speaker ´s father and his family?

They thought the family, especially the speaker ´s father, was stingy.
They thought the whole family was wishy-washy when it came to politics.
They thought the family members were too uppity.
They thought the family members, especially the speaker, were show-offs.

How did the speaker ´s mathematical education differ from that of her father´s?

Her father ´s education was more formal.
Her father ´s education followed the same format, but at a more rapid pace.
The speaker ´s coursework was more topically organized.
The speaker ´s coursework covered more advanced topics.

When did the speaker´s father purchase his first store-bought suit and shoes?

A month after he turned 18 and was officially an adult.

After he returned from the military.
A week after he arrived in the US and began his first job.
After he earned some money for painting the floors of his parents house.

What were the speaker´s feelings when her father inquired about her homework?

The speaker was embarrassed to have underestimated her father ´s abilities.
The speaker was irritated at being repeatedly interrupted.
The speaker was amused by her father ´s timid questions.
The speaker was impressed by the depth and breadth of her father ´s education.

Which statement would the speaker most likely agree with?

The quality of education has become worse since my father ´s era, because it takes much longer to cover the same material.
The quality of education has improved since my father's era, because they cover topics that children were not expected to know then.
The quality of education is about the same today as it used to be, even though teachers today use a different approach.
The quality of education is about the same today as it was then, because the basic educational methods are the same.

Text 7

Well, my father I don't know if he was a streetcar conductor or not, but he met my uncle, my mother's brother, who was a streetcar conductor, and through them, my parents met. Initially, my father was a jewelry salesman, and he traveled throughout the country. He had all his merchandise in the money belt, and he used to sell it individually. When he met my mother, he decided that this business wasn't for him. The family, from the tailor business, developed an interest in embroidery. My uncles, there were four of them, my mother had four brothers, manufactured it and my father did the selling.

So, my father's business was called the Famous Embroidery Company, and my uncles' business was called The Famous Art Embroidery Company. It was the same building in Jersey City, and they had the heavy machines downstairs, and he was upstairs, but the family's relationship between my father and my mother's brothers was a very close one. The family was very close. So I really had two merged families.

Most families do not do that that well, and I consider us lucky. It was a very successful thing. They had their ups and downs. They made a great deal of money in the '20s, and they lost everything in the Depression of 1929, but the family still stayed together through it all. My father's family became pharmacists. One comes to mind, a lawyer who became a successful mystery writer. He wrote like Mickey Spillane, that sort of thing, quite successful. Today, most of them are gone.

The Depression had a tremendous effect on the family, and it had a tremendous effect upon me. My father, during the middle '20s, actually was a very wealthy man. I didn't know this. We lived in Jersey City, we had a big car, we had a chauffeur, and we would go away for the summertime to the mountains. I went to summer camps. It was a middle-class family. We never were poor, and along came the Depression, and like so many millions of people, my father lost everything. I recall one incident where he threatened to jump out the window of our apartment in Jersey City. My father never got over it. He never, psychologically, got over the trauma of the Depression.

Even as time went on I never forgot this. I was practicing medicine and doing fairly well. This was in the early '40s. My father came to me, and he said he was going to go into a business with somebody else. He had to invest $4000, which he had. He said to me, "Norman, I'd like you to do me a favor. I'm going to give you $4000 and give me a check for $4000. I don't want my partners to know that I have any money." Do you follow the psychology of it? He had the money, he had recovered. This was twenty years after the Depression, not twenty, but maybe, fifteen, but he had the fear and it affected him tremendously, and of course, affected me.

I came to Rutgers in 1928, driven down with the family chauffeur, and I had a suite right over here at Ford Hall. There were several suites. When I left, in 1932, I was waiting on tables to pay my tuition. When I joined a fraternity in 1929, I was just a rich boy. I always had the money to pay for tuition, or allowance or whatnot. That was the story for so many of us in those days. Then when I went to medical school, my dad only had the money for the first two years, and then my wife, at that time my girlfriend, she was a teacher in New Brunswick, and she advanced me the money to finish my medical school tuition.

Questions Text 7

Why did the speaker consider his family to be 'lucky'?

His family did not 'lose everything' like many families did during the Depression.
His family was talented, and they also could afford to send everyone to graduate or professional school after college.
The Depression did not break them up; they all stuck together through all the ups and downs of the '20s and '30s.
The Depression did not cause his family much hardship; instead, by combining their businesses, they became very wealthy during the '30s.

Why did the speaker's father ask him to write a check for $4,000?

Appendix

His father was afraid his business partners would try to take advantage of him if they found out that he had that much money at his disposal.
Although his father had enough money to make a business investment, he was afraid to dip into the nest egg that he had built up.
His father was afraid his business associates would not accept a money order.
His father wanted to impress his partners and friends with his son's success as a doctor.

Which statement about the Depression do you think the speaker would agree with most?

The Depression brought out the worst in everyone, except for his two uncles who were able to go back to school and become pharmacists.
The Depression was both economically devastating and psychologically traumatizing.
The Depression provided an opportunity for his family to capitalize on the desperate situation everyone else in the country was facing.
Although people lost money during the Depression, most of them rallied and did not experience long-lasting psychological effects.

Who in the speaker's family do you think was affected the most by the Depression?

the speaker's mother
the speaker
the speaker's uncles
the speaker's father

One of the speaker's relatives was a lawyer who became a successful:

business executive
doctor, specializing in orthopedics
writer of mystery novels
Senator from New Jersey

The speaker refers to his father as having "the fear"; what do you think he meant by this?

His father was fearful of losing his money again.
His father simply did not trust the government.
His father was afraid that the speaker would not get married to his girl friend.
His father feared that that he would not be able to afford to send his son to medical school.

Text 8

My father was born in Newark, and when I was eighteen months old, the family moved to Irvington. My father started a grocery store in Irvington, my mother and father. I had an older sister. She was nine years older than me. The things that I remember about the grocery store was that we were open seven days a week, from seven in the morning until eleven at night, seven days a week, and the only times we ever closed was on Rosh Hashanah and a half a day on Yom Kippur. That was it.

We used to write the names of the person or we never knew the names of our customers. We just knew who they were and we trusted them. There was a translation, "the woman with the white dog," "the one who limps a little," those are the ones that come to mind, but we had other ones, "the person who lives on Nesbit Terrace." Those were the memories I have.

We used to have this spindle with a nail on it, and all these things would be on the spindle, and their names would be there, and we just happened to know where they were. We'd go find the names, Varians, or the Onions, or the Buechlers, whoever those names were, and we would write down that they owed us for a quarter of a pound of salami, or some ham, or rolls, or Jewish rye bread, or something like that, but we never knew their names, really. Some people we did know their names, but others we knew just by description. That's the way he carried on his business.

I of course worked at our store. I would open the store every morning";" then I would deliver news papers and go to school. First thing in the morning, I would take the rolls that had come from the baker and carry them into the store, and put them in the front window where we kept them. Then, I would trudge off to Irvington High School, which was about a mile away, and deliver The New York Times.

I also remember that my father was arrested for breaking the blue laws in Irvington, the blue laws, you know. When I went back to research it, because I, too, am an archivist, they spelt his name wrong, and I had a hell of a time finding him in the Newark Evening News, but there was his picture, smiling as he was led off by the cops for breaking the blue laws. The only reason he did that was because our competitor was open on Sundays, too, and we couldn't allow that.

The other thing I remember about Irvington that's memorable, was that we were held up in an armed robbery on a Sunday night, a rainy Sunday night, and they got sixty dollars, which was a lot of money. It was an enormous amount of money. I remember, we lived just above the grocery store on, for archival purposes, 825 Stuyvesant Avenue, on the corner of Prospect Avenue, in Irvington.

We lived above the store. I was upstairs, apparently asleep at the time, around nine o'clock at night. My sister, and my mother, and father were in the store. My father, describing this, had said, Oy," and he clapped his hands together, and said, take what you want," and he threw his wallet down, and they opened the cash register, and escaped. I remember, the next day, the police coming in their open touring car, in Irvington. It was kind of a yellowish thing. That's all I remember, all I want to remember about Irvington and the store.

Appendix

Questions Text 8

Which of the following occurred first on the night of the robbery?

The speaker fell asleep upstairs.
The speaker's mother gave the robbers all the money in her purse.
The speaker's sister opened the cash register for the robbers.
The speaker woke up and heard her father say, "Take what you want."

Where did the speaker put the rolls that she picked up every morning during high school?

on the bakery shelf, adjacent to the crackers
in the back of the store where her mother made sandwiches
next to the deli counter
in the store's front window

Based on what you know about how the speaker's family managed their grocery store, which description best matches the family?

friendly, disorganized, and religiously devout
dedicated, competitive, and flexible
organized, charitable, and resourceful
lazy, disorganized, and inefficient

Why do you think the speaker told the story of her father's arrest?

This early incident traumatized the speaker and caused her to repress her memories of Irvington.

The story showed that her father was competitive to the degree that he welcomed the notoriety.
This story explained why the people in Irvington disliked her father.
This incident foreshadowed the later bankruptcy of her family's store.

Which of the following questions do you think the speaker was most likely responding to?

What was your relationship to your family when you were growing up?
Would you please describe your parents?
What was your role in your parents' business when you were growing up?
Tell me what you remember about your sister when you were growing up?

Where did the speaker's family record their credit customers?

on the blackboard behind the counter
on a piece of cardboard attached to a chain
on papers they kept on a spindle
on a list nailed to the wall

Text 9

My mother's older sisters came to the United States from a place between Poland and Russia, – they were European Jews. My father's family came with two little children and my father, an infant when he came here. We don't know just where he came from, 'cause he never spoke about it. My mother had decided that he was born in the United States, which she thought was the most important thing that could happen to you. So, if anyone asked her, she always said, "He was born here." My mother graduated from Schenectady High School, New York State.

My father went to Townsend-Harris in Manhattan, which was for outstanding students. From there, he went to CCNY, and, after he was there for two years, someone told him about an agricultural school, he had hardly ever been out of the city, that was located in South Jersey, and they thought that he might like to go there. That was two years. They raised all their own crops. They learned everything that they could about being a farmer there, and then, you could specialize in one thing or another. The school was named the Baron de Hiosh Cultural School. The money was given by a French Jew.

They had always said that the Jews could not be farmers that they weren't prepared to be farmers, but, the thing is, in Europe, Jews were not allowed to own land, and that was the reason they said that. It wasn't true. My father became a poultry man, but, in one summer, he was working at a hotel as the bookkeeper, up in the Catskills, and my mother and her sisters were up there on vacation, so, they met on a hay ride. My mother said she put straw down my father's back, and he got angry, and she said, "Well, forget it," but, he also wrote her beautiful poetry. So, she turned around when they got back into the city.

He worked, first, on estates until he had enough money to buy his own poultry farm and he bought one in New Jersey. I guess I was about two by then. My brother had been born on the Grace Estate, Manhasset, New York. The life on the farm was very, very hard, even with just two children. We had neighbors with nine. They used to steal a bottle of our milk. The milkman came, and, every morning it came at five o'clock, and they would take a quart of milk, and I said to my mother, "Why don't you say something?" She said, "I'd rather they have the milk," and then, on the school bus, we talked about what we had for breakfast, and we always had a substantial breakfast.

Those kids had tea with milk in it, so, it was really very, very hard. It was in the late '20s, possibly after the Crash. Anyway, in the early 1930s, my mother said she'd never planned to work that hard and she said that she just couldn't stay there any longer. So, they sold the farm. My father went into New Brunswick, and he found a real estate agency that said, "Farms – a specialty," and they liked having him, because he was able to teach.

People came out from New York City, like furriers who had gotten fur in their lungs, and that kind of thing, and so, he was able to help them, and, a lot of them, they came out and bought from him. There was also something called the Jewish Agricultural Society in New York, and, when Hitler began to be popular in Germany, many of the Jews left, and they came here to farm, even though they were doctors, and dentists, and lawyers, and all.

Questions Text 9

Why did the speaker's mother often claim that her husband was born in America?

She was embarrassed by the fact that her husband did not know where he was born.
He was an infant when he arrived which was almost as good as being born here.
It allowed her to avoid discussion of which part of Europe his family was from.
Rather than deal with the confusion surrounding his birth, she opted to simplify the story.

The speaker's mother graduated from:

Schenectady High School.
Townsend-Harris in Manhattan.
Baron de Hiosh Cultural School.
City College of New York (CCNY).

When the speaker's father first met his future wife he apparently offended her but fortunately he was successful in obtaining her hand in marriage after:

writing short stories based on her childhood.
crooning popular love songs to her over the phone.
wooing her with a dozen white roses.
writing her beautiful poetry.

How many years total did the speaker's father spend getting an education after high school?

2 years
3 years
4 years
6 years

Why did the speaker's mother remain silent when her neighbors took a quart of her milk each morning?

She knew that her neighbor's children were not well fed.
She wanted to teach her children a lesson in charity.
She was uncertain as to which neighbor child had actually stolen the milk.
She was ambivalent about confronting her neighbors.

Why did the real estate office in New Brunswick especially appreciate the speaker's father?

his knowledge of poultry farming
his ability to teach
his bookkeeping skills
his willingness to arrive early and stay late

Text 10

We encountered the first German enemy there on the river, and they were very proficient in protecting their rivers and natural barriers. I had a very critical, crucial experience in crossing the Danube. We got to the point of getting them on the run, pretty much, going down through Bavaria. We would capture town after town, and, at one point, toward the end, I remember, my troops, even though we were a heavy .81 mm mortar group, we fought, where we had to, like the riflemen.

We officers, then, instead of our .45 caliber pistols we were issued carbines. A carbine is a smaller rifle and it was more effective for us, because we could really use it more accurately, for longer range. Officers were the only ones who were issued carbines. The riflemen had the Garand rifle, the M1. We were capturing towns and these were pretty hard fights. You ran into all kinds of situations. I remember, particularly, a time that we'd captured towns, I think it was close to Attendorn, Germany, we'd gone through this battle and we'd captured towns two or three days in a row.

We made good progress going down through Bavaria, and, finally, the men didn't have much sleep and rest, and I finally said, "Well, as soon as we take this town, you're going to be able to rest." I didn't have the right to say that, but, they were getting careless, and, you know, you go day after day, and you don't have enough rest, no place to sleep, and, you know, it's kind of dangerous.

So, we captured this town. It was a tough, tough fight. My friend, Lieutenant Seiders, was killed. He was the commander of the machine gun platoon right next to me, and then, the other machine gun platoon, Lieutenant Gustafson, he wasn't able to "take it." We got right up to the Danube River and this is where I'd said, "Men, once we capture this town," they could rest, we could recoup. We'd just lost our two platoon leaders, two heavy machine gun platoon leaders.

It seems to me it was the afternoon, and I'd told the men that, and about fifty yards up the river, I couldn't believe it, I could see, Colonel Austin, I think, our battalion commander, I'm not sure, and here is this person walking up with the two white pistols, and it was General George Patton, and I could see George Patton waving his arm and pointing towards the other side of the river, which meant we're going to cross the river, and I thought, "Oh, no, we can't do it," but, you don't say that. See, to him, strategically, he knew what he was doing, but, tactically it was a risky thing, because I knew our troops really were tired and weren't prepared for it.

So, I led the crossing. We had rubber boats in darkness, and I lost quite a few people, but, we captured the ground, and, when you do this at night, you don't know what the situation is. You study it, and you try to plan things as best you can, but, when you're in new territory, and particularly at night, it's a very hard thing to feel comfortable and reorganize. I remember, some of the men were hit, "Lieutenant Hale, I'm hit," and I'd hear it here and there. You always do the best you can. We did consolidate, but, it was costly for us. From the very high level of General Patton, you know, we conquered the territory and kept driving. That was important to him. It was important to me, tactically, not strategically, but, tactically, to try to have reasonable control of our troops, but, that's war, you know.

Questions Text 10

Why did the speaker consider General Patton's plan to cross the Danube risky?

The speaker's troops had been engaged in tough military combat for 2-3 days straight.
The speaker had already advised his troops that they could rest before crossing the Danube.
The speaker's troops were not trained to make river crossings at night.
The speaker's troops were emotionally drained after watching their comrades die in battle.

Which of the troops were issued the Garand rifle, also known as the 'M-1'?

only the officers
only the riflemen
only the platoon leaders
all of the troops

What was the speaker referring to when he said that his troops had made good progress down through Bavaria?

They had suffered only minor injuries as they captured towns traveling through Bavaria.
They had steadily captured town after town as they moved through Bavaria.
They had captured a large number of enemy soldiers without sacrificing any American lives.
His troops were very successful even when they were asked to cross the Danube in small rubber boats.

From the speaker's perspective, crossing the Danube seemed like it would be:

a situation that could backfire strategically.
an opportunity to lead a crucial mission and possibly receive a promotion to colonel.
a risky but exciting chance to follow the direct orders of General Patton.
regrettable from a tactical standpoint.

Who was Lieutenant Seiders?

the speaker's college roommate
Colonel Austin's best friend
the commander of a machine gun platoon
the officer who conferred with General Patton

From General Patton's perspective, crossing the Danube was the right thing to do because:

his goal was to keep up the momentum of the progress already attained by the troops drive through Bavaria.
he could not have known about the emotional toll on the troops when he made his decision to cross the river at night.
he was unaware of how few boats were available to the troops that night.
his perspective was to maintain a focus on tactics rather than strategy.

Text 11

My father never worked too much and, in fact, my mother and he separated. He had to move out of the house because he wouldn't work and she was a single mother. Here, she had all those kids at home and she worked, I don't know. She was an embroiderer, you know, Naval officers, those stripes, she used to do that. That's similar type of work. So, she had her own business when she married him, and so, after he left the house, I think one of my relatives used to pay the rent, because there wasn't enough money for everything, but we survived.

I don't think anybody really went hungry, but it was tough and we lived in a place with two bedrooms, I think, no hot water. You know, we had a kettle like this, one of these hot water burners to get hot water, and all us kids, we were in the same boat, so, we used to go to the "Y" every Saturday, so that we could take a shower, because we didn't have a shower. We thought that was great, but, you know, when I look back, I had a happy childhood, at least I thought I did. I've always been an optimist anyway.

When we were in Latin School, there were three of us there at the same time. I was a freshman, my brother next to me was a sophomore, my oldest brother was a senior and my mother used to make us lunches and get them all mixed. This one didn't like this and this one didn't like that and we would have to chase each other down to change the sandwiches around.

When I started school, I started kindergarten when I was four years and no months, and so, I went in the first grade, and they said I was too smart for the first grade. I'm not bragging or anything, but they put me in the second grade. So, here I was, six years old, in the third grade. So, when I graduated grammar school, I was eleven years and ten months, and [when] I started Latin School, I was twelve years old and no months, and here I was, with kids fifteen years old in the class, and I was about this high, and it was quite an experience.

I always worked. I had a paper route and I worked on a paper truck. We used to jump off the paper truck and put papers into the stores. I did that after school. Sometimes, I don't know how I did it, because I had to get up at four o'clock in the morning when I sold my papers and had all this homework to do because they loaded us up. We used to get sixty lines of Latin, four pages of German, four pages of French and math and English. When we studied English, we always had to find the Latin root for the words. The teachers were superb. My oldest brother used to say any one of these could walk into a college and be a professor right away, because they were good, and all they made was eighteen hundred a year.

My sister, she got a scholarship for Radcliffe because we had no money to go to school, and she graduated Radcliffe in 1932 and she is still living. She's ninety-one years old. We got eight degrees in the family. My two older brothers, my youngest brother and my oldest brother, both graduated as engineers and my brother next to me dropped out of high school.

Questions Text 11

Which of the following did the speaker not have available in her home when she was a child?

hot water
enough food for everyone
her own bed
a shower

How do you think the speaker would describe her family's experience at Latin School?

With mixed feelings; it was a good education, but they did not learn anything practical.
Excellent; it provided his family with a strong academic foundation.
Poor; the teachers assigned too much homework, which interfered with students' after-school jobs and family responsibilities.
Disappointing; the school offered a strong multi lingual education, but the teachers were not qualified to teach high school.

The speaker could best be described as what type of student?

Academically advanced and successful at managing both a job and school.
Uninterested, and more dedicated to her family and her paper route than to education.
Academically poor, and unable to complete the homework assigned every evening.
Hard working, but more focused on her practical responsibilities outside of school.

What languages did the speaker study at Latin School?

Latin and Greek
Latin, French, and Spanish
Latin, German, and French
Latin, French, German, and Spanish

How do you think the speaker felt about being in high school with two of her brothers?

Fairly isolated, because her brothers were so much older than he was.
Proud, because she finished high school before her brothers.
Happy, even if it meant that sometimes her mother mixed up their lunches.
Embarrassed, because one of her brothers was constantly making fun of her height.

What do you think most defined the speaker's childhood?

poverty
going to the Y
her paper route
getting an education

Text 12

On the platform, in front of the tracks where the train was still standing, with whatever, a couple of suitcases, perhaps, at that moment, there was an air raid and the locomotive of the train from which we had just gotten off was hit. It was a steam engine and the sheer noise from that explosion, you know, the steam escaping was so strong that we were all thrown with great force to the ground. We all had bruises, you know, it was a cement platform. But fortunately, nobody was hurt because, you know, the engine was way up in front and we were way in the back someplace. We stayed in a hotel overnight. Again, there were air raids all night long. I only remember that we didn't even bother going out. We were so inured to these air raids all the time that we didn't bother anymore.

