Changing the Narrative: Leveraging Dyslexic Strengths through Narrative Information Formats

Eefje van Moorsel

SNR: 2092370

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Tilburg University, Tilburg

Supervisor: Dr. Renske van Enschot

Second reader: Dr. Jan de Wit

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Technology statement

For this thesis, I used Grammarly to check spelling and grammar. Moreover, I used AI programs

ChatGPT and Consensus.app.

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perspectives.

Abstract

This study aimed to utilize the strengths of people with dyslexia better, to increase reading comprehension. As textual- and verbovisual narratives arguable adhere to the natural processing mode of people with dyslexia, this study tried to determine if these two narrative types could increase reading comprehension compared to expository text. Moreover, it is examined if test anxiety and self-efficacy mediated the possible effect on reading comprehension. Participants, people with dyslexia >18 years old (N = 51), were randomly assigned to one of the three conditions (expository text, textual narrative, and verbovisual narrative). Test anxiety (state and trait), self-efficacy, reading comprehension, and narrative reasoning were measured. Serial and simple mediation analyses were performed to answer the RQ. Results show that textual narratives scored significantly higher than verbovisual narratives in reading comprehension overall and when focussing on participants with intermediate and high English proficiency. Moreover, participants in the expository text condition scored significantly higher than those in the verbovisual narrative condition regarding reading comprehension when all English proficiency levels (basic, intermediate, and fluent) were included. These findings are contrary to the hypothesis, as it was expected that reading comprehension would be highest for verbovisual narratives, followed by textual narrative, and lastly, expository text. Additionally, the data did not support the anticipated serial mediation through test anxiety and self-efficacy (H2). However, the positive relationship between self-efficacy and reading comprehension was confirmed (H2c). The study suggests caution in using visuals for individuals with dyslexia and emphasizes the need for future research on enhancing self-efficacy in people with dyslexia.

Keywords: Dyslexia, reading comprehension, narratives, narrative reasoning, multimedia, test anxiety, self-efficacy

Changing the narrative: Leveraging Dyslexic Strengths through Narrative Information Formats

Dyslexia is a learning disorder marked by challenges in reading and spelling and has consistently been addressed with a predominantly negative, deficit-centred perspective (Bartlett et al., 2010; de Beer et al., 2014). People with dyslexia (PwD) show alarming statistics related to the academic and professional careers, such as higher rates of high school dropouts (Olofsson et al., 2015; Tops et al., 2021), overrepresentation in the prison population (Al-Lamki, 2012; Lindgren et al., 2002), and workplace discrimination (Alexander-Passe & Head of Learning Support, Mill Hill School, London., 2015). Moreover, research shows low self-efficacy (Gosiewska-Turek, 2022; Hen & Goroshit, 2014; Nalavany et al., 2018; Stagg et al., 2018), and poor skills in reading comprehension (Georgiou et al., 2022). However, it is crucial to recognize that PwD also possess unique strengths. However, limited research is done on how the strengths of PwD can be utilized in reading comprehension.

In Eide & Eide's (2023) book 'The Dyslexic Advantage' different strengths of PwD are explored. One strength that is important for this study, is narrative reasoning. This can be defined as a thinking style in which information is often retained scene-based, in narratives or examples, frequently derived from personal experiences (Haines & Wright, 2023; Nesbit et al., 2016). However, examining the empirical evidence in the book of Eide and Eide and scholarly articles, little to no research confirms this strength.

Nonetheless, empirical evidence addresses strengths of PwD, which could make narratives an effective way of processing information for them. Firstly, PwD often employ a holistic thinking style (Stein, 2001, 2022; Tso et al., 2021; von Károlyi et al., 2003; Williams & Casanova, 2010). Holistic thinking involves perceiving and comprehending complex situations as interconnected systems, considering multiple variables and their relationships, and anticipating how events will unfold by contemplating the interconnected systems (McIntyre, 1998; Stein, 2001, 2022; Xia et al., 2023). This closely relates to how narratives are built. Narratives provide a broader context with interconnected variables such as events and characters, which together form 'the bigger picture', the storyline

(Dahlstrom & Ho, 2012; Mar et al., 2021). This holistic thinking style that PwD often possess could indicate that individuals with dyslexia better understand narratives than other text types.

Secondly, narratives respond to another strength: the visual thinking style of PwD (Bacon & Handley, 2010; R. D. Davis & Braun, 2011; Duranovic et al., 2015; West, 2009). According to a study, PwD use visual memory as a compensatory resource for their deficits in verbal processing (Bacon & Handley, 2014). Narratives are claimed to evoke mental imagery (Brosch, 2018; Chang, 2013; Clark & Van Der Wege, 2015; Green, 2006), which can manifest in visual mental imagery (Boccia et al., 2015). Concluding, narratives arguably adhere to the natural thinking style of PwD, facilitating narrative reasoning, holistic thinking and allowing for visual imagery.

Building on this, recent meta-analyses highlight the broader benefits of narratives, indicating that narratives are generally more effectively memorized and understood than expository text (Clinton et al., 2020; Mar et al., 2021). Enhanced comprehension holds particular promise in aiding PwD, as research shows reading comprehension is a deficit in PwD (Georgiou et al., 2022; Ransby & Lee Swanson, 2003). Besides textual narratives, studies have shown that PwD benefit from graphic novels and comics in terms of memory and comprehension (Hallenbeck, 1976; Smith et al., 2021; Themelis & Sime, z.d.; Toh et al., 2017; Wong et al., 2023). Research argues that verbovisual narratives (e.g., graphic novels and comics) benefit reading comprehension by offering a less demanding reading experience, extracting meaning from text and images (Wong et al., 2023). The exposure to images besides text may be especially beneficial for PwD as they experience heightened reading anxiety (Carroll & Iles, 2006) and test anxiety (Nelson et al., 2015). Lastly, verbovisual narratives benefit from multimedia (incooperating text and images), enhancing learning (Mayer, 2003).

Despite their unique strengths, PwD often grapple with low self-esteem and self-efficacy (Boetsch et al., 1996; Cameron, 2016; Carroll & Iles, 2006). Self-efficacy, coined by Bandura, pertains to an individual's confidence to successfully complete a task (Bandura, 1989; Zulkosky, 2009). To build self-efficacy, Bandura (1982) poses four strategies, including mastery experience (success experiences of your own) and physiological state management (predicting performance based on physiological states

such as anxiety). Self-efficacy is often low in PwD, especially academic self-efficacy (Stagg et al., 2018).
When self-efficacy is low, individuals may experience increased anxiety and poorer academic
achievements (Bandura, 1982; Barrows et al., 2013; Muris, 2002). The increased reading anxiety may
impact test anxiety, which in turn may impact self-efficacy through psychological state management.
Moreover, self-efficacy predicts performance, aligning with the findings that reading self-efficacy
predicts reading comprehension (E et al., 2019; Solheim, 2011; Tobing, 2013).

As narratives conceivably adhere to the natural processing of PwD, allowing for narrative
reasoning (Eide & Eide, 2023), and visual- (Bacon & Handley, 2010)and holistic thinking (Tso et al.,
2021), it is plausible that narratives build self-efficacy through mastery experiences (Bandura, 1982).
Verbovisual narratives can potentially enhance this effect. Verbovisual narratives rely less on the
deficit of PwD by adopting a multimedia approach, creating a less demanding reading experience
(Wong et al., 2023). Therefore, verbovisual narratives can enhance reading comprehension by
providing visual aids to guide the reader through the story on a non-verbal level, creating success
experiences (mastery experience). Moreover, increased self-efficacy can increase reading
comprehension (E et al., 2019; Solheim, 2011; Tobing, 2013). As current research has not yet focussed
on the potential of verbovisual and textual narratives on reading comprehension and the potential
(serial) mediating role of test anxiety and self-efficacy, this research poses the following research
question:

RQ: "How do textual and verbovisual narratives, as opposed to expository text, influence reading
comprehension among individuals with dyslexia, and to what extent do test anxiety and self-efficacy
(serially) mediate this effect?"