The next day we boarded this ancient French boat called De Grasse, that had been taken out of mothballs. It had already been discarded, but they weren't going to risk any modern or newer boats. This boat was full of Spanish loyalists, refugees, because the Spanish Civil War was just over. We were probably the only non-Spaniards on that boat. Everybody spoke Spanish. The boat just crossed the Channel, to the British port, Southampton, and we stayed there for two weeks until a convoy of about 200 ships assembled. Most of these, of course, were merchant ships escorted by several British destroyers and cruisers. This was the end of December, beginning of January, 1940.

After two weeks this convoy left for New York because that was the period of the great submarine warfare. Germans were sinking merchant ships right and left. And I remember two things; number one, it was an extremely stormy passage. My mother was so deathly seasick, and so were most of the other people. For some reason I wasn't seasick at all. But, I still remember playing Ping Pong at one end of the boat, and the ball would remain suspended in midair, you know, it was going up and down like that.

It was very, very stormy. Most of the people, who were not too seasick, were just walking around with life vests all day long. They saw submarines everywhere. Again, you have to remember these were people who had just escaped from the Spanish Civil War, and so they were very paranoid about this kind of thing. But, the voyage was completely uneventful and I don't remember whether it took five days or seven days to reach New York. Then, we had the pleasure to be interned for four days on Ellis Island, because we didn't have any visas for the States, and we had to wait for a boat to Cuba.

So, we were on Ellis Island, and I remember it very fondly because the thing that really sticks out in my mind is getting fresh milk to drink. I hadn't seen fresh milk in a long time. Then we were on one of the luxury Grace Line boats from New York to Havana, which was like being in a paradise of food, and the quantity of food, and all that. Then, we were reunited with my father in Havana and stayed in Cuba for about a year, until February 1941. At that time we were able to get visas for the States.

Questions Text 12

In order to cross the English Channel, the speaker and her mother apparently crossed boarded a ship at:

a French port.
a British port.
a Dutch port.
a Norwegian port.

How long did they have to wait in Southampton before they crossed the Atlantic?

2 days
4 days
2 weeks
4 weeks

The speaker and her mother set out on their journey from Germany in order to join:

her mother's brother and sister in New York.
her siblings who were living with family friends in New York.
the speaker's father who was waiting with visas for his family on Ellis Island.
the speaker's father who had emigrated earlier to Havana, Cuba.

Why were the other passengers on the merchant ships so terrified that they imagined seeing submarines everywhere during their passage from England to America?

The Germans were targeting all Spanish loyalists in the winter of 1940.
The passengers were Spanish spies trying to escape Spain before war broke out.
They had so recently been under attack during the Spanish Civil War.
They spoke only Spanish and could not understand the crew whose reassurances were spoken only in English.

After crossing the Atlantic, the speaker and the speaker's mother were interned for several days:

in Havana, Cuba.
on Ellis Island.
on the De Grasse.
on the Grace Line.

Which of the following questions was the speaker most likely trying to answer?

How did each member of your family immigrate to Cuba?
How did you and your mother make your way to North America?
Describe any memories about traveling from England to Ellis Island.
Describe the most traumatic event in your childhood.

Appendix

A2

Language Experience and Proficiency Questionnaire (LEAP-Q), Version for Canada

Language Experience and Proficiency Questionnaire (LEAP-Q), Version for Canada

Participant Code:		Study code:		Today's Date:	
Age:		Country of citizenship:		Gender:	
Your native language:					
Other languages:					

(1) Please name the cultures with which you identify. On a scale from zero to ten, please rate the extent to which you identify with each culture. (Examples of possible cultures include Canadian, US-American, Chinese, etc):

List cultures here					
List percentage here:					

(2) How many years of formal education do you have? ______________________________
How many full years have you spent in your current educational institution (0, 1, 2…)? _________

Please check your highest education level (or the approximate Canadian equivalent to a degree obtained in another country):

	Less than High School		College / CEGEP		Masters
	High School		Some University		Ph.D./M.D./J.D.
	Professional Training		University		Other:
	Some College / CEGEP		Some Graduate School		

(3) Date of immigration to Canada, if applicable ______________________________

(4) Have you ever had a vision problem, hearing impairment, language disability, or learning disability? (List all applicable). If yes, please explain (including any corrections):

____

(5) Age when you…:

began acquiring **English**:	*became fluent* in **English**:	*began reading* in **English**:	*became fluent reading* in **English**:

(6) Please list the number of years and months you spent in English environment:

	Years	Months
A country where **English** is spoken		
A family where **English** is spoken		
A school and/or working environment where **English** is spoken		

(7) On a scale from 0 to 10, please select your *level of* ***proficiency*** in speaking, understanding, and reading **English**:

Speaking		Understanding spoken langua		Reading	

(8) On a scale from 0 to 10, please select how much the following factors contributed to you learning **English**:

Interacting with friends		Language tapes/self instructi	
Interacting with family		Watching TV	
Reading		Listening to the radio	

(9) Please rate to what extent you are currently exposed to **English** in the following contexts:

Interacting with frienc		Listening to radio/music	
Interacting with famil		Reading	
Watching TV		Language-lab/self-instruction	

Appendix B

Full GLMM Models for Experiment 1

Table B1
Full GLMM model for comprehension as a function of reading speed (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	-0.07	0.28	-0.26	.798
fixed		Speed1	0.09	0.35	0.25	.801
fixed		Speed2	-0.07	0.13	-0.51	.611
fixed		Speed3	-0.01	0.13	-0.09	.925
fixed		Speed4	0.09	0.13	0.66	.508
fixed		Speed5	-0.44	0.13	-3.33	< .001
ran_pars	subject	SD (Intercept)	0.43			
ran_pars	id_text	SD (Intercept)	0.42			

Table B2
Full GLMM model for comprehension as a function of reading speed and baseline reading rate (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	-1.07	0.57	-1.87	.062
fixed		Speed1	-0.51	0.62	-0.82	.411
fixed		Speed2	-0.19	0.53	-0.36	.721
fixed		Speed3	0.10	0.53	0.19	.853
fixed		Speed4	-0.39	0.53	-0.73	.464
fixed		Speed5	-1.19	0.54	-2.21	.027
fixed		mean_WPM_baseline	0.00	0.00	2.00	.046
fixed		Speed1:mean_WPM_baseline	0.00	0.00	1.19	.235
fixed		Speed2:mean_WPM_baseline	0.00	0.00	0.24	.807
fixed		Speed3:mean_WPM_baseline	0.00	0.00	-0.22	.824
fixed		Speed4:mean_WPM_baseline	0.00	0.00	0.93	.353
fixed		Speed5:mean_WPM_baseline	0.00	0.00	1.43	.152
ran_pars	subject	SD (Intercept)	0.38			
ran_pars	id_text	SD (Intercept)	0.43			

Appendix

Table B3
Full GLMM model for comprehension as a function of reading speed and word reading efficiency (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	-3.33	1.45	-2.30	.022
fixed		Speed1	1.13	1.49	0.76	.449
fixed		Speed2	0.32	1.45	0.22	.826
fixed		Speed3	0.01	1.45	0.01	.992
fixed		Speed4	-0.31	1.45	-0.21	.831
fixed		Speed5	-1.85	1.45	-1.28	.202
fixed		TOWRE	0.02	0.01	2.29	.022
fixed		Speed1:TOWRE	-0.01	0.01	-0.72	.471
fixed		Speed2:TOWRE	0.00	0.01	-0.27	.789
fixed		Speed3:TOWRE	0.00	0.01	-0.02	.984
fixed		Speed4:TOWRE	0.00	0.01	0.28	.782
fixed		Speed5:TOWRE	0.01	0.01	0.97	.330
ran_pars	subject	SD (Intercept)	0.41			
ran_pars	id_text	SD (Intercept)	0.42			

Table B4
Full GLMM model for fixation probability as a function of reading speed (Experiment 1)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	0.97	0.05	19.55	< .001
fixed		Speed1	-0.03	0.02	-1.81	.070
fixed		Speed2	-0.22	0.02	-13.69	< .001
fixed		Speed3	-0.32	0.02	-20.17	< .001
fixed		Speed4	-0.01	0.02	-0.34	.734
fixed		Speed5	-0.58	0.02	-37.82	< .001
ran_pars	WordClean	SD (Intercept)	0.77			
ran_pars	subject	SD (Intercept)	0.29			

Table B5
Full GLMM model for first fixation duration as a function of reading speed (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	204.60	1.38	148.48	< .001
fixed		Speed1	12.93	0.70	18.37	< .001
fixed		Speed2	-3.68	0.70	-5.28	< .001
fixed		Speed3	-7.06	0.70	-10.04	< .001
fixed		Speed4	-1.08	0.70	-1.55	0.122
fixed		Speed5	-9.94	0.72	-13.76	< .001
ran_pars	WordClean	SD (Intercept)	11.30			
ran_pars	subject	SD (Intercept)	7.95			
ran_pars	Residual	SD Observation	0.36			

Table B6
Full GLMM model for gaze duration as a function of reading speed (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	228.04	1.69	134.84	< .001
fixed		Speed1	15.89	0.92	17.23	< .001
fixed		Speed2	-6.77	0.90	-7.53	< .001
fixed		Speed3	-11.46	0.90	-12.77	< .001
fixed		Speed4	-1.59	0.89	-1.80	.072
fixed		Speed5	-15.99	0.90	-17.73	< .001
ran_pars	WordClean	SD (Intercept)	22.24			
ran_pars	subject	SD (Intercept)	9.05			
ran_pars	Residual	SD Observation	0.42			

Table B7
Full GLMM model for total viewing time as a function of reading speed (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	269.19	2.56	105.31	< .001
fixed		Speed1	16.93	1.45	11.65	< .001
fixed		Speed2	-28.01	1.38	-20.34	< .001

effect	group	term	estimate	*SE*	*t*	*p*
fixed		Speed3	-32.52	1.28	-25.40	< .001
fixed		Speed4	-2.92	1.21	-2.40	.016
fixed		Speed5	-28.43	1.20	-23.64	< .001
ran_pars	WordClean	SD (Intercept)	35.57			
ran_pars	subject	SD (Intercept)	13.73			
ran_pars	Residual	SD Observation	0.53			

Table B8

Full GLMM model for refixation probability as a function of reading speed (Experiment 1)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-2.39	0.07	-34.13	< .001
fixed		Speed1	0.01	0.03	0.31	.758
fixed		Speed2	-0.13	0.03	-4.44	< .001
fixed		Speed3	-0.21	0.03	-6.59	< .001
fixed		Speed4	-0.03	0.03	-0.77	.441
fixed		Speed5	-0.37	0.04	-9.50	< .001
ran_pars	WordClean	SD (Intercept)	0.71			
ran_pars	subject	SD (Intercept)	0.39			

Table B9

Full GLMM model for regresiion-in probability as a function of reading speed (Experiment 1)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-1.83	0.08	-23.34	< .001
fixed		Speed1	-0.07	0.02	-3.00	.003
fixed		Speed2	-0.15	0.02	-7.13	< .001
fixed		Speed3	-0.29	0.02	-12.22	< .001
fixed		Speed4	-0.04	0.03	-1.40	.161
fixed		Speed5	-0.25	0.03	-8.80	< .001
ran_pars	WordClean	SD (Intercept)	0.80			
ran_pars	subject	SD (Intercept)	0.48			

Table B10
Full GLMM model for fixation probability as a function of reading speed, word length, and word frequency (Experiment 1)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-0.34	0.16	-2.11	.035
fixed		Speed1	0.06	0.13	0.42	.678
fixed		Speed2	-0.21	0.11	-1.90	.058
fixed		Speed3	-0.40	0.11	-3.73	< .001
fixed		Speed4	0.00	0.10	0.00	.997
fixed		Speed5	-0.55	0.10	-5.75	< .001
fixed		WordLength	0.25	0.02	11.32	< .001
fixed		lFreq	-0.13	0.03	-3.64	< .001
fixed		Speed1:WordLength	0.01	0.02	0.53	.599
fixed		Speed2:WordLength	0.00	0.01	0.12	.905
fixed		Speed3:WordLength	0.02	0.01	1.30	.193
fixed		Speed4:WordLength	0.00	0.01	0.05	.959
fixed		Speed5:WordLength	-0.02	0.01	-1.75	.080
fixed		Speed1:lFreq	-0.02	0.02	-1.45	.148
fixed		Speed2:lFreq	0.00	0.01	-0.24	.812
fixed		Speed3:lFreq	0.00	0.01	0.11	.916
fixed		Speed4:lFreq	0.00	0.01	-0.13	.900
fixed		Speed5:lFreq	0.02	0.01	1.28	.201
fixed		WordLength:lFreq	0.01	0.01	1.31	.189
ran_pars	WordClean	SD (Intercept)	0.41			
ran_pars	subject	SD (Intercept)	0.29			

Table B11

Full GLMM model for first fixation duration as a function of reading speed, word length, and word frequency (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	207.34	5.28	39.28	< .001
fixed		Speed1	2.38	4.65	0.51	.609
fixed		Speed2	0.04	4.06	0.01	.992
fixed		Speed3	-5.26	4.09	-1.29	.198
fixed		Speed4	-8.07	4.02	-2.01	.045
fixed		Speed5	-6.85	4.09	-1.68	.093
fixed		WordLength	1.09	0.67	1.64	.102
fixed		lFreq	-1.23	1.06	-1.16	.244
fixed		Speed1:WordLength	0.47	0.53	0.88	.381
fixed		Speed2:WordLength	0.08	0.46	0.17	.863
fixed		Speed3:WordLength	0.28	0.46	0.61	.543
fixed		Speed4:WordLength	0.46	0.45	1.03	.305
fixed		Speed5:WordLength	0.10	0.46	0.23	.822
fixed		Speed1:lFreq	2.02	0.60	3.37	< .001
fixed		Speed2:lFreq	-1.01	0.54	-1.86	.063
fixed		Speed3:lFreq	-0.79	0.55	-1.44	.150
fixed		Speed4:lFreq	1.16	0.54	2.13	.033
fixed		Speed5:lFreq	-0.94	0.55	-1.72	.086
fixed		WordLength:lFreq	-0.33	0.15	-2.15	.031
ran_pars	WordClean	SD (Intercept)	11.12			
ran_pars	subject	SD (Intercept)	7.99			
ran_pars	Residual	SD Observation	0.36			

Table B12
Full GLMM model for gaze duration as a function of reading speed, word length, and word frequency (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	194.28	7.64	25.44	< .001
fixed		Speed1	5.28	6.34	0.83	.405
fixed		Speed2	0.99	5.35	0.18	.854
fixed		Speed3	-11.62	5.32	-2.18	.029
fixed		Speed4	-9.89	5.17	-1.91	.056
fixed		Speed5	-6.08	5.16	-1.18	.239
fixed		WordLength	7.85	1.01	7.75	< .001
fixed		lFreq	2.34	1.67	1.40	.161
fixed		Speed1:WordLength	0.68	0.74	0.93	.354
fixed		Speed2:WordLength	-0.43	0.62	-0.70	.486
fixed		Speed3:WordLength	0.05	0.60	0.08	.936
fixed		Speed4:WordLength	0.60	0.59	1.02	.309
fixed		Speed5:WordLength	-1.63	0.59	-2.78	.005
fixed		Speed1:lFreq	1.66	0.82	2.04	.042
fixed		Speed2:lFreq	-1.37	0.71	-1.92	.054
fixed		Speed3:lFreq	-0.04	0.71	-0.05	.957
fixed		Speed4:lFreq	1.31	0.69	1.89	.059
fixed		Speed5:lFreq	-0.43	0.69	-0.63	.531
fixed		WordLength:lFreq	-1.38	0.25	-5.46	< .001
ran_pars	WordClean	SD (Intercept)	20.18			
ran_pars	subject	SD (Intercept)	9.25			
ran_pars	Residual	SD Observation	0.42			

Table B13
Full GLMM model for total reading time as a function of reading speed, word length, and word frequency (Experiment 1)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	225.29	11.55	19.50	< .001
fixed		Speed1	-2.88	10.16	-0.28	.777
fixed		Speed2	-12.58	8.41	-1.50	.135
fixed		Speed3	-22.03	7.77	-2.83	.005
fixed		Speed4	-10.93	7.24	-1.51	.131
fixed		Speed5	-19.69	7.01	-2.81	.005
fixed		WordLength	12.72	1.54	8.26	< .001
fixed		lFreq	1.77	2.54	0.70	.485
fixed		Speed1:WordLength	1.46	1.18	1.25	.213
fixed		Speed2:WordLength	-1.92	0.97	-1.97	.048
fixed		Speed3:WordLength	-2.47	0.88	-2.81	.005
fixed		Speed4:WordLength	0.61	0.82	0.75	.453
fixed		Speed5:WordLength	-2.09	0.80	-2.62	.009
fixed		Speed1:lFreq	2.46	1.31	1.88	.060
fixed		Speed2:lFreq	-1.45	1.11	-1.30	.193
fixed		Speed3:lFreq	0.31	1.04	0.30	.764
fixed		Speed4:lFreq	1.18	0.97	1.22	.224
fixed		Speed5:lFreq	0.48	0.94	0.51	.613
fixed		WordLength:lFreq	-1.97	0.39	-5.08	< .001
ran_pars	WordClean	SD (Intercept)	30.96			
ran_pars	subject	SD (Intercept)	13.41			
ran_pars	Residual	SD Observation	0.52			

Table B14
Full GLMM model for refixation probability as a function of reading speed, word length, and word frequency (Experiment 1)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-3.66	0.23	-15.71	< .001
fixed		Speed1	0.17	0.19	0.93	.350
fixed		Speed2	-0.01	0.16	-0.05	.961
fixed		Speed3	-0.46	0.17	-2.75	.006
fixed		Speed4	0.03	0.17	0.15	.884
fixed		Speed5	-0.43	0.20	-2.14	.032
fixed		WordLength	0.24	0.03	8.71	< .001
fixed		lFreq	-0.05	0.04	-1.22	.223
fixed		Speed1:WordLength	-0.02	0.02	-0.73	.465
fixed		Speed2:WordLength	-0.01	0.02	-0.29	.769
fixed		Speed3:WordLength	0.04	0.02	2.25	.024
fixed		Speed4:WordLength	-0.01	0.02	-0.28	.778
fixed		Speed5:WordLength	-0.01	0.02	-0.31	.759
fixed		Speed1:lFreq	-0.02	0.02	-0.82	.412
fixed		Speed2:lFreq	-0.03	0.02	-1.21	.224
fixed		Speed3:lFreq	0.00	0.02	0.01	.991
fixed		Speed4:lFreq	0.00	0.02	-0.15	.882
fixed		Speed5:lFreq	0.03	0.03	0.98	.326
fixed		WordLength:lFreq	0.00	0.01	-0.27	.789
ran_pars	WordClean	SD (Intercept)	0.45			
ran_pars	subject	SD (Intercept)	0.40			

Table B15
Full GLMM model for regression-in probability as a function of reading speed, word length, and word frequency (Experiment 1)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-1.79	0.26	-6.95	< .001
fixed		Speed1	-0.48	0.16	-2.98	.003
fixed		Speed2	0.05	0.13	0.36	.719
fixed		Speed3	-0.22	0.14	-1.55	.121
fixed		Speed4	-0.16	0.15	-1.07	.287
fixed		Speed5	-0.44	0.16	-2.70	.007
fixed		WordLength	-0.01	0.03	-0.25	.803
fixed		lFreq	0.11	0.06	1.95	.051
fixed		Speed1:WordLength	0.05	0.02	2.72	.007
fixed		Speed2:WordLength	-0.03	0.01	-2.01	.044
fixed		Speed3:WordLength	-0.01	0.02	-0.69	.493
fixed		Speed4:WordLength	0.02	0.02	1.02	.310
fixed		Speed5:WordLength	0.03	0.02	1.59	.113
fixed		Speed1:lFreq	0.04	0.02	1.95	.051
fixed		Speed2:lFreq	-0.01	0.02	-0.79	.428
fixed		Speed3:lFreq	0.00	0.02	-0.20	.842
fixed		Speed4:lFreq	0.01	0.02	0.46	.648
fixed		Speed5:lFreq	0.01	0.02	0.53	.599
fixed		WordLength:lFreq	-0.02	0.01	-2.15	.031
ran_pars	WordClean	SD (Intercept)	0.79			
ran_pars	subject	SD (Intercept)	0.48			

Table B16
Full GLMM model for fixation probability as a function of reading speed and word position in paragraph (Experiment 1)

effect	group	term	estimate	*SD*	*z*	*p*
fixed		(Intercept)	0.40	0.02	17.65	< .001
fixed		Speed1	0.05	0.02	2.01	.046
fixed		Speed2	0.04	0.01	3.08	.002
fixed		Speed3	0.03	0.01	2.35	.019
fixed		Speed4	0.03	0.01	1.72	.085
fixed		Speed5	0.08	0.01	5.32	< .001
fixed		word_pos	0.00	0.00	4.67	< .001
fixed		Speed1:word_pos	0.00	0.00	-2.28	.023
fixed		Speed2:word_pos	0.00	0.00	-0.05	.961
fixed		Speed3:word_pos	0.00	0.00	1.90	.057
fixed		Speed4:word_pos	0.00	0.00	-1.40	.162
fixed		Speed5:word_pos	0.00	0.00	2.21	.027
ran_pars	TRIAL_INDEX	SD (Intercept)	0.01			
ran_pars	subject	SD (Intercept)	0.05			
ran_pars	Residual	SD Observation	0.49			

Appendix C

Full GLMM Models for Experiment 2

Table C1
Full GLMM model for comprehension as a function of reading speed (comparing adjacent speeds) (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	0.06	0.23	0.25	.806
fixed		Speed1	-0.58	0.26	-2.26	.024
fixed		Speed2	-0.04	0.15	-0.27	.790
fixed		Speed3	-0.13	0.15	-0.89	.372
fixed		Speed4	-0.14	0.15	-0.94	.348
fixed		Speed5	-0.17	0.15	-1.09	.276
ran_pars	subject	SD (Intercept)	0.62			
ran_pars	id_text	SD (Intercept)	0.27			

Table C2
Full GLMM model for comprehension as a function of reading speed (comparing 180wpm to the remining speeds) (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	-0.32	0.15	-2.09	.036
fixed		Speed1	-0.17	0.09	-1.75	.080
fixed		Speed2	-0.03	0.10	-0.32	.749
fixed		Speed3	0.11	0.10	1.16	.245
fixed		Speed4	0.29	0.10	2.96	.003
ran_pars	subject	SD (Intercept)	0.69			
ran_pars	id_text	SD (Intercept)	0.26			

Table C3
Full GLMM model for comprehension as a function of reading speed and baseline reading rate (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	-0.39	0.70	-0.56	.578
fixed		Speed1	-0.90	0.60	-1.49	.135

effect	group	term	estimate	*SD*	*t*	*p*
fixed		Speed2	-0.70	0.61	-1.14	.255
fixed		Speed3	0.68	0.63	1.08	.282
fixed		Speed4	-0.38	0.64	-0.59	.557
fixed		mean_WPM_baseline	0.00	0.00	-0.03	.977
fixed		Speed1:mean_WPM_baseline	0.00	0.00	1.49	.137
fixed		Speed2:mean_WPM_baseline	0.00	0.00	0.95	.343
fixed		Speed3:mean_WPM_baseline	0.00	0.00	-1.34	.180
fixed		Speed4:mean_WPM_baseline	0.00	0.00	0.32	.752
ran_pars	subject	SD (Intercept)	0.67			
ran_pars	id_text	SD (Intercept)	0.25			

Table C4
Full GLMM model for comprehension as a function of reading speed and word reading efficiency (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	-2.76	1.10	-2.51	.012
fixed		Speed1	-0.93	1.02	-0.92	.360
fixed		Speed2	-1.00	1.06	-0.94	.348
fixed		Speed3	1.07	1.06	1.00	.315
fixed		Speed4	-1.59	1.07	-1.49	.137
fixed		TOWRE	0.02	0.01	2.18	.029
fixed		Speed1:TOWRE	0.01	0.01	0.89	.372
fixed		Speed2:TOWRE	0.01	0.01	0.82	.411
fixed		Speed3:TOWRE	-0.01	0.01	-1.15	.250
fixed		Speed4:TOWRE	0.01	0.01	1.34	.180
ran_pars	subject	SD (Intercept)	0.57			
ran_pars	id_text	SD (Intercept)	0.26			

Table C5
Full GLMM model for fixation probability as a function of reading speed (Experiment 2)

effect	group	term	estimate	*SD*	*z*	*p*
fixed		(Intercept)	1.41	0.07	21.42	< .001
fixed		Speed1	-0.26	0.02	-12.98	< .001
fixed		Speed2	-0.36	0.02	-19.20	< .001
fixed		Speed3	-0.20	0.02	-11.06	< .001
fixed		Speed4	-0.47	0.02	-26.79	< .001
fixed		Speed5	-0.06	0.02	-3.80	< .001
ran_pars	WordClean	SD (Intercept)	0.66			
ran_pars	subject	SD (Intercept)	0.36			

Table C6
Full GLMM model for first fixation duration as a function of reading speed (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	243.00	1.74	139.92	< .001
fixed		Speed1	7.42	0.85	8.75	< .001
fixed		Speed2	-3.51	0.86	-4.09	< .001
fixed		Speed3	-3.98	0.87	-4.56	< .001
fixed		Speed4	-6.76	0.90	-7.53	< .001
fixed		Speed5	-0.54	0.92	-0.59	.557
ran_pars	WordClean	SD (Intercept)	12.48			
ran_pars	subject	SD (Intercept)	8.91			
ran_pars	Residual	SD Observation	0.36			

Table C7
Full GLMM model for gaze duration as a function of reading speed (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	287.96	2.19	131.31	< .001
fixed		Speed1	9.51	1.15	8.30	< .001
fixed		Speed2	-7.92	1.14	-6.95	< .001
fixed		Speed3	-7.28	1.14	-6.36	< .001

effect	group	term	estimate	*SD*	*t*	*p*
fixed		Speed4	-13.49	1.16	-11.65	< .001
fixed		Speed5	-0.31	1.17	-0.27	.791
ran_pars	WordClean	SD (Intercept)	28.01			
ran_pars	subject	SD (Intercept)	10.39			
ran_pars	Residual	SD Observation	0.42			

Table C8
Full GLMM model for total reading time as a function of reading speed (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	367.89	3.42	107.42	< .001
fixed		Speed1	-0.91	1.86	-0.49	.625
fixed		Speed2	-34.78	1.78	-19.59	< .001
fixed		Speed3	-26.29	1.67	-15.73	< .001
fixed		Speed4	-27.53	1.61	-17.14	< .001
fixed		Speed5	0.23	1.59	0.15	.885
ran_pars	WordClean	SD (Intercept)	44.68			
ran_pars	subject	SD (Intercept)	16.40			
ran_pars	Residual	SD Observation	0.52			

Table C9
Full GLMM model for refixation probability as a function of reading speed (Experiment 2)

effect	group	term	estimate	*SD*	*z*	*p*
fixed		(Intercept)	-1.69	0.06	-26.62	< .001
fixed		Speed1	-0.06	0.03	-1.87	.061
fixed		Speed2	-0.09	0.03	-3.20	.001
fixed		Speed3	-0.11	0.03	-3.64	< .001
fixed		Speed4	-0.25	0.03	-7.42	< .001
fixed		Speed5	-0.02	0.04	-0.67	.503
ran_pars	WordClean	SD (Intercept)	0.70			
ran_pars	subject	SD (Intercept)	0.31			

Table C10
Full GLMM model for regression in probability as a function of reading speed (Experiment 2)

effect	group	term	estimate	*SD*	*z*	*p*
fixed		(Intercept)	-2.04	0.06	-33.37	< .001
fixed		Speed1	0.09	0.03	2.93	.003
fixed		Speed2	-0.09	0.03	-3.28	.001
fixed		Speed3	-0.09	0.03	-2.98	.003
fixed		Speed4	-0.10	0.03	-2.87	.004
fixed		Speed5	-0.03	0.04	-0.87	.383
ran_pars	WordClean	SD (Intercept)	0.51			
ran_pars	subject	SD (Intercept)	0.31			

Table C11
Full GLMM model for fixation probability as a function of reading speed, word length, and word frequency (Experiment 2)

effect	group	term	estimate	*SD*	*z*	*p*
fixed		(Intercept)	0.07	0.15	0.49	.621
fixed		Speed1	-0.27	0.17	-1.59	.112
fixed		Speed2	-0.41	0.13	-3.14	.002
fixed		Speed3	-0.16	0.12	-1.39	.166
fixed		Speed4	-0.42	0.11	-3.68	< .001
fixed		Speed5	-0.09	0.11	-0.88	.381
fixed		WordLength	0.29	0.02	17.13	< .001
fixed		lFreq	-0.09	0.02	-4.99	< .001
fixed		Speed1:WordLength	-0.04	0.02	-2.00	.046
fixed		Speed2:WordLength	-0.02	0.02	-1.09	.277
fixed		Speed3:WordLength	0.01	0.01	0.90	.370
fixed		Speed4:WordLength	-0.02	0.01	-1.44	.149
fixed		Speed5:WordLength	-0.01	0.01	-0.57	.571
fixed		Speed1:lFreq	0.03	0.02	1.35	.176
fixed		Speed2:lFreq	0.03	0.02	1.53	.127
fixed		Speed3:lFreq	-0.02	0.02	-1.26	.208

effect	group	term	estimate	*SD*	*z*	*p*
fixed		Speed4:lFreq	0.01	0.01	0.59	.555
fixed		Speed5:lFreq	0.01	0.01	1.04	.300
ran_pars	WordClean	SD (Intercept)	0.35			
ran_pars	subject	SD (Intercept)	0.36			

Table C12

Full GLMM model for first fixation duration as a function of reading speed, word length, and word frequency (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	228.33	5.40	42.27	< .001
fixed		Speed1	21.66	5.69	3.80	< .001
fixed		Speed2	-17.16	5.10	-3.36	< .001
fixed		Speed3	6.76	5.13	1.32	.188
fixed		Speed4	-18.01	5.23	-3.45	< .001
fixed		Speed5	2.81	5.28	0.53	.595
fixed		WordLength	2.40	0.60	4.03	< .001
fixed		lFreq	-0.32	0.69	-0.46	.645
fixed		Speed1:WordLength	-1.86	0.65	-2.84	.005
fixed		Speed2:WordLength	1.48	0.58	2.57	.010
fixed		Speed3:WordLength	-1.09	0.58	-1.87	.061
fixed		Speed4:WordLength	1.20	0.59	2.03	.043
fixed		Speed5:WordLength	-0.52	0.60	-0.87	.384
fixed		Speed1:lFreq	-1.34	0.73	-1.82	.069
fixed		Speed2:lFreq	1.53	0.68	2.25	.025
fixed		Speed3:lFreq	-1.30	0.68	-1.89	.058
fixed		Speed4:lFreq	1.28	0.70	1.83	.067
fixed		Speed5:lFreq	-0.18	0.70	-0.25	.803
ran_pars	WordClean	SD (Intercept)	12.10			
ran_pars	subject	SD (Intercept)	9.02			
ran_pars	Residual	SD Observation	0.36			

Table C13
Full GLMM model for gaze duration as a function of reading speed, word length, and word frequency (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	230.04	7.62	30.18	< .001
fixed		Speed1	15.93	8.10	1.97	.049
fixed		Speed2	-8.84	7.03	-1.26	.209
fixed		Speed3	3.82	6.97	0.55	.583
fixed		Speed4	-21.85	6.94	-3.15	.002
fixed		Speed5	5.90	6.93	0.85	.395
fixed		WordLength	12.55	0.86	14.52	< .001
fixed		lFreq	-6.06	1.00	-6.06	< .001
fixed		Speed1:WordLength	-2.42	0.95	-2.56	.011
fixed		Speed2:WordLength	-0.85	0.81	-1.05	.293
fixed		Speed3:WordLength	-1.67	0.80	-2.07	.038
fixed		Speed4:WordLength	-0.12	0.80	-0.14	.885
fixed		Speed5:WordLength	-0.51	0.80	-0.64	.519
fixed		Speed1:lFreq	0.34	1.04	0.32	.746
fixed		Speed2:lFreq	1.10	0.93	1.19	.235
fixed		Speed3:lFreq	-0.74	0.92	-0.80	.424
fixed		Speed4:lFreq	2.13	0.92	2.31	.021
fixed		Speed5:lFreq	-0.90	0.92	-0.98	.329
ran_pars	WordClean	SD (Intercept)	20.86			
ran_pars	subject	SD (Intercept)	10.96			
ran_pars	Residual	SD Observation	0.42			

Table C14
Full GLMM model for total viewing time as a function of reading speed, word length, and word frequency (Experiment 2)

effect	group	term	estimate	*SD*	*t*	*p*
fixed		(Intercept)	301.74	11.83	25.51	< .001
fixed		Speed1	-9.78	13.39	-0.73	.465

effect	group	term	estimate	*SD*	*t*	*p*
fixed		Speed2	-23.79	11.28	-2.11	.035
fixed		Speed3	-14.66	10.46	-1.40	.161
fixed		Speed4	-31.85	9.83	-3.24	.001
fixed		Speed5	1.29	9.54	0.13	.893
fixed		WordLength	17.12	1.34	12.79	< .001
fixed		lFreq	-12.29	1.55	-7.93	< .001
fixed		Speed1:WordLength	-1.36	1.56	-0.87	.385
fixed		Speed2:WordLength	-3.46	1.30	-2.65	.008
fixed		Speed3:WordLength	-2.95	1.20	-2.45	.014
fixed		Speed4:WordLength	-2.07	1.13	-1.83	.067
fixed		Speed5:WordLength	0.04	1.10	0.03	.973
fixed		Speed1:lFreq	2.10	1.72	1.22	.222
fixed		Speed2:lFreq	1.07	1.49	0.72	.472
fixed		Speed3:lFreq	0.49	1.39	0.36	.721
fixed		Speed4:lFreq	3.30	1.31	2.52	.012
fixed		Speed5:lFreq	-0.30	1.27	-0.24	.813
ran_pars	WordClean	SD (Intercept)	32.52			
ran_pars	subject	SD (Intercept)	17.39			
ran_pars	Residual	SD Observation	0.52			

Table C15
Full GLMM model for refixation probability as a function of reading speed, word length, and word frequency (Experiment 2)

effect	group	term	estimate	*SD*	*z*	*p*
fixed		(Intercept)	-2.93	0.17	-17.09	< .001
fixed		Speed1	-0.10	0.17	-0.61	.539
fixed		Speed2	0.13	0.15	0.88	.381
fixed		Speed3	-0.07	0.16	-0.45	.656
fixed		Speed4	-0.49	0.18	-2.73	.006
fixed		Speed5	0.24	0.19	1.25	.213

effect	group	term	estimate	*SD*	*z*	*p*
fixed		WordLength	0.29	0.02	15.87	< .001
fixed		lFreq	-0.15	0.02	-6.65	< .001
fixed		Speed1:WordLength	-0.02	0.02	-1.25	.211
fixed		Speed2:WordLength	-0.03	0.02	-1.80	.072
fixed		Speed3:WordLength	0.00	0.02	-0.18	.856
fixed		Speed4:WordLength	0.02	0.02	1.26	.206
fixed		Speed5:WordLength	-0.01	0.02	-0.72	.473
fixed		Speed1:lFreq	0.03	0.02	1.55	.120
fixed		Speed2:lFreq	-0.02	0.02	-0.75	.455
fixed		Speed3:lFreq	-0.01	0.02	-0.26	.795
fixed		Speed4:lFreq	0.02	0.02	1.01	.315
fixed		Speed5:lFreq	-0.05	0.03	-1.96	.050
ran_pars	WordClean	SD (Intercept)	0.31			
ran_pars	subject	SD (Intercept)	0.31			

Table C16
Full GLMM model for regression-in probability as a function of reading speed, word length, and word frequency (Experiment 2)

effect	group	term	estimate	*SD*	*z*	*p*
fixed		(Intercept)	-1.95	0.20	-9.66	< .001
fixed		Speed1	0.10	0.20	0.49	.625
fixed		Speed2	-0.07	0.17	-0.43	.664
fixed		Speed3	-0.26	0.18	-1.47	.142
fixed		Speed4	0.20	0.20	1.01	.313
fixed		Speed5	-0.02	0.21	-0.11	.909
fixed		WordLength	0.00	0.02	0.17	.862
fixed		lFreq	-0.02	0.03	-0.91	.361
fixed		Speed1:WordLength	-0.02	0.02	-0.84	.399
fixed		Speed2:WordLength	-0.02	0.02	-0.84	.399
fixed		Speed3:WordLength	0.02	0.02	0.80	.421

effect	group	term	estimate	*SD*	*z*	*p*
fixed		Speed4:WordLength	-0.05	0.02	-2.11	.035
fixed		Speed5:WordLength	0.00	0.02	-0.14	.889
fixed		Speed1:lFreq	0.01	0.03	0.54	.590
fixed		Speed2:lFreq	0.01	0.02	0.62	.537
fixed		Speed3:lFreq	0.02	0.02	0.93	.353
fixed		Speed4:lFreq	-0.01	0.03	-0.54	.588
fixed		Speed5:lFreq	0.00	0.03	0.08	.939
ran_pars	WordClean	SD (Intercept)	0.52			
ran_pars	subject	SD (Intercept)	0.31			

Table C17

Full GLMM model for fixation probability as a function of reading speed and word position in paragraph (Experiment 2)

effect	group	term	estimate	*SD*	*z*	*p*
fixed		(Intercept)	0.29	0.03	9.66	< .001
fixed		Speed1	0.10	0.03	2.96	.003
fixed		Speed2	0.10	0.02	5.80	< .001
fixed		Speed3	-0.01	0.02	-0.39	.698
fixed		Speed4	0.10	0.02	6.35	< .001
fixed		Speed5	0.01	0.02	0.38	.703
fixed		word_pos	0.00	0.00	3.79	< .001
fixed		Speed1:word_pos	0.00	0.00	-1.93	.055
fixed		Speed2:word_pos	0.00	0.00	-2.11	.035
fixed		Speed3:word_pos	0.00	0.00	3.29	< .001
fixed		Speed4:word_pos	0.00	0.00	-1.10	.270
fixed		Speed5:word_pos	0.00	0.00	0.59	.559
ran_pars	TRIAL_INDEX	SD (Intercept)	0.02			
ran_pars	subject	SD (Intercept)	0.07			
ran_pars	Residual	SD Observation	0.48			

Appendix D

Model comparison of Experiment 1 and Experiment2

Table D1
ANOVA-style results for comprehension as a function of and language (Experiment 1 & 2)

Effect	Chisq	Df	p
language	15.45	1	< .001
speed	17.29	6	< .001
Language:speed	38.33	4	< .001

Table D2
Full GLMM model for comprehension as a function of reading speed and language (Experiment 1 & 2)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	0.25	0.28	0.88	.377
fixed		language	0.23	0.18	1.23	.217
fixed		Speed225	0.09	0.30	0.29	.772
fixed		Speed270	0.03	0.30	0.09	.932
fixed		Speed350	0.01	0.30	0.02	.985
fixed		Speed360	0.11	0.30	0.35	.727
fixed		Speed405	-0.33	0.30	-1.10	.271
fixed		Speed180	-0.59	0.31	-1.88	.061
fixed		language:Speed225	-0.72	0.20	-3.64	< .001
fixed		language:Speed270	-0.82	0.20	-4.10	< .001
fixed		language:Speed350	-0.91	0.20	-4.57	< .001
fixed		language:Speed360	-1.16	0.20	-5.78	< .001
ran_pars	subject	SD (Intercept)	0.52			
ran_pars	id_text	SD (Intercept)	0.35			

Table D3
ANOVA-style results for first fixation duration as a function of reading speed (Experiment 1 & 2)

Effect	Chisq	Df	p
(Intercept)	22,194.26	1	< .001
Speed	396.94	3	< .001
language	98.80	1	< .001
Speed:language	2.70	3	.440

Table D4
Full GLMM model for first fixation duration as a function of reading speed (Experiment 1 & 2)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	224.32	1.51	148.98	< .001
fixed		Speed1	-3.58	0.70	-5.12	< .001
fixed		Speed2	-7.25	0.70	-10.29	< .001
fixed		Speed3	-0.90	0.70	-1.28	.200
fixed		language	22.12	2.23	9.94	< .001
fixed		Speed1:language	-0.54	1.12	-0.48	.628
fixed		Speed2:language	1.08	1.14	0.95	.344
fixed		Speed3:language	0.71	1.16	0.61	.540
ran_pars	WordClean	SD (Intercept)	10.19			
ran_pars	subject	SD (Intercept)	9.10			
ran_pars	Residual	SD Observation	0.36			

Table D5
ANOVA-style results for refixation time as a function of reading speed (Experiment 1 & 2)

Effect	Chisq	Df	p
(Intercept)	52.38	1	< .001
Speed	353.37	3	< .001
language	1.00	1	.318
Speed:language	73.38	3	< .001

Table D6

Full GLMM model for refixation time as a function of reading speed (Experiment 1 & 2)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	27.65	3.82	7.24	< .001
fixed		Speed1	-1.83	0.35	-5.24	< .001
fixed		Speed2	-2.28	0.16	-14.12	< .001
fixed		Speed3	0.00	0.00	0.01	.996
fixed		language	4.65	4.65	1.00	.318
fixed		Speed1:language	-0.96	0.81	-1.19	.235
fixed		Speed2:language	-3.17	0.51	-6.26	< .001
fixed		Speed3:language	0.00	0.00	0.00	.996
ran_pars	WordClean	SD (Intercept)	76.17			
ran_pars	subject	SD (Intercept)	20.65			
ran_pars	Residual	SD Observation	4.24			

Table D7

ANOVA-style results for reread time as a function of reading speed (Experiment 1 &2)

Effect	*Chisq*	*Df*	*p*
(Intercept)	1.55	1	.213
Speed	1,759.12	3	< .001
language	0.00	1	.953
Speed:language	84.46	3	< .001

Table D8

Full GLMM model for reread time as a function of reading speed (Experiment 1 &2)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	54.73	43.98	1.24	.213
fixed		Speed1	-21.43	1.46	-14.71	< .001
fixed		Speed2	-21.04	0.79	-26.51	< .001
fixed		Speed3	0.00	0.00	-0.01	.993
fixed		language	-3.88	65.97	-0.06	.953
fixed		Speed1:language	3.64	2.00	1.82	.069

effect	group	term	estimate	*SE*	*t*	*p*
fixed		Speed2:language	7.41	1.07	6.92	< .001
fixed		Speed3:language	0.00	0.00	0.01	.994
ran_pars	WordClean	SD (Intercept)	45.48			
ran_pars	subject	SD (Intercept)	295.36			
ran_pars	Residual	SD Observation	3.26			

Appendix E

Target word properties (Experiment 3)

Table E1

Independent Samples t-Text for frequency target word (Experiment 3)

	Levene-test			t-Test					
Variable	Variances	F	Sig.	t	df	P (two-tailed)	Mean difference	CI (lower)	CI (upper
Type frequency	equal	24.33	0.00	6.83	141.00	0.00	-48.21	34.25	62.16
	unequal	24.33	0.00	6.88	71.15	0.00	-48.21	34.23	62.18
Lemma frequency	equal	23.80	0.00	6.63	141.00	0.00	-93.63	65.72	121.55
	unequal	23.80	0.00	6.49	69.01	0.00	-93.63	64.86	122.40
Familarity	equal	2.97	0.09	2.67	141.00	0.01	-64.60	16.71	112.49
	unequal	2.97	0.09	2.66	126.22	0.01	-64.60	16.55	112.64
Regularity	equal	0.25	0.62	0.52	144.00	0.60	-6.56	-18.20	31.32
	unequal	0.25	0.62	0.52	131.22	0.60	-6.56	-18.22	31.34
Word length	equal	1.35	0.25	1.16	144.00	0.25	-0.10	-0.07	0.26
	unequal	1.35	0.25	1.16	143.93	0.25	-0.10	-0.07	0.26

Table E2

Independent Samples t-Text for plausibility target word (Experiment 3)

	Levene-test			t-Test					
Variable	Variances	F	Sig.	t	df	P (two-tailed)	Mean difference	CI (lower)	CI (upper
Type frequency	equal	0.01	.91	-.11	143	.91	-.39	-7.34	6.55
	unequal			-.11	126.44	.91	-.39	-7.36	6.58
Lemma frequency	equal	0.04	.84	-.18	143	.86	-1.00	-11.83	9.84
	unequal			-.18	142.35	.86	-1.00	-11.84	9.84
Familarity	equal	0.20	.65	.36	144	.72	6.70	-29.80	43.19
	unequal			.36	139.74	.72	6.70	-29.81	43.20
Regularity	equal	0.07	.79	.52	144	.61	4.97	-14.10	24.04
	unequal			.52	119.90	.61	4.97	-14.14	24.07
Word length	equal	1.23	.27	-.19	144	.85	-.47	-0.47	0.40
	unequal			-.19	142.02	.85	-.47	-0.47	0.40

Appendix F

Text stimuli Experiment 3

Font and line breaks are used as presented in both experiments.