Figure 1

Conceptual modal
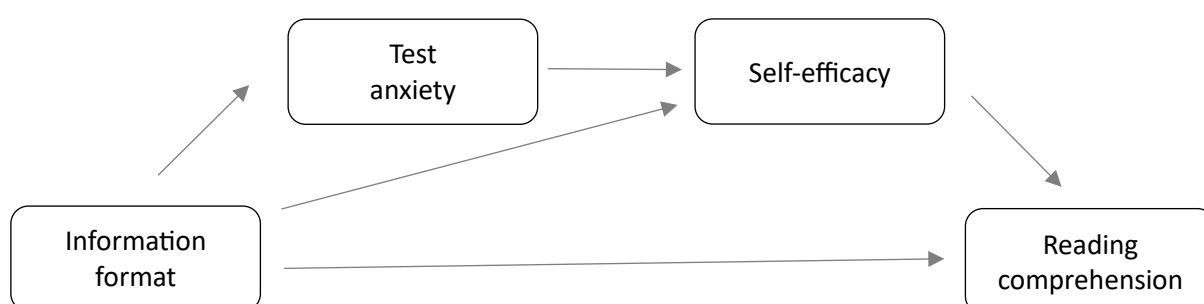
Theoretical Framework

In this theoretical framework, first, dyslexia and the accompanying strengths and weaknesses will be explained, followed by information format (IV) and test anxiety (MED 1) and self-efficacy (MED 2). Moreover, this study aims to add to the body of literature relating to narrative reasoning in people with dyslexia (PwD) by summarizing current findings.

Dyslexia

Dyslexia, the most prevalent learning disability, constitutes 80% of all learning disabilities (Lerner, 1989), and finds its origin in the brain (Eden & Moats, 2002; Kuhl et al., 2020). The most well-known difficulty is problems with reading and writing. Many attribute these problems to weaknesses in phonological skills, which is the ability to identify, articulate, and arrange letters within a word and the skill to divide words into their sound components (Bartlett et al., 2010; de Beer et al., 2014; Miller-Guron & Lundberg, 2000). This results in problems with reading, spelling (Bartlett et al., 2010; Ransby & Lee Swanson, 2003), and specifically important for this study, a deficit in reading comprehension (Georgiou et al., 2022). Furthermore, another deficit of PwD is weaker working memory (Bartlett et al., 2010; Perez et al., 2012; Ransby & Lee Swanson, 2003; Snowling, 2012). These deficits have consequences for academic performance, as PwD generally attain lower grades than their peers (Riddick et al., 1999), and have a higher dropout rate in school (Olofsson et al., 2015; Tops et al., 2021). Consequently, feelings of low self-efficacy (Gosiewska-Turek, 2022; Hen & Goroshit, 2014; Nalavany et al., 2018; Stagg et al., 2018), reading anxiety (Carroll & Iles, 2006) and test anxiety (Nelson et al., 2015) are often present in PwD.

Reading Comprehension

The deficit in reading comprehension in PwD is a secondary effect of dyslexia (Georgiou et al., 2022). Reading comprehension means extracting meaning from written text and connecting the new knowledge to previous knowledge (Duke et al., 2011; Pourhosein Gilakjani & Sabouri, 2016). Dyslexia negatively impacts skills needed for reading comprehension (e.g., phonological processing, word recognition, and working memory (Booth et al., 2000; Bruck, 1993; Castles & Friedmann, 2014; de

Oliveira et al., 2014; Smith-Spark, 2018; Smith-Spark & Fisk, 2007; Snowling, 2012; Vellutino et al., 2004)), resulting in problems with reading comprehension (Georgiou et al., 2022).

Strengths

Given the deficit in reading comprehension in PwD, it is interesting to examine how the strengths of PwD can be used to reduce or even eliminate the deficits. Therefore, three strengths of PwD are now discussed, starting with holistic thinking. Holistic thinking refers to processing information as an interconnected whole (McIntyre, 1998). A small body of research indicates that PwD operate a holistic thinking style (Stein, 2001, 2022; Tso et al., 2021; von Károlyi et al., 2003; Williams & Casanova, 2010). Concerning reading, Tso et al. (2021) found that PwD processes Chinese characters more holistically than people without dyslexia, indicating this holistic approach is also employed while reading. However, more research is needed to determine how this relates to reading comprehension and expand the literature on holistic thinking in PwD.

Secondly, PwD have strong visual mental imagery skills (hereafter referred to as 'visual imagery'). Research has found that this visual imagery is at the core of how PwD reason, while non-dyslexics seem to adopt more abstract, verbal strategies (Bacon & Handley, 2010; R. D. Davis & Braun, 2011; Duranovic et al., 2015; West, 2009). This aligns with a study showing that PwD, more often than people without dyslexia, used visual aids, such as making drawings, as a study strategy (Andreassen et al., 2017). The study also showed that PwD perceived these visual aids as more beneficial than peers without dyslexia.

Lastly, the book of Eide and Eide (2023) refers to narrative reasoning as a strength of PwD. Narrative reasoning entails processing information through stories, in which plots, characters, scene-based experiences, and vivid examples are central (Eide & Eide, 2023; Singer & Bluck, 2001). Eide and Eide (2023) pose that the strong narrative reasoning abilities of people with dyslexia stem from a superior functioning episodic memory of people with dyslexia, and therefore describe it as follows: "Individuals who rely on episodic or narrative concepts will typically reason, remember, and learn better using examples and illustrations rather than abstract concept" (p. 143). In line with this

reasoning, a study shows that PwD relied more on episodic memory (via episodic cues) in retrieving memories than people without dyslexia. These episodic cues can be aided via contextual information in a text, which supports memory retrieval in PwD (Calabrich et al., 2021). However, this contradicts earlier research stating a deficit in episodic long-term memory in PwD (Menghini et al., 2010). As there is a small research body related to narrative reasoning in PwD, and contradicting results on the role of episodic memory in PwD, more research is needed to investigate this strength. However, the (possible) strengths in PwD in holistic thinking, visual imagery, and narrative reasoning are potentially beneficial to reading comprehension in narrative texts over expository texts. However, no research has yet been done to explore these links.

Information Format

Expository Text vs Narrative Texts

Narratives should be distinguished from expository texts when exploring them. The goal of an expository text is often to inform (Brewer & Lichtenstein, 1980; Mar et al., 2021; Mosenthal, 1985). They provide information in a direct manner, such as in essays or textbooks (Weaver III & Kintsch, 1991), and are often used in educational environments (Duffelmeyer, 1994; Resnick, 2018). Narratives often have the goal of entertaining (Brewer & Lichtenstein, 1980; Mar et al., 2021; Mosenthal, 1985) but can be used in instruction and learning as well (Darejeh et al., 2021; Hiver et al., 2020; Mosenthal, 1985). Typically, narratives involve a central character (protagonist) motivated to undertake purposeful actions to achieve a specific goal (Black & Bower, 1980; Mar et al., 2021; Mosenthal, 1985; Thorndyke, 1977). Moreover, narratives involve a storyline where events unfold chronologically (Mar et al., 2021). They often use concrete language that allows for visual imagery, whereas expository texts use more abstract language (Berman & Nir-sagiv, 2007). Narratives can be split into textual narratives and verbovisual narratives. Textual narratives use text to convey information, while verbovisual narratives employ a multimodal approach incorporating text and images (Saraceni, 2001).

Expository Text vs Narratives: Effect On Reading Comprehension

Expository text and textual narratives can affect reading comprehension differently. Meta-analyses show robust findings that narratives are better understood and remembered than text (Clinton et al., 2020; Mar et al., 2021). Several arguments are posed for this beneficial effect. Firstly, narratives are considered at the core of human reasoning (Fisher, 2021; Stroud, 2016) as narratives closely relate to our everyday lives (Dochy et al., 1999). This makes it easier to relate to the events, understand the relationships between events (Mar et al., 2021), and facilitates narrative understanding and building mental models (Green et al., 2004). Moreover, narratives elicit emotions (Dunlop et al., 2008; Schoeller & Perlovsky, 2015), and emotions enhance memory (Bagri & Jones, 2018; Hamann, 2001). Especially interesting for this research regarding emotions is that narratives are effective for relaxation (Catani et al., 2009; Goßler et al., 2022). As PwD struggle with reading- and test anxiety, narratives may have a calming effect as opposed to expository text. In the research endeavours relating to the relaxation effect of narratives, mental imagery has been used to facilitate relaxation, as narratives evoke mental imagery (Clark & Van Der Wege, 2015; Green, 2006) and do so more than expository text (Brewer, 1988). This is especially interesting as PwD are skilled in visual imagery (Bacon & Handley, 2010; R. D. Davis & Braun, 2011; Duranovic et al., 2015; West, 2009), and previous research indicates that people who are skilled in mental imagery performed better on narrative comprehension than people with lower mental imagery skills (Boerma et al., 2016).