Instruction prior to the experiment:

```
Liebe Teilnehmerin, lieber Teilnehmer,
in diesem Teil der Untersuchung werden Ihnen abschnittsweise
verschiedene Texte nacheinander präsentiert.
Bitte lesen Sie den Text so, dass Sie die Inhalte gut verstehen,
aber zugleich so konzentriert und zügig, wie Sie können.
Am Ende jedes Abschnitts drücken Sie bitte die Leertaste. Dadurch
wird der nächste Text gezeigt oder eine auf den Text bezogene
Frage eingeblendet. Bitte beantworten Sie diese Frage mündlich.
Vor der Textpräsentation wird auf jeder Seite oben links ein
Punkt kurzzeitig eingeblendet. Schauen Sie bitte auf diesen
Punkt, bis der Text startet.
Wenn keine Unklarheiten zum Ablauf bestehen, drücken Sie zum
Start nun bitte die Leertaste.
```

Instruction prior to the line-by-line technique:

```
Im folgenden Versuchsteil werden Ihnen weiterhin abschnittsweise
Texte nacheinander präsentiert, die Sie bitte aufmerksam lesen
sollen.
Dazu werden Sie nun Zeile für Zeile durch den Text geführt, indem
die zu lesende Zeile schwarz hervorgehoben wird, während die
restlichen Zeilen grau dargestellt werden.
Achten Sie bitte darauf, immer nur die schwarz hervorgehobene
Zeile zu lesen. Folgen Sie dieser Markierung Zeile für Zeile
durch den Text und passen Sie, wenn nötig, Ihr Tempo an.
Im Anschluss an einige Texte wird Ihnen eine Text bezogene Frage
eingeblendet. Bitte beantworten Sie diese Frage mündlich.
Wenn keine Unklarheiten zum Ablauf bestehen, drücken Sie zum
Start nun bitte die Leertaste.
```

Text material and comprehension questions:

```
0
Theresa seufzte laut, als sie nach dem langen Weg zur Tür
hereinkam. Wie jeden Donnerstag stand heute der Wocheneinkauf im
Supermarkt an. Vom langen Tragen der schweren Tüten taten ihr
die Arme höllisch weh. Immerhin hatte sie jetzt ausreichend
Fische für das Dinner besorgt. Sie beschloss, das Abendessen
heute besonders liebevoll zuzubereiten.
0
Henrik saß im Zug nach Hause und freute sich auf das Fest. Jedes
Weihnachten sang die gesamte Familie gemeinsam alte Klassiker.
Sein Bruder spielte Gitarre und konnte den Gesang gut begleiten.
Jedoch kritisierte die Familie häufig seine Haltung beim
Spielen. Henrik beschloss, dieses Jahr extra zu üben um die Töne
besser treffen zu können.
1
Als der Kommissar aus dem Fenster blickte, dämmerte es draußen
```

bereits. Viele Stunden saß er an seinem riesigen Schreibtisch im Büro. Der komplette Bericht/Spielfilm über den Fall hätte gestern fertig sein müssen. Er fürchtete jetzt schon die große Arbeit/Unrast, die ihn diese Nacht begleiten würde. Aus Erfahrung wusste er, dass sein Vorgesetzter bei Unzuverlässigkeit keinen Spaß verstand.

2

Sebastian malt schon seit seiner Kindheit sehr gerne Naturmotive. Für das Studium malte der Künstler eine Ansicht des Bergpanoramas. Sein bester Pinsel/Stock brach nach der tagelangen Arbeit knackend entzwei. Enttäuscht stellte er das Leinöl/Wasser beiseite und kramte nach einem Ersatz. Nach einer kurzen Pause machte er sich wieder an die Arbeit und konnte das Gemälde noch am gleichen Tag fertigstellen.

3

Melina machte sich am Nachmittag auf den Weg zum Nachhilfeunterricht. Sie ärgerte sich über das katastrophale Wetter an diesem Donnerstag. Ihr neuer Mantel/Vorhang wurde komplett durchnässt durch den starken Regen. Mürrisch holte sie ihre Bücher/Hefter aus dem Rucksack, um sie abzutrocknen. Zumindest war sie erleichtert, pünktlich zum Unterricht kommen zu können.

4 FILLER

Am Donnerstagabend zog ein starker Sturm über dem Meer auf. Die Crew setzte auf See einen Notruf ab und hoffte auf ihre Rettung. Der große Frachter war in Schieflage geraten und könnte bald kippen. Noch keiner aus der Crew hatte in seiner Laufbahn zuvor ein so schweres Unwetter erlebt. Sie beteten zu Gott und hofften, dass rechtzeitig Hilfe eintreffen würde.

5

Durch die Größe des Hauses nimmt Putzen in Janas Alltag viel Raum ein. Jede Woche reinigte sie die Sofas in den Zimmern ihrer zwei Kinder. Die neuen Lappen/Bürsten entfernten Soßenflecken von allen ihren Polstern. Auch vom kürzlich gekauften Koffer/Bohrer zeigte sie sich durchaus begeistert. Der Besuch im Kaufhaus und die ausführliche Beratung dort hatten sich wirklich gelohnt.

Wer putzte die Sofas?

6

Als die Eheleute Peters noch in der Bergallee wohnten, war immer was los. Jeden Morgen bellte Hermann die vorbeikommenden Tiere auf der Straße an. Der kleine Welpe/Seelöwe wurde in der ganzen Nachbarschaft von allen verwöhnt. Die Kinder warteten öfters am Fenster/Pfosten bis das Tier an ihnen vorbeilief. Am liebsten gaben sie ihm kleine Leckerchen und tätschelten ihm den Kopf.

7 FILLER

Simone hatte schon wieder um einiges zu spät mit dem Lernen begonnen. Während der Klausur wollte sie bei ihrer schlauen Nachbarin abgucken. Die aufmerksame Lehrkraft erwischte sie jedoch und ließ sie durchfallen. Gott sei Dank hatte ihr Betrug keine weiteren Auswirkungen auf ihr Studium. Sie nahm sich vor, beim nächsten Mal früher mit dem Lernen anzufangen.

8

So stark geregnet wie an diesem Freitag hatte es schon lange nicht mehr. Der junge Postbote atmete tief durch und ging weiter auf seiner Route. Durch das feuchte Unwetter/Klima kämpfte er sich bis zur nächsten Haustür vor. Nach Schichtende schnappte er sich seinen Freund/Roller und fuhr in die Kneipe. Er entspannte sich langsam, tank ein großes Bier und hoffte, dass er nicht krank werden.

9
Für Marie hatte sich mit der Eröffnung ihres Ladens ein Traum erfüllt. Bedauerlicherweise stand die kleine Boutique kurz vor der Schließung. Wegen der neuen Passage/Therme zwei Straßen weiter kamen kaum noch Kunden. Deshalb verursachten die letzten Monate viel Furcht/Trubel wegen der finanziellen Situation.
10
Stefan war handwerklich schon immer außerordentlich begabt gewesen. Im Urlaub schnitt er vorsichtig die Äste vor der Waldhütte durch. Das scharfkantige Messer/Schilf wurde nach ein paar Minuten Arbeit stumpf. Er brauchte nun dringend Fassung/Nikotin, um die Frustration zu verkraften. Er nahm ein paar tiefe Atemzüge und machte sich leicht entmutigt an die Arbeit.
Wann zerkleinerte Stefan die Äste?
11
Zum neuen Jahr nahm sich Armin fest vor, seinen Lebensstil zu verändern.Dank viel Sport und guter Ernährung wirkte er wie ein neuer Mensch. Er hatte einige Kilos/Haare verloren und war seinem Ziel näher gekommen. Mit einem neuen Mantel/Parfum belohnte er sich für seine erkämpften Erfolge. Als nächstes stand ein Jobwechsel auf seiner To-Do Liste für das Jahr.
12 FILLER
Die Mittagssonne in Ägypten war für die meisten Lebewesen nur schwer erträglich. Manche der Jungtiere gruben sich tief unter den heissen Sand der Wüste. Die kleinen Mäuse fanden dort kühlenden Schutz vor der glühenden Hitze. So schafften sie es auch in solch einem heißen Klima zu überleben. Andere Tiere waren weniger geschickt und mussten sich der Hitze geschlagen geben.
13
Jennifer wachte erschrocken von einem seltsamen lauten Rumpeln auf. Spät in der Nacht alarmierte sie in panischer Angst die Polizei. Ein paar Einbrecher/Nachbarn standen im Flur und betrachteten ihr teures Bild. Die flinken Männer/Gauner packten das Bild und verschwanden durch das Fenster. Zutiefst erschrocken sah Jennifer ihnen nach und wartete auf die heraneilenden Beamten.
Wo betrachteten sie das teure Bild?
14
Toni war schon immer sehr fasziniert von Tieren und der Natur. Monatlich notierte er den Bestand aller wilden Tiere in der Umgebung. In seinem Garten/Keller zählte er dann die zahlreichen Vögel und Insekten. Er arbeitete bis zum Sonntag/Optimum eifrig und konzentriert an der Liste weiter. Auf einige sehr seltene Exemplare auf seiner Liste war er besonders stolz.
15
Viktor musste nach dem ausgiebigen Urlaub auf seine Ausgaben achten. Nachmittags ging er regelmäßig zur Bäckerei zwei Dörfer weiter. Nicht verkaufte Brötchen/Mehle wurden dann zur Hälfte des Preises abgegeben. Auf dem Rückweg besorgte er noch Zucker/Glasur, um selbst einen Kuchen zu backen. Seine Schwester hatte demnächst Geburtstag und er wollte ihr etwas Selbstgemachtes schenken.
16
Martin hatte heute den gesamten Tag ohne Pause auf dem Bau gearbeitet. Nach der anstrengenden Schicht freute er sich auf seinen Abend allein. Die heisse Badewanne/Marinade mit Rosenduft wartete bereits zuhause auf ihn. Ausnahmsweise verschob er das Laufen/Putzen auf einen anderen Tag in der Woche. Er war einfach zu erschöpft und brauchte mal eine Auszeit.

17 FILLER
Nach einer anstrengenden Saison ging es für Sven nun endlich ans Meer. Der Fussballer wollte während seines Urlaubs nicht belästigt werden. Seine dunkle Brille schützte ihn vor den neugierigen Blicken der Fans. Nach zwei Stunden fehlte ihm die Aufmerksamkeit und er gab sich offen zu erkennen. Einige Fans erkannten ihn und freuten sich, Fotos mit ihm schießen zu dürfen.
18
Das alte Dorf bot schon immer eine hervorragende Kulisse für Rendezvous. Mitten im Tal stand alleine ein über hundert Jahre alter Apfelbaum. Eingeritzt in seiner Rinde/Wurzel waren unzählige Initialen von Verliebten. Außerdem diente er als Zentrum/Tarnung für die Kinder beim Fangen spielen. Sie sprangen um ihn herum und versuchten nicht entdeckt zu werden.
19
Die Arbeit im Krankenhaus ist mit enorm viel Verantwortung verbunden. In der Notaufnahme mussten alle Patienten schnell versorgt werden. Dafür sollte das Personal/Catering die Ausstattung von jedem Zimmer kennen. Bei dem hohen Ausmaß/Pensum an Arbeit herrschte eine hohe Fluktuation. Die Personalabteilung kam kaum hinterher freie Stellen mit geschultem Personal neu zu besetzen.
20
Linda hatte schon seit einiger Zeit über einen Jobwechsel nachgedacht. Sie kleidete sich für die Bewerbungsfotos mit neuen Anziehsachen ein. Die farbenfrohe Bluse/Burka war von Anfang an ihr Favorit für diesen Anlass. Wegen der Mängel/Glätte auf der alten Landstraße machte sie sich zeitig auf den Weg. Sie wollte den Termin beim Fotografen auf keinen Fall verpassen.
Warum brauchte Linda neue Anziehsachen?
21
Der Ort Grafenberg eignet sich hervorragend zum Wandern und Ausreiten. Nahe dem dichten Wald ritt eine Frau entspannt auf ihrem braunen Pferd. Barbaras neue Stiefel/Sandalen aus Leder waren angenehm, praktisch und gemütlich. Heute traf sie den stadtbekannten Dichter/Trinker auf einer Parkbank sitzend an und grüßte ihn. Sie fragte sich, wie viele der Gerüchte, die um ihn kursierten wohl wahr sein.
22
Es hatte spontan ein Klient abgesagt und Simone hatte nun etwas Zeit. Beim eifrigen Aufräumen ihrer Kanzlei prellte sie sich das Jochbein. Ein roter Ordner/Stempel war aus dem Regal direkt auf ihr Gesicht gefallen. Sie verlor die Energie/Balance und ließ sich frustriert auf den Stuhl fallen. Am liebsten würde sie alle weiteren Termine des Tages einfach absagen und nach Hause fahren.
0
Maria studierte nun seit Herbst Modedesign an ihrer Wunschhochschule. Für die Modenschau am Semesterende zog sie den Models ihre Kleider an. Die gekauften Schuhe hatten alle noch ein kleines Preisschild. Auf den Videoaufnahmen der Kamera ließ sich zum Glück kein Etikett erkennen. Maria hatte keine Probleme, die Artikel im Geschäft wieder zurückzugeben.
0
Sina hegte eine tiefe Leidenschaft für ihren Sport und ihr Studium. Nach vier Monaten intensiven Trainings war sie nun nervlich etwas angeschlagen. Allerdings war ihre Kondition trotz Klausurphase an der Uni besser denn je. Auf einer Fläche an ihrem Trimmrad hatte sie immer ihre Lernzettel liegen. Ihr Ziel war es, sowohl in der Uni als auch im Sport sehr gut zu sein.
23

Jan hatte die letzte Nacht vor lauter Aufregung sehr schlecht geschlafen. Er suchte morgens seinen weißen Anzug heraus und machte sich zurecht. Auf der Hochzeit/Beerdigung am Nachmittag wollte er einen guten Eindruck machen. Hektisch schüttete er den Kaffee/Punsch in seine Tasse und kleckerte dabei. Er gab sich die größte Mühe, den entstandenen Fleck auszuwaschen, aber ein kleiner Rückstand blieb sichtbar.

24

Der Sommer in diesem Jahr war von sehr wechselhaftem Wetter geprägt. Das örtliche Freibad schloss gestern wieder früher als sonst üblich. Abends drohten Gewitter/Wolken und die Betreiber wollten kein Risiko eingehen. Die anliegende Straße/Therme war kurz nach der Schließung voller denn je. Im nahenden Herbst konnte kaum ein beständigeres Wetter erwartet werden.

25

Jens war es schon immer wichtig gewesen, auf dem neuesten Stand zu sein. Letzte Woche informierte er sich über eine Stadt im Krisengebiet. Die aktuellen Meldungen/Comichefte verschafften Klarheit über die Geschehnisse. Die kürzlich eingestürzte Brücke/Pagode war diesmal das zentrale Thema. Darüber hinaus wurde über wenig für ihn interessantes berichtet.

Über was verschaffte er sich Klarheit?

26

Melanie wusste genau, wo ihre Stärken und Schwächen beim Singen liegen. Zu ihrem großen Bedauern erteilte die Chorleiterin ihr eine Absage. Der große Sopran/Bunker war bereits voll besetzt und nahm niemanden mehr auf. Durch ihr Zeigen von Einsatz/Courage wurde dennoch ein Platz für sie geschaffen. Bei einer der nächsten Aufführungen sollte sie sogar einen Solopart singen.

27 FILLER

Ben hatte sich mit dem eigenen Bienenstock im Garten einen Traum erfüllt. Am Nachmittag durchsuchte er den Bienenstock sorgfältig nach seiner geliebten Königin. Er konnte sie allerdings nicht finden und ging zu seinem Nachbarn. Er hatte die Hoffnung, dass sie sich dorthin verlaufen hatte. Der Nachbar konnte ihm leider nicht helfen und schickte ihn zurück nach Hause.

28

In der Michaelsschule waren Mitgefühl und Nächstenliebe wichtige Werte. Kurz vor Weihnachten sammelten die Lehrer immer für einen guten Zweck. Sie erhielten viele Spenden/Kuchen und stifteten sie zusammen an Kinder in Not. Daneben wurden zudem Figuren/Murmeln oder Ähnliches von den Kindern gespendet. Es sollte ihnen schon früh beigebracht werden, dass es wichtig ist, Menschen in Not zu helfen.

29

Felix informierte sich schon immer über die verschiedensten Themen. Den Nachmittag verbrachte er oft in der Bibliothek seiner Universität. Der langjährige Archivar/Bäcker kannte ihn mittlerweile sogar schon beim Namen. Heute standen Kriege/Amöben als Thema auf seiner langen Bibliotheksagenda. Das Thema interessierte ihn sehr und er freute sich seit Wochen darauf.

30

Martha und ihr Partner wohnten inzwischen seit zwei Monaten zusammen. In der Küche schenkte sie ihrem Freund eine frische Tasse Kaffee ein. Sie ließ die Kanne/Teller aus Versehen fallen und putzte die große Pfütze weg. Dann klingelte auch noch der Bischof/Spanner von nebenan und stresste Martha. Sie hatte unangenehme Geschichten über ihn gehört und fühlte sich in seiner Gegenwart nicht wohl.