When further exploring how narratives are processed, research suggests that narratives are processed more holistically than other sorts of text (Adaval & Wyer, 1998; Spector-Mersel, 2011). According to Adaval & Wyer (1998), once a mental representation of a narrative is formed, it is perceived as a cohesive whole, with individual components no longer considered independently. As explained earlier, holistic thinking is a strength of PwD. The interconnected, chronological narrative structure arguably allows for holistic processing of narratives. However, as the holistic processing of narratives and holistic thinking of PwD have been investigated separately, they seem to have an unexplored link that deserves exploration.

Textual Narrative vs Verbovisual Narrative: Effect On Reading Comprehension

Considering the differential effects of verbovisual and textual narratives on cognition, Mayer (2003) showed that students achieve a deeper level of learning when they have access to both text and images than text alone. Combining text and images is called multimedia learning (Mayer, 2002, 2003, 2014). Additionally, the study by Mayer (2003) found that students grasp information more effectively when written words are positioned close to, rather than distant from, the related images. Lastly, students achieve a deeper comprehension when information is presented in an informal and conversational style, in contrast to a more formal tone (Mayer, 2003). Therefore, Mayer's (2003) research suggests that a verbovisual narrative, where words are positioned near images, and the tone of voice is conversational, can benefit reading comprehension. This is in line with the earlier findings of Avadal and Wyer (1998), who found that images that support events in a narrative can facilitate building a mental representation of the narrative. Another study had a similar finding, stating that readers who struggle with comprehension, such as people with dyslexia, especially benefit from visual images that support the text (Hibbing & Rankin-Erickson, 2003). In summary, incorporating images alongside text can enhance comprehension as the reader can extract meaning from text and images, creating a less demanding reading experience (Wong et al., 2023), which is especially beneficial for PwD.

Concluding, a deficit in reading comprehension is a secondary effect of dyslexia (Georgiou et al., 2022), as PwD struggle with cognitive processes involved with reading comprehension (Booth et al., 2000; Bruck, 1993; Castles & Friedmann, 2014; de Oliveira et al., 2014; Smith-Spark, 2018; Smith-Spark & Fisk, 2007; Snowling, 2012; Vellutino et al., 2004). Narratives have shown to benefit comprehension and memory due to its content and structure (Clinton et al., 2020; Mar et al., 2021). The holistic thinking strength of PwD (Stein, 2001, 2022; Tso et al., 2021; von Károlyi et al., 2003; Williams & Casanova, 2010) may enhance this beneficial effect of narratives on comprehension and memory, as narratives are often processed holistically (Adaval & Wyer, 1998). Additionally, the yet underexplored possible strength of narrative reasoning may benefit PwD in processing narratives. Moreover, PwD employ a visual thinking style (Bacon & Handley, 2010; R. D. Davis & Braun, 2011;

Duranovic et al., 2015; West, 2009), and as narratives can evoke (visual) mental imagery (Clark & Van Der Wege, 2015; Green, 2006), they can align with the visual thinking style of PwD. As a study showed that people skilled in mental imagery perform better at narrative comprehension than those poorly skilled in mental imagery (Boerma et al., 2016), narratives seem particularly useful for PwD to increase their reading comprehension. Verbovisual narratives seem to enhance this advantageous effect of narratives by incorporating a multimedia approach, allowing for deeper learning (Mayer, 2003). Moreover, verbovisual narratives create a less demanding reading experience as the reader can extract meaning from both texts as images. Based on these findings, the following hypothesis is proposed:

H1: *PwD's reading comprehension is highest for verbovisual narratives, followed by textual narratives, and lowest in expository texts.*

Self-Efficacy And Test Anxiety

When defining the relationship between information format and reading comprehension, considering self-efficacy is crucial, as a meta-analysis shows a significant association between self-efficacy and reading comprehension (Shehzad & Rawian, 2019). Moreover, self-efficacy positively predicts academic performance (Byars-Winston et al., 2017; Dixson et al., 2016; Elias & Loomis, 2002; Manzano-Sanchez et al., 2018; Zajacova et al., 2005). Therefore, the question arises of how self-efficacy manifests in PwD.

Self-efficacy was coined by Albert Bandura (Bandura, 1977) and is the belief in oneself to complete a specific task successfully (Bandura, 1982; Bandura & Bandura, 2006). It reflects the perceived capabilities rather than the actual performances (Bandura & Bandura, 2006) and can vary per construct based on personal experiences (Bandura, 1982). Self-efficacy can influence learning domains, such as effort and determination during challenging situations (Bandura, 1993). When someone believes in their capabilities, they will put more effort into meeting the challenges (Bandura, 1982), and perseverance often results in accomplishments (Bandura, 1982, 1989).

However, when someone feels like the materials are too easy and self-efficacy beliefs are very high, they will likely put less effort into the task (Bandura, 1982).

Self-efficacy in PwD is under-researched. However, studies indicate low levels of self-efficacy among PwD or people with learning disabilities in general (Gosiewska-Turek, 2022; Hen & Goroshit, 2014; Nalavany et al., 2018; Stagg et al., 2018). This manifests in different fields, including low academic self-efficacy (Stagg et al., 2018). Related to self-efficacy, PwD experience high reading anxiety, which is a predictor of reading self-efficacy (Edwards et al., 2023). Another study found low academic self-concept in pupils with dyslexia compared to peers without (Polychroni et al., 2006). Note that academic self-concept is a broader term and refers to the overall belief of oneself as a student. In contrast, self-efficacy refers to one own capability of accomplishing a specific academic task (Jansen et al., 2015). Although the body of research regarding self-efficacy levels and dyslexia remains limited, these studies are concerning as they indicate low levels of self-efficacy in PwD.

Self-efficacy predicts reading comprehension (Cho et al., 2021; Solheim, 2011; Tobing, 2013) and academic performance (Byars-Winston et al., 2017; Dixson et al., 2016; Elias & Loomis, 2002; Manzano-Sanchez et al., 2018; Zajacova et al., 2005), and as PwD struggle with reading comprehension (Georgiou et al., 2022), it is interesting to examine how self-efficacy can be built, to facilitate reading comprehension. According to research, self-efficacy can be built in four ways (Bandura, 1982; Hagger et al., 2020). 'Mastery experiences' is the most influential way (Bandura, 1982; Fletcher, 2005), and refers to success experiences of your own that provide the most trustworthy validation of your abilities (Bandura, 1982). Therefore, when creating a learning environment tailored to the learner's strengths, it is plausible this will positively influence their mastery experience and, consequently, contribute to the development of self-efficacy. This can be supported by a study by Andreassen et al. (2017), who showed that PwD, more often than people without dyslexia, used visual aids, such as making drawings, as a study strategy. This aligns with their strength of visual thinking. PwD perceived these visual aids as more beneficial than peers without dyslexia (Andreassen et al., 2017). This could indicate that PwD built self-efficacy through mastery

experience by consulting visual aids during studying. Although there is little research on the effects of a learning environment that supports the learner's strengths on self-efficacy, it is plausible to assume that it will enhance self-efficacy through mastery experiences.

Physiological state management is the second most influential factor influencing self-efficacy (Fletcher, 2005). This refers to ascribing a physiological state (e.g., arousal, sweating) to the feeling of self-efficacy (Bandura, 1982; Schunk, 1987). Anxiety is a physiological state, and the effect of anxiety on performance in tests is negative (Ali et al., 2023; Barrows et al., 2013; Chapell et al., 2005; H. A. Davis et al., 2008; Shin et al., 2023). This study focusses on test anxiety, as test scores are crucial in academic achievements. Research underscores the importance of supporting PwD in test settings, as PwD often attain lower grades than people without dyslexia (Richardson, 2010). However, as tests often require extensive reading, and reading anxiety during a test can contribute to overall test anxiety, reading anxiety is also considered but not measured in this study. Studies show higher general levels of anxiety in PwD (Carroll & Iles, 2006) or poor readers such as PwD (Francis et al., 2019). Additionally, another study indicated that PwD are at risk of higher anxiety in specific contexts such as school (Novita, 2016). More specifically, PwD report high reading anxiety (Carroll & Iles, 2006), and reading anxiety is a predictor of reading self-efficacy (Edwards et al., 2023). Additionally, research shows higher test anxiety in students with dyslexia compared to students without dyslexia (Nelson et al., 2015). Concluding previous research, concerns are drawn to anxiety in examination settings for PwD, as PwD express higher test anxiety, anxiety in school settings, and reading anxiety compared to non-dyslexic peers.

Summarizing the findings of self-efficacy and test anxiety, it becomes evident that higher self-efficacy in PwD can contribute to reading comprehension, as academic self-efficacy is a predictor of academic performance (Chemers et al., 2001). As self-efficacy can be built, among other things, through mastery experience and physiological state management (Bandura, 1982), this study aims to examine how the strengths of people with dyslexia can be used to increase reading comprehension through building self-efficacy. Studies have shown a negative relationship between anxiety and self-

efficacy (Ali et al., 2023; Barrows et al., 2013; Chapell et al., 2005; H. A. Davis et al., 2008; Shin et al., 2023), and a positive relationship between self-efficacy and reading comprehension (Shehzad & Rawian, 2019). Therefore, decreasing test anxiety before taking a test could increase self-efficacy and reading comprehension. The relaxing effect of narratives can decrease test anxiety compared to expository texts (Catani et al., 2009; Goßler et al., 2022). Verbovisual narratives can possibly further decrease this anxiety, as PwD experience reading anxiety, and a verbovisual narrative places less emphasis on reading as text and images are combined (Wong et al., 2023). Moreover, self-efficacy can be enhanced through mastery experience by creating a learning environment that adheres to the strengths of PwD (holistic- (Tso et al., 2021) and visual thinking (Bacon & Handley, 2010) and narrative reasoning (Eide & Eide, 2023)), possibly meaning that textual narratives enhance self-efficacy through mastery experience. Verbovisual narratives enhance this effect by aiding the learner with visual cues (images), making it possibly easier to comprehend the information than text alone. Moreover, PwD find visual aids beneficial in their learning (Andreassen et al., 2017), aligning with their visual thinking style and possibly enhancing the mastery experience. Lastly, self-efficacy is expected to increase reading comprehension. Therefore, the empirical evidence provided leads to the following hypotheses for this study:

H2: *The effect of information format on reading comprehension is serially mediated through test anxiety and self-efficacy.*

H2a: *People with dyslexia will feel highest self-efficacy in the verbovisual narrative, followed by textual narrative and lastly expository text.*

H2b: *The effect of information format on self-efficacy will be mediated through text anxiety, PwD experience the highest test anxiety in the expository text, followed by the textual narrative, the verbovisual narrative respectively and test anxiety affects self-efficacy negatively.*

H2c: *Self-efficacy will positively predict reading comprehension.*

Method

Design

This research employed a quantitative study with a 3x1 between-subject design. Participants were randomly assigned to a condition (expository text vs. textual narrative vs. verbovisual narrative). The independent variable is information format, mediators are self-efficacy and test anxiety, and reading comprehension is the dependent variable.

The study was conducted in collaboration with fellow student Judith Tanta Nova, who aims to determine the effect of an (interactive) narrative information format on intrinsic motivation and reading comprehension. Therefore, the expository text and textual narrative have been developed in collaboration with Judith Novia Tanta, as well as the information letter, preliminary questions, demographic questions, pre-test familiarity long COVID and the reading comprehension test. The study has been approved by the ethical committee of Tilburg University, identification code REDC2020.172e.

Participants

The participants in this study comprised dyslexic individuals aged 18 years or older. The study aimed for a medium effect size (f^2 = 0.15) and a desired power level of 0.80, resulting in a minimum of 77 participants (alfa level of 0.05). 51 participants completed the survey (N = 51), of whom 22 were male and 29 were female. Therefore, the study was underpowered, which draws attention to careful interpretation of the results since a type 2 error is more plausible. The attrition rate was high, around 50%, combining this study and the study of Judith Novia Tanta. One participant in the verbovisual condition finalized the survey in 2 minutes and 45 seconds, which is improbably fast. Therefore, this participant is removed before analysis. Participants were recruited through non-probability convenience sampling methods, utilizing the Human Subject Pool of Tilburg University where participants received 0.5 credit for their participation. Moreover, the researchers' and the supervisors' networks were approached via social media. Lastly, participants were recruited via flyers distributed at Tilburg University. Regarding familiarity with long COVID, 94.1% of the participants

knew what long covid was, 13.7% experienced it themselves, 39.2% knew someone in their surroundings with long covid, and 39.2% had investigated what is was.

In total, 20 participants participated in the 'expository text' condition, 11 in the 'textual narrative' condition, and 20 in the 'verbovisual narrative' condition. Due to privacy regulations, only age (M = 18-34), gender (22 male, 29 female), English proficiency level (basic = 21.6%, intermediate = 51%, fluent = 27.5%) , and education level (highschool = 25.5%, MBO = 15.7%, bachelor's degree = 52.9%, master's degree = 5.9%) were collected as personal data.

Materials

Pre-Test Long COVID

Before starting the study, a pre-test (appendix A) (N = 18) was conducted to test general knowledge of long COVID, as this will be the topic of all texts in this experiment. This pre-test aimed to avoid a ceiling effect by incorporating information about long COVID in the study, unfamiliar to the participants. The results showed that the most common symptoms were also the most well-known, and symptoms that occur less often were less well-known. Furthermore, it was found that the participants had no prior knowledge of the possible causes of long COVID, and the risk factors were also scarcely known. The results of the pre-test (appendix A) were considered when developing the experimental materials, where unknown information is incorporated in the texts. Since pre-test participants can no longer participate in the study, PwD were not included in the pre-test.

Intervention

The materials of this study use information provided by C-support, an organization that supports and researches long COVID. All three conditions contain the same information but were provided in different formats (expository text vs. textual narrative vs. verbovisual narrative). The expository text condition served as the control group. The materials used the Verdana font, as research indicates this font supports reading comprehension for PwD (Rello & Baeza-Yates, 2013). Moreover, the font sizes have been adjusted to a larger size, as research suggests PwD benefit from larger font sizes (Rello et al., 2013). See appendix D for full versions of the materials.

Expository Text. This text contains a factual overview of symptoms, risk factors and possible causes of long COVID, for example: 'A very common symptom is (extreme) tiredness. The patients need a lot of rest.'.

Textual Narrative. This text conveys identical information as the expository text but in a textual narrative format. The main character is Alex (10-year-old boy), whose mom is battling long COVID. Therefore, Alex has decided to present about long COVID at school. He and his mom prepare the presentation together, and his mom provides him with information. For example: 'For her, long COVID made her feel tired all the time. I understood; Mom needed a lot of rest, and we couldn't play in the garden like we used to.'.

Verbovisual Narrative. The verbovisual narrative contains the same storyline as the textual narrative, but is provided in a verbovisual format with images (made by the researcher) added to the text. An example can be found in figure 2. The focus of the visualization is visualizing the information provided in all conditions. In the provided example, the fatigue is visualized by bags under her eyes. To keep the cognitive load (Hiscox et al., 2014; McNamara & Wong, 2003) as low as possible, the background is kept clean, and only a few drawings are used to illustrate information irrelevant to the comprehension test.

Figure 2

Characters verbovisual narrative
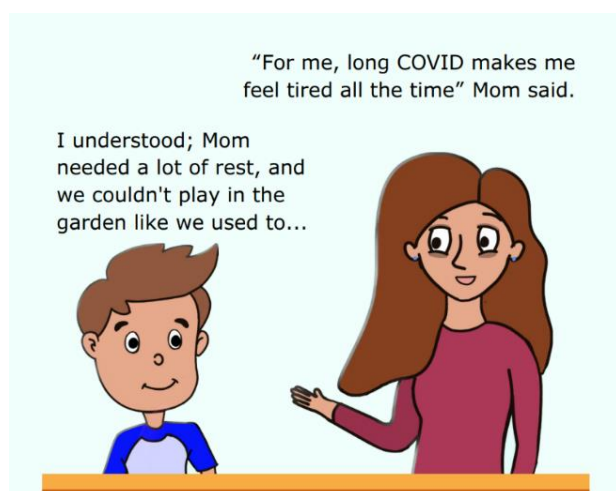
Measures

The complete questionnaire can be found in appendix C.

Prior Knowledge Long COVID

The general knowledge about long COVID is tested with four multiple-choice questions (e.g., 'Do/did you experience post-covid syndrome yourself?').