31
Schon seit vier Monaten arbeiteten die Bauarbeiter an dem Projekt. Voller Vorfreude schweißten die Handwerker die letzten Teile zusammen. Die kaputte Leitung/Sprühdose konnte nach langer Arbeit wieder repariert werden. Im Anschluss genossen sie die Erfolge/Seeluft am nahegelegenen Strand mit Bier. Das nächste größere Projekt stand schon vor der Tür und sie wollten die kurze Pause richtig auskosten.
Wann konnte das Teil wieder repariert werden?
32
Simons Friseursalon war bei allen Dorfbewohnern sehr beliebt. Für seine treuesten Kunden vergab der Friseur gerne gesonderte Termine. Der kleine Salon/Keller öffnete dann auch spätabends seine Pforten für Gäste. Der auf derselben Straße ansässige Richter/Optiker kam oft nach Dienstschluss. Da sie sich gut verstanden tranken sie nach dem Termin oft sogar noch ein Getränk in der benachbarten Kneipe.
33
Inas Arbeitstag zog sich wegen eines schwierigen Kunden in die Länge. Nach der Arbeit hatte sie großen Hunger und machte sich auf den Heimweg. Zuhause wartete ihr Freund/Mieter schon mit einer frisch gekochten Bolognese. Zudem waren die bestellten Gläser/Poster angekommen und verstärkten die Freude. Die Lieferung hatte sich um Wochen verzögert und Ina hatte schon fast nicht mehr damit gerechnet, dass sie noch ankommen.
34 FILLER
Marie hatte sich heute in der Buchhandlung einen neuen Roman gekauft. Oft las sie über Stunden in ihren Büchern ohne eine Pause zu machen. Beim Lesen des Romans schlief sie jedoch nach wenigen Minuten ein. Dennoch nahm sie sich vor den Roman in dieser Woche zuende zu lesen. Auf ihrer Bücherliste standen noch einige Werke, die sie in diesem Jahr noch lesen wollte.
35
Einige Dinge in der Wissenschaft haben sich über Jahrzehnte hinweg bewährt. Im Krankenhaus säuberte der Doktor die Wunden mit farbloser Tinktur. Der handelsübliche Alkohol/Verband war seit der Antike ein Mittel der Medizin. Auch neuere Ansätze/Behelfe konnten das Mittel nicht aus der Medizin verdrängen. Die Fortschritte in anderen Bereichen sind dafür umso bemerkenswerter.
Was behandelte der Doktor?
36
Innerhalb von zehn Jahren hatte Marian ganze sieben Bücher publiziert. Beim Schreiben seines neuen Romans geriet der Autor ins Stocken. Das letzte Kapitel/Spiel hatte er seit Monaten nicht zu Ende bringen können. Das Hoffen/Bangen um die Geduld seines Verlegers belastete ihn sehr. Er gab nicht auf und suchte in Gesprächen mit Bekannten nach Inspiration.
37
Wegen der Pandemie herrschte aktuell eine hohe Fluktuation im Unternehmen. Die neue Aushilfe kaufte zu viele Waren für die Kantine der Firma ein. Das kleine Lager/Becken war völlig überfüllt und die Tür schloß nicht mehr ab. Notgedrungen stellte sie die Sachen im Inneren/Rohbau des neuen Bürogebäudes ab. Der Chef war überhaupt nicht begeistert über den Vorfall und ermahnte die Aushilfe.
38
Arthur wollte sich zu seiner Abschlussprüfung etwas Besonderes gönnen. Nach dem Essen zahlte er seine hohe Rechnung im noblen Restaurant. Der gut gekleidete Kellner/Türsteher nahm das Geld

mit einem Lächeln entgegen. Beim Rausgehen lief er gegen die Scheibe/Vitrine und hinterließ einen Kratzer. Er entschuldigte sich bei dem Personal und war sehr erleichtert, dass er vor einiger Zeit eine Haftpflichtversicherung abgeschlossen hatte.

39 FILLER

Rainer fasste den Entschluss, sich beruflich komplett neu zu orientieren. Er freute sich sehr über den Start der Ausbildung zum Heilpraktiker. Die Kosten des Instituts erforderten einen hohen Kredit bei seiner Bank. Das hielt Rainer allerdings nicht davon ab, diesen Schritt zu gehen. Er sparte dafür nun ein wenig mehr beim Einkaufen und ging weniger aus.

40

Letzte Woche hatte Nils einen Ausflug zur polnischen Grenze gemacht. An Silvester hatte er illegale Böller aus nächster Nähe gezündet. Das ständige Piepen/Morsen in seinem Ohr störte ihn seitdem beim Schlafen. Er ärgerte sich über seine Schäden/Unreife und bereute die unüberlegte Aktion. Am nächsten Morgen ging er auf Drängen seiner Freundin zum Ohrenarzt.

41

Peter nutzte den freien Tag, um eine Runde über den Flohmarkt zu gehen. Am Abend nagelte er das neue Poster an die Wand des Schlafzimmers. Der eiserne Bolzen/Speer glitt mühelos durch die Mauer und hielt das Bild an der Wand. Er hatte sein handwerkliches Wissen/Gespür wieder einmal gekonnt eingesetzt. Mit seinem Vater verbrachte er als Kind einige Nachmittage in der Werkstatt.

42

Timo war schon seit seiner Geburt ein eher anstrengendes Kind. Während des Wocheneinkaufs quengelte der nervige Junge die ganze Zeit. Sein Erzieher/Anwalt würde später mit ihm ein sehr ernstes Wort reden müssen. Nach dem Essen war er ohne Strafe/Ansage kaum noch zu besänftigen gewesen. Einige Stunden später spielte er dann jedoch wieder unbeschwert mit seinen Autos.

Warum sollte mit dem Jungen geredet werden?

43

Jenny lernte damals von ihrer Großmutter die Grundlagen des Nähens. Gestern Abend nähte sie einige Flicken auf ihrer blauen Jeans an. Später verlor sie die Nadel/Gabel und konnte die Arbeit leider nicht beenden. Sie nahm das Papier/Lineal und bereitete schon einmal das nächste Projekt vor. Dann klingelte sie bei ihrer Nachbarin, um sich von dieser Ersatz zu borgen.

44 FILLER

Linda brauchte in ihrem stressigen Alltag dringend einen Ausgleich. Nach der Arbeit ging sie oft in den Stadtwald und fütterte die Tiere. Die vielen Spatzen im Park fraßen ihr immer die Brotkrumen aus der Hand. Das besondere Verhältnis zu den Tieren gab ihr jedes Mal neue Kraft. Auch die frische Luft wirkte sich jedes Mal sehr positiv auf ihr Befinden aus.

45

Nach mehreren Monaten Arbeit am Stück hatte Hannah bald endlich frei. Im Sommer flog sie dieses Mal nicht zum Strandurlaub nach Portugal. Leider wurden ihre Flüge/Wände gestrichen und sie musste zuhause bleiben. Die landesübliche Nahrung/Schwüle hatte sie körperlich sowieso nie richtig vertragen. Sie überlegte sich wie sie ihre freie Zeit sinnvoll nutzen könnte.

46

Direkt an den Bauernhof grenzt nun seit vierzehn Jahren ein Hofladen. Traditionell erntet der deutsche Bauer im September seine Felder ab. Die frische Gerste/Sahne wird oft innerhalb einer Woche zum Verkauf angeboten. Besonders beliebt bei den

Kindern waren die Pferde/Fohlen auf der Koppel direkt vor dem Laden. Auch der eigene Spielplatz war gerade im Frühling und im Sommer gut besucht.
Wann erntet der Bauer seine Felder?
47
Dennis war nun schon seit zwei Wochen konsequent auf strikter Diät. Nach dem Sport nippte er mit Genuss an seinem zuckerfreien Tee. Die heiße Tasse/Brille glitt ihm dabei versehentlich aus seinen Schweißhänden. Sie landete auf der Platte/Empore und ging glücklicherweise nicht kaputt. Er hatte allerdings schlechte Laune und seufzte mürrisch.
48
In der gesamten Stadt herrschte große Aufregung unter der Bevölkerung. Trotz aller Vorkehrungen flüchtete ein Häftling aus dem Gefängnis. Während des Hofgangs/Urlaubs kletterte er über die Mauer und sprang herunter. Dass man ihn in einer Kirche/Gondel wieder aufspürt, hätte wohl keiner gedacht. Als die Beamten ihn wieder festnahmen, zeigte er sich geistig leicht verwirrt.
49 FILLER
Vergangene Woche hatte Petras Sohn einen schweren Autounfall gebaut. Auf der Suche nach Ersatzteilen für ihr Auto war sie fast verzweifelt. Sie wurde im Internet fündig und konnte mit der Reparatur beginnen. Ihr Sohn war zum Glück mit leichten Verletzungen am Arm davongekommen. Ins Fahrzeug wird er wegen des Schrecks jedoch erstmal nicht steigen.
50
Die Konzerte von Bens Idol waren meist nach wenigen Minuten ausverkauft. Für die anstehende Tour des Sängers hatte er Tickets bekommen können. Die hart erkämpften Plätze/Tische befanden sich relativ mittig im Oberrang. Sie saßen direkt hinter zwei Männern/Leisten, welche ihnen die Sicht verdeckten. Trotz dieser Enttäuschung war das Konzert ein unvergessliches Erlebnis.
51
Nina war bei Freunden und Familie als ausgesprochen hilfsbereit bekannt. Für ihre Oma schaufelte sie ein großes Loch in den harten Gartenboden. Ihr rostiger Spaten/Grill machte den unerwarteten Auftrag nicht gerade leicht. Insgesamt beanspruchte die Stelle/Tortur mehrere Stunden von ihrem Nachmittag. Aus Liebe zu ihrer Großmutter investierte sie diese Zeit allerdings gerne.
Warum machte Nina ein Loch im Gartenboden?
52
Stefans Vormittag startete mit heißem Kaffee und der Lektüre des Wochenplans. Im Laufe des Tages fasste er mutig einen aufsässigen Kriminellen. Als erfahrener Fahnder/Tänzer hatte er die Situation schnell unter Kontrolle. Vor dem Fenster/Gemäuer der alten Produktionsstätte hatte er ihn entdeckt. Am Abend erzählte er stolz seinen Kindern von seinem erfolgreichen Tag.
53
Simon war zuständig für die Organisation und Moderation von Pressekonferenzen. Das exklusive Interview mit dem Politiker dauerte länger als gedacht. Die geduldigen Reporter/Zuschauer brachen das Gespräch dann nach zwei Stunden ab. Simon sah es als Hinweis/Ansporn, seine Zeitplanung beim nächsten Mal zu verbessern. Wegen der Verzögerung musste er leider auch seine wöchentliche Yogastunde absagen.
54
Peter erledigte seine Arbeit normalerweise immer sehr zuverlässig. Der Auftrag wurde nicht fertig und der Bildhauer

war langsam nervös. Er bearbeitete den Stein/Roman bis tief in die Nacht und ging nach Hause. Das wachhaltende Mittel/Elixier hatte ihn in dieser langen Nacht gerettet. Er war selten so gestresst und musste sich nun erstmal einen Tag frei nehmen.
55 FILLER
Jonas wurde schon immer von Ärzten für seine Schmerzfreiheit gelobt. Er freute sich immer auf die jährliche Untersuchung beim Zahnarzt. Dort gab es Bonbons nach jeder Behandlung für alle tapferen Kinder. Zu Hause bekam er von seinen Eltern nur selten so etwas Ungesundes. Seiner Mutter gefiel diese ungesunde Art Belohnung überhaupt nicht.
56
Jens machte nun seit einem Jahr mindestens dreimal die Woche Sport. Mit aller Kraft warf er den Ball zu seinem entferntesten Mitspieler. Seit Wochen ist Handball/Langlauf für ihn die interessanteste neue Sportart. Durch seinen Willen/Impetus konnte er sich fokussieren und verbessern. Sein bester Freund zeigte sich stolz und fasziniert über seinen Ehrgeiz.
57
Am Ende jedes Semesters veranstaltete die Musikschule ein Konzert. Bei der Aufführung spielte Liam schwierige Stücke von Mozart und Bach. Er hatte die Noten/Pfiffe mit viel Fleiß stundenlang im Proberaum eingeübt. Nach dem Auftritt war das Wetter/Buffet das Gesprächsthema mit seinem Lehrer. Bereits eine Woche später begann dann wieder der intensive Unterricht.
Wer trat bei der Aufführung auf?
58
Jonas hatte letzte Nacht schlecht geschlafen und kam kaum aus dem Bett. Vor der Schule druckte er den Bericht für den Deutschunterricht aus. Leider staute sich Papier/Wasser im Gerät und er kam viel zu spät zur Schule. Kurz vor dem Läuten/Eingang fiel ihm auf, dass er seine Stifte vergessen hatte. Zurück zu Hause schlief er dann innerhalb von wenigen Minuten auf der Couch ein.
59 FILLER
Nur etwa zehn Minuten vom Stadtzentrum entfernt lag ein Waldgebiet. Zwischen den dichten Tannen des Waldes hatte sich ein Fuchs hingelegt. Vor den Jägern hatte er endlich ein gutes Versteck für sich gefunden. Als die Gefahr vorüber schien, schlich er aus dem Versteck hervor. Die Ruhe endete jedoch als eine Familie mit Kindern um die Ecke kamen.
60
Wegen dem Stress zu Hause war Leonie momentan nicht ganz bei der Sache. In der ersten Halbzeit spielte sie den Ball oft deutlich zu spät ab. Ihr genervter Trainer/Begleiter wechselte sie zur Pause aus und redete mit ihr. Sie vereinbarten eine Analyse/Auszeit über die kommenden zwei Wochen hinweg. Sie war dennoch froh, den Sport als Ausgleich zum familiären Stress zu haben.
61
Annika wollte ihrer Oma dieses Jahr ein Gemälde zum Geburtstag schenken. Beim Malen des Bildes rutschte sie ärgerlicherweise mit dem Pinsel ab. Der blaue Fleck/Faden ließ sich auch mit sehr viel Mühe nicht entfernen. Sie verdeckte die Stelle mit zwei Motiven/Flicken, um ihn zu verschleiern. Das Gemälde gefiel ihrer Oma trotzdem sehr und sie hängte es über ihr Bett.
62
Ein eigenes Haus zu bauen war schon immer ein Traum für Kai gewesen. Mit schwerer Technik baute er sein neues Eigenheim direkt am Strand. Die geliehenen Bagger/Backöfen waren für das

Unterfangen zwingend notwendig. Bald konnte er das fertige Gebäude/Domizil endlich zum ersten Mal bewundern. Er war fünf Jahre lang mit Planung und Umsetzung dieses Projektes beschäftigt gewesen.
63
Jana hatte über das ganze Wochenende Besuch aus der Heimat erhalten. Heute Vormittag brachte sie ihre Freundinnen zum neuen Einkaufszentrum. Das weiße Fahrrad/Pferd brachte sie schnell und sicher in Richtung Stadtmitte. Mit einem Konzert/Imbiss am Abend rundeten die Freundinnen den Tag ab. Für den nächsten Tag war ein Ausflug in den Stadtpark mit Picknick geplant.
Wo lag das Einkaufszentrum?
64 FILLER
Gegen seine Gelenkschmerzen nach dem Laufen kaufte sich Jan neue Schuhe. Er probierte seine neuen Laufschuhe direkt nach dem Aufstehen aus. Die neuartige Sohle entlastete sofort seine anfälligen Gelenke und Füße. Nun konnte er das intensive Training für den Marathon wieder aufnehmen. Er hatte die Empfehlung im letzten Monat von seinem Orthopäden erhalten.
65
Der Platz in der alten Wohnung reichte für das Ehepaar nicht mehr. An einem Tag im Mai zimmerte Klaus die Möbel für die neue Wohnung. Leider standen die Regale/Computer wegen des schiefen Bodens nicht an der Wand. Wegen der extravaganten Figuren/Zierde fiel dies allerdings gar nicht auf. Nun musste nur noch die Küche eingebaut werden und dann war alles fertig.
66
Ulrike war eine sehr vorsichtige und ängstliche Autofahrerin. Ihr Opa verlor vor zwei Jahren sein rechtes Bein bei einem Autounfall. An einer roten Ampel/Linie war ihm ein abgelenkter Fahrer hinten aufgefahren. Nach diesem Umstand/Trauma hatte sie die Freude am Fahren vollkommen verloren. Sie dachte darüber nach, ihr Auto an ihre jüngere Schwester weiterzugeben.
67
Am Sonntagnachmittag war in Werthoven ein riesiges Feuer ausgebrochen. Die Flammen erfassten das Altenheim und das ganze Dorf eilte zu Hilfe. Alle gefährdeten Bewohner/Pfleger konnten jedoch rechtzeitig gerettet werden. Dadurch konnte ein größeres Unglück/Debakel von den Helfern verhindert werden. Eine Katastrophe dieses Ausmaßes war zuletzt vor einer Ewigkeit vorgekommen.
68
Auf ihrem Heimweg entdeckte Melanie einen jaulenden Hund am Straßenrand. In Eile brachte sie das verletzte Tier in die nächstgelegene Praxis. Der großzügige Tierarzt/Augenarzt versorgte die Wunde nach Feierabend kostenfrei. Als kleinen Ersatz/Obolus für die Arbeitszeit schickt sie dem Retter Wein und Pralinen. Der Arzt hatte nicht damit gerechnet, aber zeigte sich dankbar über die Aufmerksamkeit.
69
Für die Absolventen stand endlich die feierliche Zeugnisübergabe an. Während der Rede klingelte Karls Telefon und der ganze Saal erschrak. Das laute Bimmeln/Dröhnen sorgte für böse Blicke des Redners in Karls Richtung. Karl schämte sich für das Unglück/Maleur und stellte sein Telefon auf lautlos. Nach der Zeremonie sprach ihn seine Mutter erzürnt auf den Vorfall an.
Warum blickte der Redner böse in seine Richtung?
70
Kati hatte von ihrer Oma ein Plüschtier zum fünften Geburtstag bekommen. Tagsüber versteckte sie ihren geliebten Teddy an immer

neuen Orten. Ihre verhasste Cousine/Putzfrau sollte auf keinen Fall damit spielen können. Den großen Flügel/Tresor ihres Vaters hielt sie für ein zuverlässiges Versteck. Am Abend stellte Kati fest, dass ihr Teddy sehr schmutzig geworden war.
71
Lara war unter all ihren Freunden als besonders ehrgeizig bekannt. Dank ihres starken Willens siegte sie beim Marathon mit neuer Bestzeit. Die nächste Läuferin kam ganze zwei Minuten später über die Ziellinie. Stolz auf den Erfolg/Triumph buchte sie sich für den Folgetag eine Massage. Noch nie hatte sie so einen starken Muskelkater wie an diesem Tag gehabt.
72
Beteiligung am Haushalt spielte in der Erziehung eine wichtige Rolle. Jeden Abend spülte Lukas das Geschirr um sein Taschengeld zu bekommen. Der neue Schwamm/Löffel war sehr hilfreich beim Entfernen der Reste. Er kaufte sich einen kleinen Ritter/Kaktus von seinem fleißig verdienten Taschengeld. Als nächstes plante er, für einen neuen Fußball zu sparen.
73
Unter der Woche hielt Isabella sich mehr oder weniger streng an ihren Ernährungsplan. Am Wochenende ernährte sie sich ausschließlich von Chips und Alkohol. Mit großer Übelkeit/Euphorie verbrachte sie den Montag zwischen Bett und Bad. Aber ihr Streben/Kumpane motivierte sie im Laufe der Woche wieder, mehr auf ihren Körper und ihre Fitness zu achten. Dazu gehörte nicht nur regelmäßiges Kochen, sondern auch viel Sport und Bewegung.
74
Martin war an der Universität für seine Kochkünste bekannt gewesen. In der Cafeteria frittierte er jeden Tag überaus leckere Gerichte. Seine Spezialität Pommes/Spinat konnte er fast jeden zweiten Mittag servieren. Dennoch machte ihm die Arbeit/Einöde in der Cafeteria öfters zu schaffen. Als Kind hatte er immer davon geträumt, ein eigenes Restaurant zu besitzen.
Wann konnte seine Spezialität serviert werden?
75
Lina beobachtete gerne mit einer warmen Tasse Tee in der Hand die Tiere. Miris kurzes Fell glänzte schwarz und nicht wie üblich braun-weiß. Von den anderen Kühen/Vögeln unterschied sie sich damit bereits von Weitem. Auch ihre beiden Töchter/Knirpse hatten sichtlich Freude beim Beobachten der Geschöpfe. Sie freuten sich immer, wenn sie etwas Spannendes aus dem Fenster zu sehen bekamen.
76
Der Monteur hatte ein komisches Gefühl, als er am Einsatzort ankam. Er vergaß sein wichtigstes Werkzeug in der Firma und ärgerte sich sehr. Die neueste Heizung/Software konnte er so nicht installieren und fuhr zurück. Bei der ganzen Unruhe/Hektik passierten dem Monteur mehrere kleine Missgeschicke. Beim rückwärts Einparken am Einsatzort beschädigte er ein fremdes Auto.
77 FILLER
Nach einem langen Abend in der Kneipe machte sich Erik auf den Heimweg. Er fuhr nachts zu schnell mit seinem Rad und stürzte in einer Kurve. Mit kaputtem Licht musste er es dann vorsichtig nach Hause schieben. Niemals hätte er gedacht, dass ihm so ein Unfall/Unsegen passieren würde. Zu Hause angekommen, ließ er sich völlig durchgefroren ein heißes Bad ein.
78
Letzte Woche hatte Sarah ein erstes Date mit einem

Arbeitskollegen. Für das zweite Date überlegte sie sich etwas Besonderes für den Abend. Ein romantisches Picknick/Bankett auf dem Dach sollte das Treffen beschließen. Diesmal wollte sie aber auf Alkohol/Pastete verzichten. Sie kaufte stattdessen einen Traubensaft und bereitete einen Salat vor.
79
Martin war kein Mensch, der den Abend gerne vor dem Fernseher verbringt. Am späten Abend verbrannte er zwei Holzbretter in seiner Garage. Sein silbernes Feuerzeug/Klebeband war dabei ein sehr hilfreiches Werkzeug. Anschließend begoss er alles mit einer Lösung/Mixtur und beendete damit sein Projekt. Die handwerkliche Arbeit am Abend half ihm dabei, von seinem Alltag abzuschalten.
Was für eine Farbe hatte sein Werkzeug?
80
Ab acht Uhr konnten die Eltern ihre Kinder im Kindergarten abgeben. Jeden Abend um fünf Uhr füllten sich die Flure des Kindergartens. Dann wurden die Kleinen/Erzieher immer von ihren Eltern am Eingang abgeholt. Die Szene bereitete einem schon beim Ansehen/Zusehen ein ganz wohliges Gefühl. Die Gesichter der Kinder zauberten jedem ein Lächeln ins Gesicht.
81 FILLER
Der Alltag an der Universität war für Martin sehr stressig. Am Sonntag nahm der Dozent gerne Abstand vom Trubel unter der Woche. Alleine auf seiner Terrasse hörte er sich dann ein ruhiges Hörbuch an. Im Hintergrund hört er das schöne Fließen des Bachs. So konnte er in der Regel genug Kraft für die nächste Woche sammeln.
82
Jeden Sonntag machten die Müllers nach dem Abendessen einen Spieleabend. Auch die elfte Partie Schach in Folge verlor Mia gegen ihre Schwester. Sie schmiss die Figuren/Karten gegen die Wand und verließ wütend das Zimmer. Es ertönte lautes Brüllen/Gelärme aus ihrem Zimmer und sie knallte die Tür zu. Die Eltern beschlossen, den Spieleabend für diesen Sonntag zu beenden.
83
Peter fuhr seit langem wieder mal mit dem Bus zu seiner Schwester. Durch seine Sehschwäche konnte er den Fahrplan nur schwerlich lesen. Er nahm seine Brille/Linse, um die winzigen Ziffern besser erkennen zu können. Überrumpelt von den vielen Nummern/Kürzeln suchte er Hilfe bei dem Schaffner.
Mit der Unterstützung war er nun optimistisch, sein Ziel zu erreichen.
84
In der lokalen Kirchengemeinde gab es seit kurzem eine neue Leitung. Die öden Predigten des Pfarrers erlangten schnell regionale Bekanntheit. Zahlreiche Christen/Muslime hörten dennoch jeden Samstag Morgen aufmerksam zu. Zudem ließ er einige antike Rahmen/Ikonen restaurieren, um den Altar aufzuwerten. Die Gemeinde war von der Schönheit der Objekte begeistert und bedankte sich herzlich.
85
Am Wahltag werden die Stimmzettel zunächst in den Kabinen ausgefüllt. Am Ende sollten alle berechtigten Wähler ihre Stimmzettel einwerfen. Die großen Urnen/Töpfe standen dafür prominent neben dem Ausgang platziert. Plötzlich fiel ein Teller/Kiesel auf den Boden und erschreckte einige Wähler. Insgesamt verlief der Tag allerdings ziemlich ereignislos und konnte als Erfolg gewertet werden.