Test Anxiety

Test anxiety, adopted from the validated scale 'Motivated Strategies for Learning Questionnaire' (MSLQ) (Duncan et al., 2015), was measured at two points in time: before (test anxiety trait, pre-test) and after (test anxiety state, post-test) the intervention, to be able to define the difference score. The pre-test consists of four items: ' I feel my heart beating fast when I take an exam'. The post-test examined the same four items but was slightly adjusted to fit the situation (e.g., 'I feel my heart beating fast now I will take this exam'). The participants indicated on a 7-point Likert scale (Huang, 2016) to what agree they agreed with the given statement (1 = *Strongly disagree* and 7 = *Strongly agree*). Reliability was good (pre-test α = .75, post-test α = .87).

Self-Efficacy

The MSLQ was also used to measure self-efficacy (Duncan et al., 2015). Seven items were used to measure self-efficacy, one item of the original questionnaire was removed due to lack of relevance. Three items were slightly adjusted to fit the situation of this research. An example of a question is: 'I believe I will receive an excellent grade in this test'. The participants indicated on a 7-point Likert scale to what degree they agreed with the statement (1 = *strongly disagree* and 7 = *strongly agree*). Reliability was good (α = .86).

Reading Comprehension

Reading comprehension was measured after the intervention using a test. Participants answered ten multiple-choice questions about the just-learned information on long COVID. For example, a definition of long COVID is given in the text, and a question in the test is 'According to the text, what

is long COVID?'. The researchers developed the comprehension test, which can be found in appendix C.

Narrative Reasoning

Narrative reasoning is measured using five items (Eide & Eide, 2023), in which the participants had to indicate on a 7-point Likert scale (1 = *strongly disagree* and 7 = *strongly agree*) to what degree they agreed with the given statement (e.g., 'When I am trying to learn a new concept, I prefer my instructor to start with a story, case, or example, rather than to start with a precise definition.' (appendix C)). The initial questionnaire contained thirteen items, but the most relevant items were chosen due to the feasibility of this study and avoidance of a high attrition rate. By measuring this construct, this study aims to contribute to research on the potential link between dyslexia and narrative reasoning. The reliability of this scale was insufficient (α = .57).

Manipulation Check

For the manipulation check, the participants were asked if they agreed with two statements 'Was the information provided in a story format?' (yes/no) and (2) 'Was the information provided using a visual story?' (yes/no).

Procedure

Before participating in the study, participants provided informed consent (Appendix B). An informed consent form included information regarding the research procedures, potential benefits and risks, the voluntary nature of participation, the option to withdraw from the study at any point, contact information for the research team, and a confirmation of their dyslexia status.

Upon initiating the survey, participants were asked to provide information about their dyslexia diagnosis, age, gender, educational level, and English proficiency. Moreover, questions about their familiarity with long COVID followed, and their test anxiety (trait) was measured.

After random assignment to one of three conditions, participants were informed about the knowledge test post-intervention. To provide the participants with the time they needed, no time limit was set for the intervention or comprehension test. After the intervention, participants

answered questions about self-efficacy, followed by test anxiety (state). Then, the reading

comprehension test begins, followed by narrative reasoning items. Lastly, two questions were asked

as a manipulation check, and after finalizing the questionnaire, participants were debriefed.

Data Analyses

First, data were cleaned. For test anxiety, the difference score (post - pre) was computed. A chi-

square test of independence was used to assess the effectiveness of the manipulation. To test

hypotheses 1, 2, and 2c, a PROCESS serial mediation analysis was done (model 6; Andrew F. Hayes,

2022), with information format (multicategorical IV), test anxiety (MED 1, difference score), self-

efficacy (MED 2), and reading comprehension (DV). Additionally, a simple mediation analysis was

performed using information format (multicategorical IV), test anxiety (MED), and self-efficacy (DV) to

test hypotheses 2a and 2b. The serial- and simple mediation analyses were performed in SPSS, using

95% CI and 5.000 bootstrap samples.

Results

Overall Results

Table 1 briefly overviews the primary constructs measured in this study, divided by condition. A one-
way ANOVA, Bonferroni, determines the differences between groups.

Table 1

Overview of data

Variable	Expository text (control) (n = 20)	Textual narrative (n=11)	Verbovisual narrative (n=20)	p-value
	M (SD)	*M (SD)*	*M (SD)*	
Test anxiety trait (pre)	4.01 (1.16)[1]	4.20 (1.34)[1]	4.79 (0.84)[1]	.077
Test anxiety state (post)	3.46 (1.45)[1]	3.33 (1.27)[1]	4.04 (1.17)[1]	.248
Test anxiety difference	-0.55 (1.07)[1]	-0.87 (0.74)[1]	-0.75 (1.00)[1]	.652
Self-efficacy	4.76 (0.86)[1]	5.07 (0.80)[1]	4.58 (1.06)[1]	.367
Reading comprehension	6.80 (1.88)[1,2]	8.27 (1.42)[1]	5.25 (2.59)[2,3]	<.001

Note. The greater the gap between pre- and post-test scores, the more negative the test anxiety difference score becomes, indicating a greater reduction in test anxiety. Moreover, numbers 1,2 and 3, located after the SD, refer to the pairwise comparison of One-Way ANOVA. If values significantly differ, they are given different numbers, and those that do not are given the same number.

Manipulation Check

For the manipulation check, a chi-square test for independence was used for questions (1) was the information perceived as a story, $\chi^2(2) = 11.74$, *p* = .003, Cramér's V = 0.48, and (2) was the information perceived as a visual story, $\chi^2(2) = 23.22$, *p* < .001, Cramér's V = 0.68. Frequencies are shown in table 2, showing that as anticipated, participants in the narrative conditions (textual and verbovisual) more frequently reported encountering a story compared to those in the expository text condition. Moreover, participants in the verbovisual narrative indicated more frequently being exposed to a visual narrative than those in the textual narrative or expository text conditions. Results indicate a significant and large effect of information format on perceived (visual) narrativity, confirming the success of the manipulation.

Table 2

Frequencies manipulation check

	No Narrativity (1)	Yes Narrativity (1)	Yes Visual (2)	No Visual (2)
Control	11	9	1	19
Textual narrative	0	11	6	5
Verbovisual narrative	4	16	16	4
Total	15	36	23	28

Note. The numbers represent the count of participants who answered yes or no to question (1) and (2)

Hypothesis Testing

Total Effect Of Information Format On Reading Comprehension

H1 assumes that PwD's reading comprehension is highest for verbovisual narrative, followed by textual narrative, and lowest for expository text. To test this hypothesis, a serial PROCESS mediation analysis was performed (model 6, Hayes, 2013), with information format (multicategorical IV), test anxiety (MED 1), self-efficacy (MED 2), and reading comprehension (DV). Surprisingly, reading comprehension was highest in the textual narrative condition, N = 11 (M = 8.27, SD = 1.42), followed by the expository condition, N = 20 (M = 6.80, SD = 1.88), and lastly the verbovisual narrative condition N = 20 (M = 5.25, SD = 2.59). This difference is not significant for the expository text versus textual narrative (b= 1.473, SE = .0795, BCa *95% CI* [-0.125, 3.071]. However, the difference between the expository text and verbovisual narrative is significant (b= -1.550, SE = .669, BCa 95% CI [-2.896, -0.676]), as well as the difference between the textual narrative text and verbovisual narrative (b= -3.023, SE = 0.795, BCa 95% CI [-4.621, -1.425]). Overall, the results did not support the hypothesized total effect of information format on reading comprehension, nor did they results follow the expected order.

Mediation Effect Of Information Format On Reading Comprehension Through Test Anxiety And Self-Efficacy

The same serial mediation analysis was used to assess the mediation effect of information format on reading comprehension through test anxiety and self-efficacy (H2). The mediation analysis showed no significant serial mediation effect, regardless of which conditions were compared (expository text vs. textual narrative, b = 0.049, SE= 0.088, BCa 95% CI [-0.049, 0.293], expository text vs. verbovisual narrative, b = 0.038, SE = 0.089, BCa 95% CI [-0.063, 0.277], textual narrative vs. verbovisual narrative, b = -0.062, SE= 0.102, BCa 95% CI [-0.327, 0.051]). Hypotheses H2a, H2b, and H2c zoom in on the separate paths within this mediation model.

The Effect Of Information Format On Self-Efficacy. H2a assumed that participants in the verbovisual narrative condition showed the highest feeling of self-efficacy, followed by textual narrative and lastly expository text. To test H2a, a simple PROCESS mediation analysis was performed (model 4, Hayes 2013), with information format (IV), test anxiety (MED), and self-efficacy (DV). Self-

efficacy was highest in the textual narrative condition, N = 11 (M = 5.08, SD = 0.80), followed by the expository condition N = 20 (M = 4.79, SD = 0.86), and the verbovisual narrative N = 20 (M = 4.58, SD = 1.06). Nevertheless, there is no statistical significance observed between conditions of the effect of information format on self-efficacy (expository text vs. textual narrative, b= 0.292, SE = 0.350, BCa 95% CI [-0.406, 0.991], expository text vs. verbovisual narrative b = -0.207, SE = 0.295, BCa 95% CI [-0.800, 0.386], textual narrative vs. verbovisual narrative b= -0.499, SE = 0.350, BCAa 95% CI [-1.203, 0.204]). Overall, the results did not support the hypothesized total effect of information format on self-efficacy.

The Effect Of Information Format On Self-Efficacy Mediated By Test Anxiety. Hypothesis H2b assumed that the effect of information format on self-efficacy was mediated by test anxiety (lowest test anxiety for verbovisual narrative, followed by textual narrative and highest for expository text), and that test anxiety negatively impacted self-efficacy. To test H2b, the same simple mediation analysis was performed as for H2a. Test anxiety difference score was highest in the textual narrative N = 11 (M = -0.87, SD = 0.74), followed by the verbovisual narrative N = 20 (M = -0.75, SD = 1.00), and the expository text has the lowest text anxiety difference score N = 20 (M = -0.55, SD = 1.07). Nevertheless, there is no statistical significance observed between conditions of the effect of information format on self-efficacy, mediated through test anxiety (expository text vs. narrative text, b = 0.071, SE = 0.119, BCa 95% CI [-0.061, 0.397] expository text vs. verbovisual narrative b= 0.044, SE = 0.103, BCa 95% CI [-0.066, 0.339], textual narrative and verbovisual narrative b= -0.027, SE= 0.088, BCa 95% CI [-0.226, 0.151]). Moreover, the results did not show a significant negative effect of test anxiety difference score on self-efficacy (b = -.221, SE = 0.135, BCa 95% CI [-0.493, 0.050]). Overall, the results did not support the hypothesized mediation effect of information format on self-efficacy through test-anxiety, nor the negative effect of test anxiety on self-efficacy.

The Effect Of Self-Efficacy On Reading Comprehension. To assess the effect of self-efficacy on reading comprehension (H2c), the same serial mediation analysis as before was used as in H1 and H2. The mediation analysis showed a significant result, b = 0.862, SE = 0.317, BCa 95% CI [0.224, 1.500],

with 95% CI not crossing zero. This supports H2c: self-efficacy affects reading comprehension positively.

Exploratory Analyses

Controlling For English Proficiency

A correlation analysis was performed (N = 51) to determine constructs that possibly influence reading comprehension. A (Spearman) correlation analysis showed a significant correlation between English proficiency (M = 2.06, SD = 0.70), and reading comprehension (M = 6.51, SD = 2.38), (r = .46, *95% Bootstrapped CI* [0.211, 0.670], p < .001, r^2 = .21, (one-tailed)). English proficiency is measured by self-report (basic, intermediate, or fluent). The data is normally distributed, no bootstrapping was performed. English proficiency was highest for participants in the textual narrative condition (M = 2.27, SD = 0.79), followed by participants in the expository text condition (M = 2.15, SD = 0.67), and participants in the verbovisual narrative condition scored the lowest on English proficiency (M = 1.85, SD = 0.67). However, the difference was insignificant, $F(48, 2)$ = 1.589, p = .215, η^2 = .62.

As English proficiency and reading comprehension showed a significant correlation, this relationship is further explored. In a follow-up analysis, the participants who indicated their English level as 'basic' were excluded. As people with dyslexia already struggle with reading and reading comprehension, the study would be extra challenging for participants with a basic level of English (Oren & Breznitz, 2005). Moreover, in everyday life, participants are more likely to interact with reading materials in their native rather than a second language. To investigate the data with the highest ecological validity, an additional serial mediation analysis was run, excluding the participants who reported their proficiency level in English as 'basic'. The notable differences between the serial mediation with all participants (EP_all) (N= 51) and the serial mediation without English proficiency = basic (EP_selection) (N= 40) are now discussed. First, the differences in descriptives are shown in table 3.

Table 3

Overview of data comparing EP_all and EP_selection

Variable	Expository text (Control) (n = 20)	Expository text (Control) (n = 17)	Textual narrative (n=11)	Textual narrative (n = 9)	Verbovisual narrative (n=20)	Verbovisual narrative (n = 14)
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Test anxiety trait (pre)	4.01 (1.16)	4.00 (1.21)	4.20 (1.34)	4.13 (1.38)	4.79 (0.84)	4.73 (0.92)
Test anxiety state (post)	3.46 (1.45)	3.62 (1.46)	3.33 (1.27)	3.44 (1.19)	4.04 (1.17)	3.93 (1.25)
Test-anxiety difference	-0.55(1.07)	-0.36 (0.98)	-0.87 (0.74)	-0.69 (0.67)	-0.75 (1.00)	-0.80 (0.88)
Self-efficacy	4.76 (0.86)	4.84 (0.83)	5.07 (0.80)	5.24 (0.69)	4.56 (1.06)	4.55 (1.20)
Reading comprehension	6.80 (1.88)	7.24 (1.64)	8.27 (1.42)	8.44 (1.33)	5.25 (2.59)	6.07 (2.43)

Note. In blue, the *M* and *SD* of EP_selection are shown, and in white the descriptives of EP_all.

What stands out in this table is that for all conditions, the reading comprehension score increased for the EP_selection. What is also remarkable, is that the test anxiety difference score has decreased for the expository text condition and the textual narrative condition, but remained nearly stable for the verbovisual condition. Moreover, the difference in self-efficacy for EP_all and EP_selection are less pronounced for the verbovisual narrative compared to the expository text and textual narrative.

The difference between the serial and simple mediation for EP_all versus EP_selection is now discussed. In EP_all, the effect of information format on reading comprehension was significant when comparing expository text versus verbovisual narrative (*b*= -1.550, *SE* = .669, BCa 95% CI [-2.896, -0.676]), but becomes insignificant in EP_selection (*b*= -1.16, *SE* = 0.687, BCa 95% CI [-2.557, 0.229]). This shows that when English proficiency levels increase, the total effect between expository text and verbovisual narrative on reading comprehension decreases and becomes insignificant.

Narrative Reasoning, Study Duration, And Long COVID Familiarity

To examine what we can learn from this study regarding narrative reasoning, a correlation analysis was performed to check for a correlation between narrative reasoning and reading comprehension.

No significant correlation was found (r = -.05, *95% Bootstrapped CI* [-0.323, 0.227], *p* < .72, r^2 = .003, (two-tailed)). Due to the low reliability of the narrative reasoning scale (α = .57), the items were also considered separately, as shown in table 4.

Table 4

Narrative reasoning per item

Item	Description	*M (SD)*
Item 1	When I am trying to learn a new concept, I prefer my instructor to start with a story, case, or example, rather than to start with a precise definition.	5.82 (1.14)
Item 2	I typically reason, remember, and learn better using stories, cases, or examples, rather than abstract concepts or definitions.	5.78 (1.15)
Item 3	I often need to memorize rote information (naked facts or lists), like making up a story, song or rhyme about them.	4.98 (1.64)
Item 4	If someone asked me to think about an abstract term like justice, I'd usually think first about stories or images or examples of behaviour, rather than abstract definitions of justice.	5.18 (1.41)
Item 5	When I think of historical events, I see scenes in my mind, rather than just verbal descriptions.	5.59 (1.27)

Note. Means are based on a 7-point Likert scale, where 1 = *strongly disagree*, 7 = *strongly agree*

Table 4 shows that for each item, the mean scores were high, meaning that overall, they agreed with the narrative statements. The high scores of items 1 (M = 5.82) and 2 (M = 5.78) are especially promising for using narrative formats in learning and processing new information.

Moreover, study duration was examined as an attention check to see if the duration time was reasonable for the task and if it affected reading comprehension. A boxplot (appendix E) shows six outliers in the data, all on the higher end of the duration. This makes sense, as the participants could leave and return to the study anytime. As there were multiple outliers, the median is used to

measure central tendency, where the median is 15 minutes and 20 seconds for the study. A correlation analysis did not show any significant correlations with study duration. This fairly long duration time may resulted in the high attrition rate (around 50%).