86 FILLER
Anja war nun seit drei Monaten mit ihrer Musik auf Tournee gewesen. Für ihr letztes Konzert hatte Anja sich etwas Besonderes überlegt. Mit ihren größten Klassikern wollte sie um Mitternacht furios enden. Sie erntete fulminanten Beifall und stand am Folgetag in der Zeitung.
87
Marie hatte den gesamten Nachmittag wegen des Missgeschicks geweint. Erleichtert fand Manuel den Ehering im Keller seiner Eltern wieder. Zwischen diverse Kisten/Tasten war er gefallen und dort kaum zu erkennen. Gleich daneben fand er Knochen/Relikte von den Expeditionen seines Vaters. Er fühlte sich zurückversetzt in Geschichten einer längst vergangenen Zeit.
88
Die Freunde machten wie jedes Jahr einen Abenteuerurlaub in den Alpen. Tim und Lars ruderten mit viel Anstrengung auf dem Fluss in den Bergen. Sie verloren ihre Paddel/Pfannen mitten auf dem Wasser und hingen nun fest. Durch die Wellen/Gischt gerieten sie langsam ins Schwanken.
Sie versuchten, das Gleichgewicht zu halten und das Boot zu retten.
Wo befand sich der Fluss?

Appendix G

Full GLMM Models for Experiment 3

Table G1

Full GLMM model for fixation probability as a function of reading speed (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	0.78	0.07	11.27	< .001
fixed		Speed1	-0.05	0.03	-2.12	.034
fixed		Speed2	-0.28	0.03	-10.96	< .001
fixed		Speed3	-0.27	0.02	-10.79	< .001
ran_pars	Page	SD (Intercept)	0.06			
ran_pars	Subject	SD (Intercept)	0.43			

Table G2

Full GLMM model for first fixation duration as a function of reading speed (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	198.85	1.69	117.35	< .001
fixed		Speed1	10.66	0.90	11.85	< .001
fixed		Speed2	-4.41	0.92	-4.80	< .001
fixed		Speed3	-5.35	0.93	-5.73	< .001
ran_pars	Page	SD (Intercept)	2.16			
ran_pars	Subject	SD (Intercept)	9.81			
ran_pars	Residual	SD Observation	0.35			

Table G3

Full GLMM model for gaze duration as a function of reading speed (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	227.50	3.05	74.69	< .001
fixed		Speed1	17.21	1.65	10.41	< .001
fixed		Speed2	-9.73	1.68	-5.80	< .001
fixed		Speed3	-10.77	1.69	-6.39	< .001
ran_pars	Page	SD (Intercept)	4.42			
ran_pars	Subject	SD (Intercept)	17.59			

effect	group	term	estimate	*SE*	*t*	*p*
ran_pars	Residual	SD Observation	0.47			

Table G4
Full GLMM model for total reading time as a function of reading speed (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	272.90	4.90	55.64	< .001
fixed		Speed1	3.99	2.29	1.74	.081
fixed		Speed2	-31.45	2.28	-13.82	< .001
fixed		Speed3	-20.87	2.24	-9.31	< .001
ran_pars	Page	SD (Intercept)	6.00			
ran_pars	Subject	SD (Intercept)	29.25			
ran_pars	Residual	SD Observation	0.54			

Table G5
Full GLMM model for refixation probability as a function of reading speed (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-1.82	0.08	-21.84	< .001
fixed		Speed1	0.07	0.04	1.92	.055
fixed		Speed2	-0.11	0.04	-2.99	.003
fixed		Speed3	-0.14	0.04	-3.66	< .001
ran_pars	Page	SD (Intercept)	0.09			
ran_pars	Subject	SD (Intercept)	0.50			

Table G6
Full GLMM model for regression-in probability as a function of reading speed (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-1.73	0.07	-26.35	< .001
fixed		Speed1	-0.10	0.02	-5.23	< .001
fixed		Speed2	-0.24	0.02	-11.04	< .001
fixed		Speed3	-0.19	0.03	-7.71	< .001
ran_pars	TrialNum	SD (Intercept)	0.01			

effect	group	term	estimate	*SE*	*z*	*p*
ran_pars	Subject	SD (Intercept)	0.41			

Table G7
Full GLMM model for fixation probability as a function of reading speed and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	0.49	0.08	6.44	< .001
fixed		Speed1	-0.05	0.03	-1.56	.118
fixed		Speed2	-0.26	0.03	-8.69	< .001
fixed		Speed3	-0.29	0.03	-9.88	< .001
fixed		baseline_rate	0.58	0.10	5.56	< .001
fixed		Speed1:baseline_rate	-0.02	0.03	-0.48	.629
fixed		Speed2:baseline_rate	-0.03	0.03	-1.02	.308
fixed		Speed3:baseline_rate	0.05	0.03	1.53	.127
ran_pars	Page	SD (Intercept)	0.06			
ran_pars	Subject	SD (Intercept)	0.33			

Table G8
Full GLMM model for first fixation duration as a function of reading speed and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	183.75	1.99	92.39	< .001
fixed		Speed1	10.32	1.08	9.56	< .001
fixed		Speed2	-5.43	1.12	-4.86	< .001
fixed		Speed3	-4.69	1.15	-4.08	< .001
fixed		baseline_rate	29.80	2.68	11.11	< .001
fixed		Speed1:baseline_rate	0.74	1.21	0.62	.538
fixed		Speed2:baseline_rate	2.01	1.26	1.59	.112
fixed		Speed3:baseline_rate	-1.28	1.31	-0.98	.328
ran_pars	Page	SD (Intercept)	2.17			
ran_pars	Subject	SD (Intercept)	7.98			

effect	group	term	estimate	*SE*	*t*	*p*
ran_pars	Residual	SD Observation	0.35			

Table G9

Full GLMM model for gaze duration as a function of reading speed and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	205.17	3.25	63.13	< .001
fixed		Speed1	14.32	1.88	7.61	< .001
fixed		Speed2	-11.06	1.92	-5.75	< .001
fixed		Speed3	-6.58	1.95	-3.37	< .001
fixed		baseline_rate	43.03	4.30	10.00	< .001
fixed		Speed1:baseline_rate	6.34	1.90	3.34	< .001
fixed		Speed2:baseline_rate	2.67	1.98	1.35	.177
fixed		Speed3:baseline_rate	-8.72	2.01	-4.34	< .001
ran_pars	Page	SD (Intercept)	4.45			
ran_pars	Subject	SD (Intercept)	12.87			
ran_pars	Residual	SD Observation	0.47			

Table G10

Full GLMM model for total reading time as a function of reading speed and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	232.77	4.69	49.67	< .001
fixed		Speed1	7.25	2.57	2.82	.005
fixed		Speed2	-26.59	2.58	-10.32	< .001
fixed		Speed3	-15.19	2.55	-5.96	< .001
fixed		baseline_rate	78.52	6.27	12.52	< .001
fixed		Speed1:baseline_rate	-7.38	2.75	-2.69	.007
fixed		Speed2:baseline_rate	-10.69	2.69	-3.98	< .001
fixed		Speed3:baseline_rate	-13.04	2.58	-5.06	< .001
ran_pars	Page	SD (Intercept)	6.04			

effect	group	term	estimate	*SE*	*t*	*p*
ran_pars	Subject	SD (Intercept)	18.92			
ran_pars	Residual	SD Observation	0.54			

Table G11
Full GLMM model for refixation probability as a function of reading speed and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-2.01	0.11	-18.63	< .001
fixed		Speed1	0.01	0.05	0.22	.823
fixed		Speed2	-0.15	0.05	-3.20	.001
fixed		Speed3	-0.13	0.05	-2.47	.013
fixed		baseline_rate	0.38	0.15	2.59	.010
fixed		Speed1:baseline_rate	0.10	0.05	2.12	.034
fixed		Speed2:baseline_rate	0.07	0.05	1.36	.173
fixed		Speed3:baseline_rate	-0.02	0.05	-0.36	.722
ran_pars	Page	SD (Intercept)	0.10			
ran_pars	Subject	SD (Intercept)	0.45			

Table G12
Full GLMM model for regression-in probability as a function of reading speed and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-1.82	0.09	-19.81	< .001
fixed		Speed1	-0.04	0.03	-1.48	.140
fixed		Speed2	-0.21	0.03	-6.24	< .001
fixed		Speed3	-0.19	0.04	-4.66	< .001
fixed		baseline_rate	0.17	0.13	1.37	.170
fixed		Speed1:baseline_rate	-0.09	0.04	-2.23	.026
fixed		Speed2:baseline_rate	-0.04	0.04	-0.91	.360
fixed		Speed3:baseline_rate	-0.01	0.05	-0.24	.813
ran_pars	TrialNum	SD (Intercept)	0.01			

effect	group	term	estimate	*SE*	*z*	*p*
ran_pars	Subject	SD (Intercept)	0.40			

Table G13
Full GLMM model for fixation probability as a function of reading speed and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	0.62	0.09	7.05	< .001
fixed		Speed1	-0.03	0.03	-1.08	.281
fixed		Speed2	-0.22	0.03	-7.21	< .001
fixed		Speed3	-0.26	0.03	-8.70	< .001
fixed		wm_capacity	0.34	0.12	2.71	.007
fixed		Speed1:wm_capacity	-0.05	0.03	-1.45	.146
fixed		Speed2:wm_capacity	-0.12	0.03	-3.69	< .001
fixed		Speed3:wm_capacity	-0.03	0.03	-0.89	.372
ran_pars	Page	SD (Intercept)	0.06			
ran_pars	Subject	SD (Intercept)	0.39			

Table G14
Full GLMM model for first fixation duration as a function of reading speed and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*statistic*	*p*
fixed		(Intercept)	191.03	2.21	86.30	< .001
fixed		Speed1	11.08	1.08	10.21	< .001
fixed		Speed2	-5.16	1.12	-4.63	< .001
fixed		Speed3	-5.04	1.13	-4.48	< .001
fixed		wm_capacity	16.18	3.08	5.25	< .001
fixed		Speed1:wm_capacity	-0.80	1.21	-0.66	.507
fixed		Speed2:wm_capacity	1.49	1.26	1.18	.238
fixed		Speed3:wm_capacity	-0.62	1.31	-0.48	.634
ran_pars	Page	SD (Intercept)	2.16			
ran_pars	Subject	SD (Intercept)	9.34			

effect	group	term	estimate	*SE*	*statistic*	*p*
ran_pars	Residual	SD Observation	0.35			

Table G15
Full GLMM model for gaze duration as a function of reading speed and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	214.04	3.82	55.97	< .001
fixed		Speed1	16.40	1.89	8.69	< .001
fixed		Speed2	-10.85	1.93	-5.63	< .001
fixed		Speed3	-9.63	1.92	-5.02	< .001
fixed		wm_capacity	27.49	5.27	5.21	< .001
fixed		Speed1:wm_capacity	1.78	1.90	0.94	.348
fixed		Speed2:wm_capacity	2.37	1.98	1.19	.232
fixed		Speed3:wm_capacity	-2.44	2.02	-1.21	.226
ran_pars	Page	SD (Intercept)	4.43			
ran_pars	Subject	SD (Intercept)	16.14			
ran_pars	Residual	SD Observation	0.47			

Table G16
Full GLMM model for total reading time as a function of reading speed and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	251.85	6.12	41.17	< .001
fixed		Speed1	3.62	2.63	1.38	.168
fixed		Speed2	-30.36	2.60	-11.68	< .001
fixed		Speed3	-18.95	2.52	-7.51	< .001
fixed		wm_capacity	42.81	8.53	5.02	< .001
fixed		Speed1:wm_capacity	0.76	2.74	0.28	.781
fixed		Speed2:wm_capacity	-2.26	2.68	-0.84	.399
fixed		Speed3:wm_capacity	-4.61	2.59	-1.78	.075
ran_pars	Page	SD (Intercept)	6.01			

effect	group	term	estimate	*SE*	*t*	*p*
ran_pars	Subject	SD (Intercept)	26.48			
ran_pars	Residual	SD Observation	0.54			

Table G17

Full GLMM model for refixation probability as a function of reading speed and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-1.96	0.11	-18.26	< .001
fixed		Speed1	0.04	0.04	0.86	.392
fixed		Speed2	-0.13	0.05	-2.77	.006
fixed		Speed3	-0.13	0.05	-2.70	.007
fixed		wm_capacity	0.31	0.15	2.05	.040
fixed		Speed1:wm_capacity	0.05	0.04	1.22	.222
fixed		Speed2:wm_capacity	0.03	0.05	0.61	.545
fixed		Speed3:wm_capacity	-0.02	0.05	-0.32	.749
ran_pars	Page	SD (Intercept)	0.09			
ran_pars	Subject	SD (Intercept)	0.47			

Table G18

Full GLMM model for regression-in probability as a function of reading speed and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-1.83	0.09	-20.30	< .001
fixed		Speed1	-0.10	0.03	-3.41	< .001
fixed		Speed2	-0.23	0.03	-7.22	< .001
fixed		Speed3	-0.21	0.04	-5.60	< .001
fixed		wm_capacity	0.19	0.13	1.48	.139
fixed		Speed1:wm_capacity	0.00	0.04	-0.09	.929
fixed		Speed2:wm_capacity	-0.01	0.04	-0.19	.853
fixed		Speed3:wm_capacity	0.03	0.05	0.55	.585
ran_pars	TrialNum	SD (Intercept)	0.01			

effect	group	term	estimate	*SE*	*z*	*p*
ran_pars	Subject	SD (Intercept)	0.40			

Table G19
Full GLMM model for fixation probability as a function of reading speed and word frequency (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	1.57	0.25	6.36	< .001
fixed		Speed1	-0.03	0.29	-0.09	.928
fixed		Speed2	-0.03	0.28	-0.09	.925
fixed		Speed3	-0.88	0.27	-3.26	.001
fixed		Frequency	0.88	0.29	3.04	.002
fixed		Speed1:Frequency	-0.23	0.40	-0.57	.568
fixed		Speed2:Frequency	-0.31	0.38	-0.81	.421
fixed		Speed3:Frequency	0.33	0.34	0.95	.341
ran_pars	Page	SD (Intercept)	0.47			
ran_pars	Subject	SD (Intercept)	0.74			

Table G20
Full GLMM model for first fixation duration as a function of reading speed and word frequency (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	202.66	6.08	33.33	< .001
fixed		Speed1	-0.29	6.54	-0.04	.964
fixed		Speed2	0.45	6.57	0.07	.945
fixed		Speed3	-12.26	6.81	-1.80	.072
fixed		Frequency	21.44	6.77	3.17	.002
fixed		Speed1:Frequency	-2.69	8.35	-0.32	.748
fixed		Speed2:Frequency	-4.60	8.35	-0.55	.582
fixed		Speed3:Frequency	9.41	8.63	1.09	.275
ran_pars	Page	SD (Intercept)	10.61			
ran_pars	Subject	SD (Intercept)	18.59			

effect	group	term	estimate	*SE*	*t*	*p*
ran_pars	Residual	SD Observation	0.32			

Table G21
Full GLMM model for gaze duration as a function of reading speed and word frequency (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	217.69	8.63	25.22	< .001
fixed		Speed1	-2.87	9.22	-0.31	.755
fixed		Speed2	8.99	9.28	0.97	.332
fixed		Speed3	-23.17	9.58	-2.42	.016
fixed		Frequency	38.51	9.45	4.08	< .001
fixed		Speed1:Frequency	-2.97	11.81	-0.25	.801
fixed		Speed2:Frequency	-20.58	11.71	-1.76	.079
fixed		Speed3:Frequency	16.52	11.93	1.38	.166
ran_pars	Page	SD (Intercept)	16.39			
ran_pars	Subject	SD (Intercept)	27.30			
ran_pars	Residual	SD Observation	0.40			

Table G22
Full GLMM model for total viewing time as a function of reading speed and word frequency (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	269.79	13.83	19.51	< .001
fixed		Speed1	-5.68	15.44	-0.37	.713
fixed		Speed2	-12.77	15.00	-0.85	.395
fixed		Speed3	-35.82	14.89	-2.41	.016
fixed		Frequency	63.52	14.80	4.29	< .001
fixed		Speed1:Frequency	-28.14	19.78	-1.42	.155
fixed		Speed2:Frequency	-24.02	18.43	-1.30	.193
fixed		Speed3:Frequency	-6.18	17.41	-0.36	.722
ran_pars	Page	SD (Intercept)	30.02			

effect	group	term	estimate	*SE*	*t*	*p*
ran_pars	Subject	SD (Intercept)	42.81			
ran_pars	Residual	SD Observation	0.49			

Table G23
Full GLMM model for refixation probability as a function of reading speed and word frequency (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-2.74	0.31	-8.96	< .001
fixed		Speed1	-0.15	0.31	-0.47	.638
fixed		Speed2	0.20	0.31	0.65	.516
fixed		Speed3	-0.60	0.35	-1.70	.090
fixed		Frequency	0.79	0.33	2.38	.017
fixed		Speed1:Frequency	0.04	0.37	0.10	.917
fixed		Speed2:Frequency	-0.38	0.38	-0.99	.322
fixed		Speed3:Frequency	0.45	0.43	1.04	.298
ran_pars	Page	SD (Intercept)	0.39			
ran_pars	Subject	SD (Intercept)	0.78			

Table G24
Full GLMM model for regresiion-in probability as a function of reading speed and word frequency (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-2.27	0.24	-9.39	< .001
fixed		Speed1	0.11	0.21	0.53	.599
fixed		Speed2	-0.13	0.22	-0.59	.553
fixed		Speed3	-0.58	0.31	-1.90	.057
fixed		Frequency	0.51	0.28	1.83	.068
fixed		Speed1:Frequency	-0.37	0.27	-1.39	.165
fixed		Speed2:Frequency	0.12	0.29	0.41	.680
fixed		Speed3:Frequency	0.29	0.38	0.77	.439
ran_pars	TrialNum	SD (Intercept)	0.27			

effect	group	term	estimate	*SE*	*z*	*p*
ran_pars	Subject	SD (Intercept)	0.42			

Table G25
Full GLMM model for fixation probability as a function of reading speed, word frequency, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	1.31	0.30	4.30	< .001
fixed		Speed1	-0.40	0.35	-1.14	.254
fixed		Speed2	0.00	0.34	-0.01	.990
fixed		Speed3	-0.87	0.33	-2.65	.008
fixed		Frequency	0.49	0.37	1.34	.180
fixed		baseline_rate	0.37	0.41	0.92	.360
fixed		Speed1:Frequency	0.15	0.50	0.30	.763
fixed		Speed2:Frequency	0.09	0.49	0.18	.861
fixed		Speed3:Frequency	-0.15	0.46	-0.32	.752
fixed		Frequency:baseline_rate	1.00	0.59	1.68	.093
fixed		Speed1:frqhigh frq:baseline_rate	0.89	0.49	1.82	.069
fixed		Speed2:frqhigh frq:baseline_rate	-0.01	0.51	-0.01	.991
fixed		Speed3:frqhigh frq:baseline_rate	-0.12	0.47	-0.25	.800
fixed		Speed1:Frequency:baseline_rate	0.00	0.67	-0.01	.995
fixed		Speed2:Frequency:baseline_rate	-0.99	0.59	-1.67	.095
fixed		Speed3:Frequency:baseline_rate	1.08	0.51	2.13	.033
ran_pars	Page	SD (Intercept)	0.47			
ran_pars	Subject	SD (Intercept)	0.60			

Table G26
Full GLMM model for first fixation duration as a function of reading speed, word frequency, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	200.52	8.05	24.91	< .001
fixed		Speed1	-5.13	8.41	-0.61	.542
fixed		Speed2	3.30	8.46	0.39	.697
fixed		Speed3	-5.74	8.99	-0.64	.523
fixed		Frequency	21.46	9.35	2.29	.022
fixed		wm_capacity	4.42	10.81	0.41	.683
fixed		Speed1:Frequency	0.96	11.52	0.08	.933
fixed		Speed2:Frequency	-7.84	11.37	-0.69	.491
fixed		Speed3:Frequency	11.15	11.79	0.95	.345
fixed		Frequency:wm_capacity	-1.63	13.22	-0.12	.902
fixed		Speed1:frqhigh frq:wm_capacity	9.47	11.16	0.85	.397
fixed		Speed2:frqhigh frq:wm_capacity	-5.16	11.35	-0.45	.649
fixed		Speed3:frqhigh frq:wm_capacity	-13.50	11.86	-1.14	.255
fixed		Speed1:Frequency:wm_capacity	2.10	11.83	0.18	.859
fixed		Speed2:Frequency:wm_capacity	1.15	11.82	0.10	.922
fixed		Speed3:Frequency:wm_capacity	-19.17	11.95	-1.60	.109
ran_pars	Page	SD (Intercept)	10.56			
ran_pars	Subject	SD (Intercept)	18.11			
ran_pars	Residual	SD Observation	0.32			

Appendix

Table G27

Full GLMM model for gaze duration as a function of reading speed, word frequency, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	203.30	10.78	18.85	< .001
fixed		Speed1	-13.09	11.67	-1.12	.262
fixed		Speed2	0.34	11.46	0.03	.976
fixed		Speed3	-16.26	12.00	-1.35	.176
fixed		Frequency	23.11	12.65	1.83	.068
fixed		baseline_rate	21.26	14.06	1.51	.130
fixed		Speed1:Frequency	-3.78	15.52	-0.24	.808
fixed		Speed2:Frequency	-5.65	15.15	-0.37	.709
fixed		Speed3:Frequency	6.20	15.80	0.39	.695
fixed		Frequency:baseline_rate	32.39	18.04	1.80	.073
fixed		Speed1:frqhigh frq:baseline_rate	23.66	14.88	1.59	.112
fixed		Speed2:frqhigh frq:baseline_rate	18.79	15.25	1.23	.218
fixed		Speed3:frqhigh frq:baseline_rate	-14.20	15.87	-0.89	.371
fixed		Speed1:Frequency:baseline_rate	25.31	17.00	1.49	.136
fixed		Speed2:Frequency:baseline_rate	-15.20	16.65	-0.91	.361
fixed		Speed3:Frequency:baseline_rate	6.04	16.35	0.37	.712
ran_pars	Page	SD (Intercept)	15.79			
ran_pars	Subject	SD (Intercept)	22.09			
ran_pars	Residual	SD Observation	0.39			

Table G28
Full GLMM model for total reading time as a function of reading speed, word frequency, and baseline reading rate (Experiment 3)

effect	group	term	*estimate*	*SE*	*t*	*p*
fixed		(Intercept)	234.92	16.25	14.46	< .001
fixed		Speed1	-0.85	18.70	-0.05	.964
fixed		Speed2	-33.64	17.94	-1.87	.061
fixed		Speed3	-21.97	17.78	-1.24	.217
fixed		Frequency	30.84	18.71	1.65	.099
fixed		baseline_rate	63.19	21.09	3.00	.003
fixed		Speed1:Frequency	-12.21	24.72	-0.49	.621
fixed		Speed2:Frequency	11.92	23.57	0.51	.613
fixed		Speed3:Frequency	-23.51	22.57	-1.04	.298
fixed		Frequency:baseline_rate	71.20	28.50	2.50	.012
fixed		Speed1:frqhigh frq:baseline_rate	-11.77	23.88	-0.49	.622
fixed		Speed2:frqhigh frq:baseline_rate	47.08	23.15	2.03	.042
fixed		Speed3:frqhigh frq:baseline_rate	-30.25	22.80	-1.33	.185
fixed		Speed1:Frequency:baseline_rate	-44.64	29.87	-1.49	.135
fixed		Speed2:Frequency:baseline_rate	-37.55	27.06	-1.39	.165
fixed		Speed3:Frequency:baseline_rate	8.73	24.04	0.36	.717
ran_pars	Page	SD (Intercept)	29.47			
ran_pars	Subject	SD (Intercept)	31.86			
ran_pars	Residual	SD Observation	0.48			

Table G29

Full GLMM model for refixation probability as a function of reading speed, word frequency, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-3.17	0.61	-5.17	< .001
fixed		Speed1	-0.65	0.46	-1.41	.158
fixed		Speed2	0.04	0.53	0.08	.939
fixed		Speed3	-1.25	0.81	-1.55	.122
fixed		Frequency	0.81	0.68	1.19	.236
fixed		baseline_rate	0.45	0.70	0.64	.521
fixed		Speed1:Frequency	0.28	0.60	0.47	.637
fixed		Speed2:Frequency	0.04	0.67	0.06	.949
fixed		Speed3:Frequency	0.89	0.93	0.96	.338
fixed		Frequency:baseline_rate	0.26	0.79	0.33	.744
fixed		Speed1:frqhigh frq:baseline_rate	0.96	0.59	1.64	.101
fixed		Speed2:frqhigh frq:baseline_rate	0.23	0.62	0.37	.712
fixed		Speed3:frqhigh frq:baseline_rate	0.78	0.88	0.88	.376
fixed		Speed1:Frequency:baseline_rate	0.37	0.49	0.76	.447
fixed		Speed2:Frequency:baseline_rate	-0.40	0.52	-0.77	.439
fixed		Speed3:Frequency:baseline_rate	0.27	0.58	0.47	.640
ran_pars	Page	SD (Intercept)	0.40			
ran_pars	Subject	SD (Intercept)	0.72			

Table G30
Full GLMM model for regression-in probability as a function of reading speed, word frequency, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-2.49	0.38	-6.64	< .001
fixed		Speed1	0.42	0.32	1.31	.190
fixed		Speed2	-0.21	0.31	-0.67	.500
fixed		Speed3	-0.69	0.47	-1.46	.144
fixed		Frequency	0.38	0.45	0.85	.397
fixed		baseline_rate	0.38	0.47	0.80	.422
fixed		Speed1:Frequency	-0.28	0.42	-0.67	.503
fixed		Speed2:Frequency	0.52	0.42	1.25	.212
fixed		Speed3:Frequency	0.11	0.58	0.18	.855
fixed		Frequency:baseline_rate	0.21	0.57	0.37	.714
fixed		Speed1:frqhigh frq:baseline_rate	-0.51	0.39	-1.30	.194
fixed		Speed2:frqhigh frq:baseline_rate	0.13	0.40	0.33	.744
fixed		Speed3:frqhigh frq:baseline_rate	0.18	0.60	0.30	.762
fixed		Speed1:Frequency:baseline_rate	-0.62	0.36	-1.72	.085
fixed		Speed2:Frequency:baseline_rate	-0.60	0.40	-1.52	.129
fixed		Speed3:Frequency:baseline_rate	0.55	0.48	1.15	.248
ran_pars	TrialNum	SD (Intercept)	0.28			
ran_pars	Subject	SD (Intercept)	0.42			

Table G31

Full GLMM model for fixation probability as a function of reading speed, word frequency, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	1.71	0.32	5.29	< .001
fixed		Speed1	-0.51	0.37	-1.40	.162
fixed		Speed2	-0.09	0.34	-0.26	.798
fixed		Speed3	-0.63	0.33	-1.91	.056
fixed		Frequency	0.37	0.38	0.98	.327
fixed		wm_capacity	-0.37	0.43	-0.86	.388
fixed		Speed1:Frequency	0.09	0.51	0.17	.865
fixed		Speed2:Frequency	0.77	0.52	1.49	.137
fixed		Speed3:Frequency	-0.48	0.49	-0.99	.321
fixed		Frequency:wm_capacity	1.03	0.60	1.72	.086
fixed		Speed1:frqhigh frq:wm_capacity	1.10	0.49	2.23	.026
fixed		Speed2:frqhigh frq:wm_capacity	0.23	0.52	0.44	.663
fixed		Speed3:frqhigh frq:wm_capacity	-0.67	0.48	-1.39	.163
fixed		Speed1:Frequency:wm_capacity	0.79	0.73	1.07	.284
fixed		Speed2:Frequency:wm_capacity	-2.52	0.68	-3.68	< .001
fixed		Speed3:Frequency:wm_capacity	1.00	0.52	1.94	.052
ran_pars	Page	SD (Intercept)	0.48			
ran_pars	Subject	SD (Intercept)	0.72			

Appendix

Table G32
Full GLMM model for first fixation duration as a function of reading speed, word frequency, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	192.28	7.96	24.17	< .001
fixed		Speed1	-7.87	8.49	-0.93	.354
fixed		Speed2	-1.38	8.48	-0.16	.871
fixed		Speed3	-8.49	9.03	-0.94	.347
fixed		Frequency	12.96	9.38	1.38	.167
fixed		baseline_rate	17.72	10.42	1.70	.089
fixed		Speed1:Frequency	-3.08	11.37	-0.27	.786
fixed		Speed2:Frequency	-4.75	11.28	-0.42	.674
fixed		Speed3:Frequency	0.81	11.89	0.07	.945
fixed		Frequency:baseline_rate	15.98	13.06	1.22	.221
fixed		Speed1:frqhigh frq:baseline_rate	16.20	11.05	1.47	.142
fixed		Speed2:frqhigh frq:baseline_rate	3.86	11.22	0.34	.731
fixed		Speed3:frqhigh frq:baseline_rate	-7.23	11.76	-0.62	.538
fixed		Speed1:Frequency:baseline_rate	17.26	11.68	1.48	.139
fixed		Speed2:Frequency:baseline_rate	3.32	11.66	0.28	.776
fixed		Speed3:Frequency:baseline_rate	8.53	11.77	0.73	.468
ran_pars	Page	SD (Intercept)	10.41			
ran_pars	Subject	SD (Intercept)	16.01			
ran_pars	Residual	SD Observation	0.31			

Table G33
Full GLMM model for gaze duration as a function of reading speed, word frequency, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	212.01	10.99	19.30	< .001
fixed		Speed1	-15.43	11.46	-1.35	.178
fixed		Speed2	18.14	11.55	1.57	.116
fixed		Speed3	-22.04	12.16	-1.81	.070
fixed		Frequency	34.33	12.55	2.74	.006
fixed		wm_capacity	8.14	14.66	0.55	.579
fixed		Speed1:Frequency	-1.46	15.53	-0.09	.925
fixed		Speed2:Frequency	-23.98	15.11	-1.59	.113
fixed		Speed3:Frequency	29.27	15.62	1.87	.061
fixed		Frequency:wm_capacity	7.13	18.27	0.39	.696
fixed		Speed1:frqhigh frq:wm_capacity	28.44	15.03	1.89	.059
fixed		Speed2:frqhigh frq:wm_capacity	-21.12	15.40	-1.37	.170
fixed		Speed3:frqhigh frq:wm_capacity	-1.51	15.99	-0.09	.925
fixed		Speed1:Frequency:wm_capacity	24.52	17.16	1.43	.153
fixed		Speed2:Frequency:wm_capacity	-11.10	16.97	-0.65	.513
fixed		Speed3:Frequency:wm_capacity	-34.34	16.76	-2.05	.040
ran_pars	Page	SD (Intercept)	16.21			
ran_pars	Subject	SD (Intercept)	25.35			
ran_pars	Residual	SD Observation	0.39			

Table G34
Full GLMM model for total reading time as a function of reading speed, word frequency, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	254.79	16.98	15.00	< .001
fixed		Speed1	-18.88	18.71	-1.01	.313
fixed		Speed2	-9.70	18.06	-0.54	.591
fixed		Speed3	-30.92	18.14	-1.70	.088
fixed		Frequency	33.23	19.00	1.75	.080
fixed		wm_capacity	27.08	22.28	1.22	.224
fixed		Speed1:Frequency	-3.01	25.47	-0.12	.906
fixed		Speed2:Frequency	-9.58	23.84	-0.40	.688
fixed		Speed3:Frequency	-14.66	22.45	-0.65	.514
fixed		Frequency:wm_capacity	64.86	28.84	2.25	.025
fixed		Speed1:frqhigh frq:wm_capacity	30.31	24.15	1.26	.209
fixed		Speed2:frqhigh frq:wm_capacity	-8.66	23.50	-0.37	.713
fixed		Speed3:frqhigh frq:wm_capacity	-10.70	23.07	-0.46	.643
fixed		Speed1:Frequency:wm_capacity	-23.33	29.92	-0.78	.436
fixed		Speed2:Frequency:wm_capacity	-39.77	27.45	-1.45	.147
fixed		Speed3:Frequency:wm_capacity	9.42	24.76	0.38	.704
ran_pars	Page	SD (Intercept)	30.26			
ran_pars	Subject	SD (Intercept)	38.43			
ran_pars	Residual	SD Observation	0.49			

Table G35
Full GLMM model for refixation probability as a function of reading speed, word frequency, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-3.20	0.53	-6.05	< .001
fixed		Speed1	-0.64	0.48	-1.34	.180
fixed		Speed2	0.70	0.49	1.44	.149
fixed		Speed3	-1.47	0.66	-2.22	.026
fixed		Frequency	1.23	0.59	2.08	.038
fixed		wm_capacity	0.75	0.63	1.20	.230
fixed		Speed1:Frequency	-0.21	0.63	-0.34	.735
fixed		Speed2:Frequency	-0.66	0.67	-0.97	.330
fixed		Speed3:Frequency	1.73	0.79	2.19	.029
fixed		Frequency:wm_capacity	-0.56	0.72	-0.77	.439
fixed		Speed1:frqhigh frq:wm_capacity	0.83	0.59	1.41	.158
fixed		Speed2:frqhigh frq:wm_capacity	-0.83	0.60	-1.38	.167
fixed		Speed3:frqhigh frq:wm_capacity	1.31	0.76	1.71	.087
fixed		Speed1:Frequency:wm_capacity	1.09	0.52	2.10	.036
fixed		Speed2:Frequency:wm_capacity	-0.29	0.56	-0.52	.605
fixed		Speed3:Frequency:wm_capacity	-0.63	0.56	-1.12	.264
ran_pars	Page	SD (Intercept)	0.42			
ran_pars	Subject	SD (Intercept)	0.68			

Table G36

Full GLMM model for regression-in probability as a function of reading speed, word frequency, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*statistic*	*p*
fixed		(Intercept)	-1.97	0.31	-6.45	< .001
fixed		Speed1	0.03	0.29	0.10	.919
fixed		Speed2	-0.37	0.32	-1.18	.240
fixed		Speed3	-0.19	0.40	-0.48	.629
fixed		Frequency	-0.01	0.37	-0.02	.984
fixed		wm_capacity	-0.69	0.48	-1.45	.147
fixed		Speed1:Frequency	0.02	0.38	0.06	.955
fixed		Speed2:Frequency	0.66	0.41	1.62	.106
fixed		Speed3:Frequency	-0.34	0.49	-0.70	.486
fixed		Frequency:wm_capacity	1.07	0.57	1.86	.063
fixed		Speed1:frqhigh frq:wm_capacity	0.20	0.39	0.51	.612
fixed		Speed2:frqhigh frq:wm_capacity	0.44	0.40	1.09	.278
fixed		Speed3:frqhigh frq:wm_capacity	-0.86	0.61	-1.41	.158
fixed		Speed1:Frequency:wm_capacity	-0.54	0.36	-1.51	.131
fixed		Speed2:Frequency:wm_capacity	-0.71	0.41	-1.74	.081
fixed		Speed3:Frequency:wm_capacity	0.55	0.48	1.14	.255
ran_pars	TrialNum	SD (Intercept)	0.28			
ran_pars	Subject	SD (Intercept)	0.41			

Table G37
Full GLMM model for fixation probability as a function of reading speed and plausibility (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	1.61	0.22	7.18	< .001
fixed		Speed1	0.04	0.26	0.17	.868
fixed		Speed2	-0.29	0.26	-1.12	.262
fixed		Speed3	-0.36	0.25	-1.46	.145
fixed		Plausibility	0.66	0.27	2.45	.014
fixed		Speed1:Plausibility	-0.84	0.37	-2.29	.022
fixed		Speed2:Plausibility	0.18	0.33	0.54	.589
fixed		Speed3:Plausibility	-0.06	0.31	-0.19	.853
ran_pars	Page	SD (Intercept)	0.38			
ran_pars	Subject	SD (Intercept)	0.71			

Table G38
Full GLMM model for first fixation duration as a function of reading speed and plausibility (Experiment 3)

effect	group	term	estimate	*SE*	*statistic*	*p*
fixed		(Intercept)	203.34	5.96	34.15	< .001
fixed		Speed1	6.16	6.46	0.95	.340
fixed		Speed2	-5.30	6.67	-0.80	.426
fixed		Speed3	-1.36	6.81	-0.20	.841
fixed		Plausibility	6.80	6.32	1.07	.283
fixed		Speed1:Plausibility	-3.08	7.99	-0.39	.700
fixed		Speed2:Plausibility	4.00	8.19	0.49	.625
fixed		Speed3:Plausibility	-1.84	8.16	-0.23	.822
ran_pars	Page	SD (Intercept)	11.61			
ran_pars	Subject	SD (Intercept)	18.17			
ran_pars	Residual	SD Observation	0.30			

Table G39
Full GLMM model for gaze duration as a function of reading speed and plausibility (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	223.58	8.63	25.91	< .001
fixed		Speed1	16.05	9.24	1.74	.082
fixed		Speed2	-9.44	9.58	-0.99	.325
fixed		Speed3	-6.61	9.63	-0.69	.493
fixed		Plausibility	15.92	8.78	1.81	.070
fixed		Speed1:Plausibility	-18.19	11.20	-1.62	.104
fixed		Speed2:Plausibility	14.56	11.54	1.26	.207
fixed		Speed3:Plausibility	-5.83	11.39	-0.51	.609
ran_pars	Page	SD (Intercept)	17.39			
ran_pars	Subject	SD (Intercept)	28.55			
ran_pars	Residual	SD Observation	0.38			

Table G40
Full GLMM model for total reading time as a function of reading speed and plausibility (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	262.65	12.97	20.26	< .001
fixed		Speed1	21.20	14.47	1.47	.143
fixed		Speed2	-39.56	14.62	-2.71	.007
fixed		Speed3	-18.62	14.02	-1.33	.184
fixed		Plausibility	113.56	14.82	7.66	< .001
fixed		Speed1:Plausibility	-124.21	19.89	-6.25	< .001
fixed		Speed2:Plausibility	20.34	18.00	1.13	.258
fixed		Speed3:Plausibility	-2.73	16.77	-0.16	.871
ran_pars	Page	SD (Intercept)	26.49			
ran_pars	Subject	SD (Intercept)	43.29			
ran_pars	Residual	SD Observation	0.48			

Table G41
Full GLMM model for refixation probability as a function of reading speed and plausibility (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-2.59	0.29	-8.84	< .001
fixed		Speed1	0.32	0.30	1.07	.283
fixed		Speed2	-0.24	0.30	-0.79	.432
fixed		Speed3	-0.19	0.33	-0.57	.566
fixed		Plausibility	0.63	0.31	2.00	.045
fixed		Speed1:Plausibility	-0.92	0.39	-2.36	.018
fixed		Speed2:Plausibility	0.81	0.39	2.05	.040
fixed		Speed3:Plausibility	-0.12	0.40	-0.31	.759
ran_pars	Page	SD (Intercept)	0.41			
ran_pars	Subject	SD (Intercept)	0.84			

Table G42
Full GLMM model for regression-in probability as a function of reading speed and plausibility (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-1.95	0.23	-8.44	< .001
fixed		Speed1	-0.37	0.21	-1.74	.082
fixed		Speed2	-0.19	0.26	-0.72	.469
fixed		Speed3	0.00	0.31	0.01	.992
fixed		Plausibility	0.39	0.27	1.49	.138
fixed		Speed1:Plausibility	0.14	0.27	0.52	.606
fixed		Speed2:Plausibility	-0.23	0.32	-0.72	.471
fixed		Speed3:Plausibility	-0.09	0.38	-0.23	.821
ran_pars	TrialNum	SD (Intercept)	0.21			
ran_pars	Subject	SD (Intercept)	0.42			