Discussion

To answer the research question "How does the use of textual and verbovisual narratives, as opposed to expository text, influence reading comprehension among individuals with dyslexia, and to what extent does test anxiety and self-efficacy (serially) mediate this effect?", an experimental study was executed. The goal of this research was to further investigate how to make use of the strengths of people with dyslexia (PwD) to support them in their reading comprehension. The most important findings will now be discussed.

Firstly, H1 proposed an effect of information format on reading comprehension, where it was expected that participants in the verbovisual narrative have the highest score of reading comprehension, followed by textual narrative, and lastly, expository text (Bagri & Jones, 2018; Boerma et al., 2016; Calabrich et al., 2021; Clinton et al., 2020; Georgiou et al., 2022; Goßler et al., 2022; Mar et al., 2021; Mayer, 2003; Simonsmeier et al., 2022; Stein, 2022; Tso et al., 2021). H1 can be rejected, as information format did affect reading comprehension, but it was not in the hypothesized order. Without controlling for English proficiency level (EP_all), textual narrative and expository text scored significantly higher than verbovisual narrative on reading comprehension. When controlling for English proficiency (EP_selection), the significant difference between expository text and verbovisual narrative becomes insignificant.

Although the better performance of the textual narrative than expository text is in line with previous research (Clinton et al., 2020; Mar et al., 2021), the poor performance of the verbovisual narrative was not in line with expectations. This can possibly be explained by extraneous visual details potentially disrupting the reasoning process (Knauff & Johnson-Laird, 2002), as the vivid visual details compete for the same cognitive resources as reasoning. If more resources are allocated to processing the visual details, fewer resources are available for reasoning. This can possibly explain the poor

performance of the verbovisual condition. The limited capacity in working memory for PwD (Hiscox et al., 2014; McNamara & Wong, 2003; Ransby & Lee Swanson, 2003; Smith-Spark & Fisk, 2007) may pronounce this effect shown by Knauff & Johnson-laird (2002). It is plausible that the verbovisual narrative demanded more of the working memory compared to the textual narrative and expository text, as the participants had to process text as well as visuals, whereas in the textual narrative and expository text, only text needed to be processed (Ryoo & Winkelmann, 2021). Although this study tried to keep the visuals in the verbovisual narrative as clean and minimal as possible, it cannot be ruled out that irrelevant visual information was given that might have caused impeded reasoning.

Moreover, Bandura (1982) found that if someone perceives themselves as highly self-efficacious, they will likely put in less effort. As the drawings of the verbovisual narrative may be regarded as childish, and the story is told from the viewpoint of the 10-year-old Alex, the verbovisual narrative could have been perceived as relatively simple. Hence, participants may have felt highly efficacious in the verbovisual condition, leading to self-overestimation, resulting in a reduced effort in comprehending the text, hindering their understanding.

H2 predicted that the effect of information format on reading comprehension was serially mediated through test anxiety and self-efficacy. (Ali et al., 2023; Andreassen et al., 2017; Bandura, 1977, 1982; Byars-Winston et al., 2017; Carroll & Iles, 2006; Cho et al., 2021; Edwards et al., 2023; Gosiewska-Turek, 2022; Nelson et al., 2015; Shehzad & Rawian, 2019; Shin et al., 2023; Stagg et al., 2018). The data shows that the effect of information format on reading comprehension is not serially mediated through test anxiety and self-efficacy. Therefore, H2 cannot be accepted. This lack of statistical significance could be, among other reasons, due to the study being underpowered.

Zooming in on the separate paths of the hypothesized mediation effect, firstly H2a predicted that the PwD in the verbovisual condition experienced the highest self-efficacy, followed by the textual narrative condition, and lastly the expository text (Andreassen et al., 2017; Bacon & Handley, 2010; Bandura, 1982, 1989; Boerma et al., 2016; Catani et al., 2009; Goßler et al., 2022; Stein, 2022). This hypothesis cannot be accepted, as there was no significant difference observed between conditions.

One plausible explanation for the lack of support for H2a could be that participants might have been less acquainted with the concept of a verbovisual narrative, thereby lacking the opportunity to establish success experiences (mastery experiences) crucial for fostering self-efficacy. A study found that visual narratives require exposure to achieve fluency in comprehending visual narratives (Cohn, 2020). However, although little is known about the exposure to verbovisual narratives in a learning context, textbooks make profound usage of expository texts, which include images as well, but less frequently as with a verbovisual narrative, to convey information (Duffelmeyer, 1994; Fang, 2008; Sukiman & Azura Husin, 2022). Therefore, exposure to (verbo-) visual narratives in a study setting might be limited leading to limited fluency and comprehension in (verbo-) visual narratives. Thereby, the participants may lacked the opportunity to establish success experiences (mastery experiences) crucial for fostering self-efficacy. This can be supportedud by research on Greek students, where the students appeared to be unfamiliar with working on multimodal texts (Manoli & Papadopoulou, 2013). Conversely, participants of the current study were probably more familiar with expository texts, as these are prevalent in textbooks (Duffelmeyer, 1994; Fang, 2008; Sukiman & Azura Husin, 2022), or textual narratives, as narratives are considered a natural processing mode for humans (Fisher, 2021; Stroud, 2016). This familiarity enables the participants to draw upon past success experiences, potentially contributing to a heightened sense of self-efficacy.

H2b predicted that the effect of information format on self-efficacy would be mediated by test anxiety, where the correlation between test-anxiety and self-efficacy would be negative. More specifically, it was anticipated that participants exposed to verbovisual narratives would experience the lowest test anxiety, resulting in elevated self-efficacy and, consequently, improved reading comprehension (Bandura, 1982; Carroll & Iles, 2006; Catani et al., 2009; Francis et al., 2019; Goßler et al., 2022; Nelson et al., 2015; Novita, 2016; Riddick et al., 1999). However, no significant differences between groups were observed, nor did test anxiety significantly affect self-efficacy, meaning H2b cannot be accepted.

In contrast to the hypothesis, the self-efficacy mean for the expository text condition was higher than of the verbovisual narrative condition despite a more pronounced test anxiety difference score favouring the verbovisual narrative. Although these differences are not significant, potentially due to the underpowered study, these unexpected results raise questions that can be explored in future research. As reasoned in H2a, participants were probably less familiar with verbovisual narratives as information format, which could have deprived them of gaining self-efficacy through past success experiences (mastery experience). Nonetheless, the pronounced difference in test anxiety could indicate that the combination of text and images lowered test anxiety levels compared to the expository text. Alternatively, expository texts map most closely to general test settings in which PwD experience heightened anxiety (Nelson et al., 2015). This familiar setting might have triggered test anxiety. Future research with sufficient statistical power could further explore the link between verbovisual narratives, test anxiety, and self-efficacy.

Hypothesis 2c indicates that self-efficacy positively predicts reading comprehension (Byars-Winston et al., 2017; Cho et al., 2021; Shehzad & Rawian, 2019). The data indicates that self-efficacy significantly affects reading comprehension positively, wherein an increase in self-efficacy leads to an increase in reading comprehension. Therefore, H2c can be accepted.

Limitations And Future Research

This study has multiple limitations. Firstly, this study lacked statistical power. 77 participants should have been in the study to reach a sufficient power level, but 51 PwD participated. This was due to multiple reasons. First, the study was rather long (median of 15 minutes and 20 seconds), possibly leading to the high attrition rate of around 50%. Moreover, only around 5% to 10% of the population is diagnosed with dyslexia (Benfatto et al., 2016; Huc-Chabrolle et al., 2010), complicating assembling a large sample to reach statistical power. For future research endeavours, examining if a similar study with sufficient statistical power would yield different results is interesting.

Due to the hard-to-reach target group, this study was performed online instead of in a lab setting, leading to multiple limitations. Firstly, participants could leave and return to the study at any time,

resulting in varying duration times. Six outliers were identified, but they were retained in the study due to the low power. This varying duration time potentially impacted memory, possibly decreasing memory if duration time increases (Smith-Spark & Fisk, 2007; Yun et al., 2010). However, the results showed no significant correlation between duration time and reading comprehension. Furthermore, due to the online nature of the study, uncertainties arise regarding the participants' level of engagement and effort, especially given the study's length. Lastly, the study being online could have resulted in participants consulting external sources to answer knowledge questions, which is in line with previous findings stating that in online studies, participants more often than in lab studies, consult external sources to answer knowledge questions (Clifford & Jerit, 2014). Concerning these issues, future research is advised to perform a similar study in a lab environment.