Table G43
Full GLMM model for fixation probability as a function of reading speed, plausibility, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	1.25	0.29	4.35	< .001
fixed		Speed1	-0.09	0.33	-0.28	.777
fixed		Speed2	-0.21	0.33	-0.65	.516
fixed		Speed3	-0.55	0.31	-1.77	.076
fixed		Plausibility	0.48	0.35	1.37	.171
fixed		baseline_rate	0.69	0.39	1.76	.078
fixed		Speed1:Plausibility	-0.43	0.46	-0.93	.354
fixed		Speed2:Plausibility	0.20	0.45	0.45	.651
fixed		Speed3:Plausibility	0.04	0.43	0.10	.918
fixed		Plausibility:baseline_rate	0.69	0.59	1.17	.241
fixed		Speed1:plausibleplausible:baseline_rate	0.28	0.45	0.63	.526
fixed		Speed2:plausibleplausible:baseline_rate	-0.16	0.45	-0.35	.729
fixed		Speed3:plausibleplausible:baseline_rate	0.41	0.43	0.96	.336
fixed		Speed1:Plausibility:baseline_rate	-0.96	0.65	-1.48	.139
fixed		Speed2:Plausibility:baseline_rate	-0.22	0.46	-0.47	.639
fixed		Speed3:Plausibility:baseline_rate	0.20	0.43	0.47	.641
ran_pars	Page	SD (Intercept)	0.37			
ran_pars	Subject	SD (Intercept)	0.63			

Table G44
Full GLMM model for first fixation duration as a function of reading speed, plausibility, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	182.31	7.54	24.17	< .001
fixed		Speed1	10.56	8.22	1.28	.199
fixed		Speed2	-10.10	8.40	-1.20	.229

effect	group	term	estimate	*SE*	*t*	*p*
fixed		Speed3	-1.39	8.71	-0.16	.873
fixed		Plausibility	0.60	8.56	0.07	.944
fixed		baseline_rate	39.43	9.81	4.02	< .001
fixed		Speed1:Plausibility	-5.96	10.68	-0.56	.577
fixed		Speed2:Plausibility	9.46	11.12	0.85	.395
fixed		Speed3:Plausibility	-12.32	11.20	-1.10	.271
fixed		Plausibility:baseline_rate	13.93	12.31	1.13	.258
fixed		Speed1:plauplausible:baseline_rate	-8.59	10.39	-0.83	.408
fixed		Speed2:plauplausible:baseline_rate	9.55	10.80	0.88	.377
fixed		Speed3:plauplausible:baseline_rate	-0.53	11.29	-0.05	.963
fixed		Speed1:Plausibility:baseline_rate	-3.78	11.14	-0.34	.734
fixed		Speed2:Plausibility:baseline_rate	-0.61	11.09	-0.05	.956
fixed		Speed3:Plausibility:baseline_rate	21.97	10.96	2.00	.045
ran_pars	Page	SD (Intercept)	11.38			
ran_pars	Subject	SD (Intercept)	14.95			
ran_pars	Residual	SD Observation	0.30			

Table G45
Full GLMM model for gaze duration as a function of reading speed, plausibility, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	193.98	10.55	18.39	< .001
fixed		Speed1	20.77	11.40	1.82	.069
fixed		Speed2	-15.16	11.69	-1.30	.195
fixed		Speed3	-3.69	11.89	-0.31	.757

effect	group	term	estimate	*SE*	*t*	*p*
fixed		Plausibility	11.61	11.57	1.00	.316
fixed		baseline_rate	53.51	13.86	3.86	< .001
fixed		Speed1:Plausibility	-17.27	14.52	-1.19	.235
fixed		Speed2:Plausibility	11.46	15.10	0.76	.448
fixed		Speed3:Plausibility	-5.13	15.11	-0.34	.734
fixed		Plausibility:baseline_rate	10.81	17.19	0.63	.529
fixed		Speed1:plauplausible: baseline_rate	-10.27	14.53	-0.71	.480
fixed		Speed2:plauplausible: baseline_rate	12.40	15.30	0.81	.418
fixed		Speed3:plauplausible: baseline_rate	-6.35	15.67	-0.41	.685
fixed		Speed1:Plausibility: baseline_rate	-14.52	15.72	-0.92	.356
fixed		Speed2:Plausibility: baseline_rate	18.86	15.54	1.21	.225
fixed		Speed3:Plausibility: baseline_rate	-6.21	15.39	-0.40	.687
ran_pars	Page	SD (Intercept)	17.23			
ran_pars	Subject	SD (Intercept)	22.88			
ran_pars	Residual	SD Observation	0.38			

Table G46
Full GLMM model for total reading time as a function of reading speed, plausibility, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	214.95	14.93	14.40	< .001
fixed		Speed1	25.14	17.22	1.46	.144
fixed		Speed2	-28.96	17.56	-1.65	.099
fixed		Speed3	-21.54	16.98	-1.27	.205
fixed		Plausibility	102.68	18.61	5.52	< .001
fixed		baseline_rate	96.14	20.03	4.80	< .001

effect	group	term	estimate	*SE*	*t*	*p*
fixed		Speed1:Plausibility	-104.52	24.50	-4.27	< .001
fixed		Speed2:Plausibility	-8.12	22.57	-0.36	.719
fixed		Speed3:Plausibility	22.73	21.53	1.06	.291
fixed		Plausibility:baseline_rate	17.34	29.25	0.59	.553
fixed		Speed1:plauplausible: baseline_rate	-18.01	23.18	-0.78	.437
fixed		Speed2:plauplausible: baseline_rate	-26.93	23.05	-1.17	.243
fixed		Speed3:plauplausible: baseline_rate	13.99	21.99	0.64	.525
fixed		Speed1:Plausibility: baseline_rate	-51.35	31.05	-1.65	.098
fixed		Speed2:Plausibility: baseline_rate	35.70	25.09	1.42	.155
fixed		Speed3:Plausibility: baseline_rate	-47.96	23.48	-2.04	.041
ran_pars	Page	SD (Intercept)	26.48			
ran_pars	Subject	SD (Intercept)	30.38			
ran_pars	Residual	SD Observation	0.47			

Table G47

Full GLMM model for refixation probability as a function of reading speed, plausibility, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-3.45	0.52	-6.65	< .001
fixed		Speed1	0.92	0.52	1.77	.077
fixed		Speed2	-0.45	0.49	-0.91	.361
fixed		Speed3	-0.20	0.60	-0.34	.736
fixed		Plausibility	1.30	0.59	2.22	.027
fixed		baseline_rate	1.42	0.59	2.39	.017
fixed		Speed1:Plausibility	-1.32	0.69	-1.91	.056

effect	group	term	estimate	*SE*	*z*	*p*
fixed		Speed2:Plausibility	0.43	0.70	0.62	.538
fixed		Speed3:Plausibility	0.74	0.76	0.98	.329
fixed		Plausibility:baseline_rate	-0.94	0.69	-1.36	.174
fixed		Speed1:plauplausible:baseline_rate	-0.86	0.59	-1.47	.142
fixed		Speed2:plauplausible:baseline_rate	0.31	0.57	0.56	.578
fixed		Speed3:plauplausible:baseline_rate	0.00	0.68	0.00	.998
fixed		Speed1:Plausibility:baseline_rate	-0.33	0.58	-0.58	.563
fixed		Speed2:Plausibility:baseline_rate	0.80	0.61	1.32	.187
fixed		Speed3:Plausibility:baseline_rate	-1.20	0.56	-2.12	.034
ran_pars	Page	SD (Intercept)	0.42			
ran_pars	Subject	SD (Intercept)	0.73			

Table G48
Full GLMM model for regression-in probability as a function of reading speed, plausibility, and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-2.29	0.41	-5.62	< .001
fixed		Speed1	-0.44	0.35	-1.27	.203
fixed		Speed2	-0.03	0.39	-0.09	.932
fixed		Speed3	-0.43	0.54	-0.80	.425
fixed		Plausibility	0.52	0.47	1.10	.272
fixed		baseline_rate	0.53	0.49	1.09	.274
fixed		Speed1:Plausibility	0.38	0.42	0.90	.368
fixed		Speed2:Plausibility	-0.67	0.51	-1.33	.184
fixed		Speed3:Plausibility	0.21	0.67	0.32	.749
fixed		Plausibility:baseline_rate	-0.14	0.57	-0.25	.799
fixed		Speed1:plauplausible: baseline_rate	0.11	0.42	0.25	.802
fixed		Speed2:plauplausible: baseline_rate	-0.25	0.50	-0.51	.612
fixed		Speed3:plauplausible: baseline_rate	0.65	0.66	0.99	.322

effect	group	term	estimate	*SE*	*z*	*p*
fixed		Speed1:Plausibility: baseline_rate	-0.32	0.33	-0.98	.327
fixed		Speed2:Plausibility: baseline_rate	0.50	0.41	1.21	.225
fixed		Speed3:Plausibility: baseline_rate	0.23	0.48	0.48	.631
ran_pars	TrialNum	SD (Intercept)	0.21			
ran_pars	Subject	SD (Intercept)	0.41			

Table G49

Full GLMM model for fixation probability as a function of reading speed, plausibility, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	1.26	0.28	4.48	< .001
fixed		Speed1	0.01	0.31	0.03	.975
fixed		Speed2	0.11	0.33	0.34	.737
fixed		Speed3	-0.52	0.32	-1.63	.104
fixed		Plausibility	0.63	0.35	1.84	.066
fixed		wm_capacity	0.82	0.41	1.99	.046
fixed		Speed1:Plausibility	-0.60	0.45	-1.35	.178
fixed		Speed2:Plausibility	0.11	0.44	0.25	.800
fixed		Speed3:Plausibility	0.07	0.43	0.15	.877
fixed		Plausibility:wm_capacity	0.13	0.58	0.22	.823
fixed		Speed1:plausibleplausible:wm_capacity	-0.03	0.47	-0.07	.947
fixed		Speed2:plausibleplausible:wm_capacity	-0.88	0.46	-1.93	.054
fixed		Speed3:plausibleplausible:wm_capacity	0.35	0.43	0.82	.414
fixed		Speed1:Plausibility: wm_capacity	-0.59	0.63	-0.93	.352
fixed		Speed2:Plausibility: wm_capacity	-0.78	0.48	-1.64	.101

effect	group	term	estimate	*SE*	*z*	*p*
fixed		Speed3:Plausibility: wm_capacity	0.02	0.43	0.05	.957
ran_pars	Page	SD (Intercept)	0.37			
ran_pars	Subject	SD (Intercept)	0.66			

Table G50

Full GLMM model for first fixation duration as a function of reading speed, plausibility, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	190.11	7.72	24.61	< .001
fixed		Speed1	8.98	8.42	1.07	.286
fixed		Speed2	-2.49	8.59	-0.29	.772
fixed		Speed3	-6.97	8.64	-0.81	.420
fixed		Plausibility	8.02	8.70	0.92	.357
fixed		wm_capacity	27.38	10.23	2.68	.007
fixed		Speed1:Plausibility	-2.99	11.00	-0.27	.786
fixed		Speed2:Plausibility	-4.15	11.21	-0.37	.711
fixed		Speed3:Plausibility	4.49	11.12	0.40	.686
fixed		Plausibility:wm_capacity	-2.15	12.40	-0.17	.862
fixed		Speed1:plauplausible: wm_capacity	-5.77	10.52	-0.55	.583
fixed		Speed2:plauplausible: wm_capacity	-6.77	10.94	-0.62	.536
fixed		Speed3:plauplausible: wm_capacity	12.19	11.35	1.07	.283
fixed		Speed1:Plausibility: wm_capacity	-6.39	11.19	-0.57	.568
fixed		Speed2:Plausibility: wm_capacity	10.92	11.16	0.98	.328
fixed		Speed3:Plausibility: wm_capacity	-0.62	11.05	-0.06	.955
ran_pars	Page	SD (Intercept)	11.55			
ran_pars	Subject	SD (Intercept)	17.40			

effect	group	term	estimate	*SE*	*t*	*p*
ran_pars	Residual	SD Observation	0.30			

Table G51
Full GLMM model for gaze duration as a function of reading speed, plausibility, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	202.54	10.77	18.80	< .001
fixed		Speed1	23.05	11.62	1.98	.047
fixed		Speed2	-12.42	11.88	-1.05	.296
fixed		Speed3	-7.75	11.67	-0.66	.507
fixed		Plausibility	21.56	11.67	1.85	.065
fixed		wm_capacity	41.27	14.50	2.85	.004
fixed		Speed1:Plausibility	-24.99	15.00	-1.67	.096
fixed		Speed2:Plausibility	3.61	15.12	0.24	.811
fixed		Speed3:Plausibility	3.83	14.74	0.26	.795
fixed		Plausibility:wm_capacity	-11.04	17.27	-0.64	.523
fixed		Speed1:plauplausible: wm_capacity	-14.82	14.68	-1.01	.313
fixed		Speed2:plauplausible: wm_capacity	6.03	15.53	0.39	.698
fixed		Speed3:plauplausible: wm_capacity	2.19	15.83	0.14	.890
fixed		Speed1:Plausibility: wm_capacity	-1.85	15.65	-0.12	.906
fixed		Speed2:Plausibility: wm_capacity	30.96	15.70	1.97	.049
fixed		Speed3:Plausibility: wm_capacity	-17.72	15.65	-1.13	.257
ran_pars	Page	SD (Intercept)	17.35			
ran_pars	Subject	SD (Intercept)	26.38			

effect	group	term	estimate	*SE*	*t*	*p*
ran_pars	Residual	SD Observation	0.38			

Table G52
Full GLMM model for total reading time as a function of reading speed, plausibility, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	227.73	15.86	14.36	< .001
fixed		Speed1	28.24	18.04	1.57	.117
fixed		Speed2	-36.70	18.03	-2.04	.042
fixed		Speed3	-23.92	16.63	-1.44	.150
fixed		Plausibility	135.36	20.03	6.76	< .001
fixed		wm_capacity	72.95	21.55	3.39	< .001
fixed		Speed1:Plausibility	-150.19	26.99	-5.56	< .001
fixed		Speed2:Plausibility	2.71	23.30	0.12	.907
fixed		Speed3:Plausibility	18.38	21.39	0.86	.390
fixed		Plausibility:wm_capacity	-48.46	29.31	-1.65	.098
fixed		Speed1:plauplausible: wm_capacity	-19.14	23.29	-0.82	.411
fixed		Speed2:plauplausible: wm_capacity	-5.49	23.54	-0.23	.816
fixed		Speed3:plauplausible: wm_capacity	13.95	22.45	0.62	.534
fixed		Speed1:Plausibility: wm_capacity	41.95	30.85	1.36	.174
fixed		Speed2:Plausibility: wm_capacity	28.09	25.38	1.11	.269
fixed		Speed3:Plausibility: wm_capacity	-32.13	23.97	-1.34	.180
ran_pars	Page	SD (Intercept)	26.08			
ran_pars	Subject	SD (Intercept)	39.21			
ran_pars	Residual	SD Observation	0.48			

Table G53
Full GLMM model for refixation probability as a function of reading speed, plausibility, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-3.49	0.53	-6.61	< .001
fixed		Speed1	1.54	0.59	2.61	.009
fixed		Speed2	-1.30	0.55	-2.36	.018
fixed		Speed3	0.66	0.61	1.09	.276
fixed		Plausibility	1.39	0.60	2.31	.021
fixed		wm_capacity	1.50	0.60	2.49	.013
fixed		Speed1:Plausibility	-2.26	0.72	-3.13	.002
fixed		Speed2:Plausibility	1.20	0.73	1.64	.101
fixed		Speed3:Plausibility	-0.44	0.77	-0.57	.568
fixed		Plausibility:wm_capacity	-1.02	0.71	-1.45	.148
fixed		Speed1:plauplausible:wm_capacity	-1.66	0.65	-2.55	.011
fixed		Speed2:plauplausible:wm_capacity	1.54	0.62	2.48	.013
fixed		Speed3:plauplausible:wm_capacity	-1.20	0.69	-1.73	.084
fixed		Speed1:Plausibility:wm_capacity	0.18	0.56	0.32	.752
fixed		Speed2:Plausibility:wm_capacity	0.95	0.60	1.57	.116
fixed		Speed3:Plausibility:wm_capacity	-0.71	0.57	-1.24	.215
ran_pars	Page	SD (Intercept)	0.41			
ran_pars	Subject	SD (Intercept)	0.67			

Table G54
Full GLMM model for regression-in probability as a function of reading speed, plausibility, and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	-2.08	0.33	-6.28	< .001
fixed		Speed1	-0.51	0.32	-1.58	.113
fixed		Speed2	0.19	0.35	0.53	.593
fixed		Speed3	-0.39	0.43	-0.91	.362

effect	group	term	estimate	*SE*	*z*	*p*
fixed		Plausibility	0.66	0.38	1.73	.084
fixed		wm_capacity	0.29	0.45	0.64	.521
fixed		Speed1:Plausibility	0.38	0.39	0.97	.334
fixed		Speed2:Plausibility	-0.90	0.47	-1.93	.054
fixed		Speed3:Plausibility	0.63	0.54	1.17	.243
fixed		Plausibility:wm_capacity	-0.56	0.53	-1.06	.287
fixed		Speed1:plauplausible: wm_capacity	0.24	0.41	0.57	.566
fixed		Speed2:plauplausible: wm_capacity	-0.79	0.51	-1.56	.120
fixed		Speed3:plauplausible: wm_capacity	0.87	0.62	1.40	.161
fixed		Speed1:Plausibility: wm_capacity	-0.21	0.33	-0.63	.527
fixed		Speed2:Plausibility: wm_capacity	0.52	0.40	1.29	.197
fixed		Speed3:Plausibility: wm_capacity	-0.62	0.46	-1.35	.178
ran_pars	TrialNum	SD (Intercept)	0.21			
ran_pars	Subject	SD (Intercept)	0.42			

Table G55
Full GLMM model for text comprehension as a function of reading speed (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	69.89	1.86	37.64	< .001
fixed		Speed1	-4.80	2.87	-1.67	.094
fixed		Speed2	-1.39	2.52	-0.55	.579
fixed		Speed3	-4.14	2.38	-1.74	.082
ran_pars	Subject	SD (Intercept)	7.52			
ran_pars	Residual	SD Observation	0.27			

Table G56
Full GLMM model for text comprehension as a function of reading speed, pairwise comparisons with baseline condition (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	69.89	1.86	37.64	< .001
fixed		Speed1	-4.80	2.87	-1.67	.094
fixed		Speed2	-1.39	2.52	-0.55	.579
fixed		Speed3	-4.14	2.38	-1.74	.082
ran_pars	Subject	SD (Intercept)	7.52			
ran_pars	Residual	SD Observation	0.27			

Table G57
Full GLMM model for text comprehension as a function of reading speed and baseline reading rate (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	71.50	2.68	26.64	< .001
fixed		Speed1	-1.95	4.17	-0.47	.640
fixed		Speed2	3.74	3.48	1.07	.283
fixed		Speed3	-1.49	3.56	-0.42	.676
fixed		baseline_rate	-3.09	3.70	-0.84	.404
fixed		Speed1:baseline_rate	-5.24	5.70	-0.92	.358
fixed		Speed2:baseline_rate	-9.68	4.98	-1.94	.052
fixed		Speed3:baseline_rate	-4.92	4.75	-1.03	.301
ran_pars	Subject	SD (Intercept)	7.52			
ran_pars	Residual	SD Observation	0.26			

Table G58
Full GLMM model for text comprehension as a function of reading speed and working memory capacity (Experiment 3)

effect	group	term	estimate	*SE*	*t*	*p*
fixed		(Intercept)	73.43	2.61	28.16	< .001
fixed		Speed1	-0.25	4.18	-0.06	.952
fixed		Speed2	5.06	3.45	1.46	.143
fixed		Speed3	-1.06	3.58	-0.29	.768

effect	group	term	estimate	*SE*	*t*	*p*
fixed		wm_capacity	-7.24	3.62	-2.00	.045
fixed		Speed1:wm_capacity	-8.38	5.68	-1.47	.141
fixed		Speed2:wm_capacity	-12.21	4.97	-2.46	.014
fixed		Speed3:wm_capacity	-5.75	4.74	-1.21	.225
ran_pars	Subject	SD (Intercept)	7.12			
ran_pars	Residual	SD Observation	0.26			

Table G57
Full GLMM model for fixation probability as a function of reading speed and word position in paragraph (Experiment 3)

effect	group	term	estimate	*SE*	*z*	*p*
fixed		(Intercept)	0.30	0.02	19.07	< .001
fixed		Speed1	0.01	0.01	1.75	.080
fixed		Speed2	0.05	0.01	8.11	< .001
fixed		Speed3	0.05	0.01	8.47	< .001
fixed		Word pos	0.00	0.00	3.68	< .001
fixed		Speed1:word pos	0.00	0.00	0.01	.988
fixed		Speed2:word pos	0.00	0.00	0.64	.520
fixed		Speed3:word pos	0.00	0.00	1.20	.231
ran_pars	trial_ID	SD (Intercept)	0.02			
ran_pars	Subject	SD (Intercept)	0.09			
ran_pars	Residual	SD Observation	0.45			