A third limitation is that the study is in English, and most of the participants are Dutch-speaking. Although the study tried to control for English proficiency level by running the analysis twice (EP_all and EP_selection), a study in the participants' first language could have increased ecological validity and yielded different results. This is particularly relevant, as people with dyslexia already struggle with reading comprehension, which makes it more challenging to participate in a study in a second language than for people without dyslexia (Oren & Breznitz, 2005). Multiple participants confirmed they either quit the study as they could not understand the study due to the English language, while others expressed dissatisfaction with the study being conducted in English. Therefore, using participants' first language in future studies is advised.

Additionally, the study exclusively involved people with dyslexia; therefore, it is unknown how these results relate to people without dyslexia. Consequently, future research endeavours should incorporate a comparative analysis involving both groups—individuals with and without dyslexia. This comparative approach is essential for discerning outcomes attributable to dyslexia and those that are not. Particularly, more comparative studies between PwD and people without dyslexia can be attributed to the body of research exploring narrative reasoning as a strength of dyslexia, as this body of research remains limited.

Lastly, this study did not measure the mastery experience of the reader. Therefore, this study cannot link the varying performance to a mastery experience. Hence, future research should try to take mastery experience into account when measuring self-efficacy. If the feeling of mastery experience is known, it facilitates opportunities to develop information formats for PwD that allow for mastery experiences and, therefore, build self-efficacy.

Implications

This study yielded surprising results concerning incorporating images in learning materials for PwD, indicating that images may not always enhance reading comprehension, but can even impede it. These findings are crucial in designing study materials for PwD, and future research should indicate to what extend images are helpful, and when they become harmful. As argued before, the poor performance of the verbovisual narrative may be attributed to the weaker working memory of PwD. Therefore, it is worth examining if a verbovisual narrative that puts less demand on the working memory yields better results for reading comprehension. Building on this research, it is suggested to be very careful when adding extraneous cognitive load to the information to keep the cognitive load as low as possible.

Moreover, this research added to the small body of literature linking PwD to strong narrative reasoning skills. This study shows that PwD have a tendency to narrative reasoning, in line findings of with Eide and Eide (2023). However, more research is needed to explore this possible strength. This also applies to holistic and visual thinking, as these possible strengths hold potential of compensating for the deficits of PwD, but only a small body of research has focused on these strengths.

Conclusion

This study explored whether information format (expository text vs textual narrative vs verbovisual narrative) affected reading comprehension and if and to what extent this was serially mediated through test anxiety and self-efficacy. The findings revealed unexpected outcomes concerning the hypothesized effects. Contrary to H1, the results showed that textual narratives scored significantly higher than verbovisual narratives on reading comprehension, with and without

controlling for English proficiency. Moreover, without controlling for English proficiency, PwD in the expository text condition scored significantly higher on reading comprehension than the verbovisual narrative condition. Additionally, the data did not support H2, predicting a serial mediation of information format through test anxiety and self-efficacy on reading comprehension. However, H2c was confirmed, indicating a significant positive relationship between self-efficacy and reading comprehension. Given the effect of self-efficacy on reading comprehension, it remains imperative to investigate how self-efficacy can be increased in PwD who struggle with reading comprehension.

This study yields a new perspective on how images may impede the reading comprehension of PwD. Therefore, caution is needed when consulting images in information formats for PwD. Future research should define the dividing line between helpful and harmful visual aids in the context of reading comprehension.

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Appendix A

Pre-test knowledge long COVID

Informed consent

Dear Participant,

Thank you for taking the time to participate in this pre-test survey. Please read the information below

carefully before you continue.

Our pre-test aims to investigate the current knowledge about post-covid syndrome, also known as

long covid. Your participation is entirely voluntary. You are not required to provide any specific

responses, and you may withdraw from the survey at any time without facing any consequences. The

questionnaire will take approximately 3 minutes to complete, and your answers will be kept

anonymous. Your data will be treated with the most confidentiality and will only be accessible to the

teaching staff of the Tilburg University's department of Humanities and Digital Sciences and the

research students involved in this pre-test.

By participating in this survey, you may benefit from the knowledge provided about the post-covid

syndrome. Please note that there are no right or wrong answers as we are assessing the general

knowledge of the post-covid syndrome. If you have any questions about this research project, feel

free to contact Eefje van Moorsel, e.a.m.vanmoorsel@tilburguniversity.edu.

Informed Consent:

I have had the opportunity to read this consent form and understood the information provided in this

consent form, and I agree to participate in the pre-test as outlined above.

If you agree to participate in this survey, please select "Yes, I agree to participate" on the button

below.

By clicking the button below, you acknowledge:

Your participation in the pre-test is voluntary.

You are 18 years of age.

You are aware that you may choose to terminate your participation at any time for any reason.

Pre-test questionnaire & results

The results of the pre-test are shown here as well in blue. The first number refers to the frequency of participants who selected that answer option, and the number after the slash refers this frequency converted to percentages of total participants.

Q1 Are you familiar with the term post-covid syndrome (also known as 'long-covid')?

- o   Yes   14 / 78%

- o   No   4 / 22%

Q2 Is there anyone you know who experiences/has experienced post-covid syndrome?

- o   Yes   9 / 50%

- o   No   9 / 50%

Q3 Do/did you experience post-covid syndrome yourself?

- o   Yes   0 / 0%

- o   No   18 / 100%

Q4 Which physical symptoms do people with the post-covid syndrome experience?

Open answer

I don't know	3 / 17%
Condition loss	4 / 22%
Loss of taste	4 / 22%
Fatigue	10 / 56%
Headache	3 / 17%

Lethargy	1/ 6%
Brain fog	1/ 6%
Atten deficiency	4 / 22%
Memory problems	1/ 6%
Short of breath	5 / 28%
Sensitive to emotiens	1/ 6%
Irritable	1/ 6%
Fainting	1/ 6%
Nausia	1/ 6%
Lack of physical strength	1/ 6%
Chest pain	1/ 6%
Sleeping problems	1/ 6%
Hyper awareness to germs	1/ 6%

Q5 Do people with post-covid syndrome experience mental problems as consequence of their disease?

- o   Yes, they do   9 / 50%
- o   No, they don't → skip question 6   0 / 0%
- o   I don't know → skip question 6   9 / 50%

Q6 If you think so, which ones would that be?

Anxiety	2/ 11%
Depression	7 / 39%
Feeling like failure	1/ 6%
Social anxiety	1/ 6%
Stress	1/ 6%
obsessiveness with cleanliness	1/ 6%
can't have fun / socialize	1/ 6%

Frustration with loss of abilities   1/ 6%

Feeling misunderstood/powerless   1/ 6%

<u>Q7 Which of the following factors do you think will increase the likelihood of someone developing post-covid syndrome? Multiple answers are correct.</u>

Note: (F) after a questions refers to the answer being incorrect.

- Being a women   3 / 17%

- Being a man (F)   1 / 6%

- People with autoimmune diseases   9 / 50%

    People with a history of Epstein-Barr virus (EBV)   1 / 6%

    Infection

- People with Q fever   0

- People with ADHD   0

- People with Dyslexia (F)   0

- People who are below the age of 10 and over the age   3 / 17%

    of 70 years old (F)

- People with type 2 diabetes   5 / 28%

- People with chronic urticaria (hives)   1 / 6%

- People with Alzheimer's disease (F)   1 / 6%

- People with connective tissue disorders such as   2 / 11%

    rheumatoid arthritis

- People with a history of migraines (F)   3 / 11%

- People with allergic rhinitis (chronic inflammation of the   6 / 33%

    nasal lining)

- People of Spanish or Latino descent   0

- People who return to work too soon after a COVID-19 infection   2 / 11%

- People who are fully vaccinated (F)   1 / 6%

Q8 Do you know any hypotheses about the possible causes of post-covid syndrome?

- o Yes   2 / 11%

- o No --> skip question 9   16 / 89%

Q9 Which theory do you know?

 Open answer

1.   If your lungs were badly affected when you had covid If you were admitted into hospital If you needed oxygen if you felt claustrophobic or if you had hyperventilation

2.   I am assuming that it's because they have been locked away from people for such a long period of time, which makes them scared to go outside and interact with others due to the possibility that they might get sick by interacting with others or by just simply being outside.

Q10 Does post-covid syndrome follow a linear path in recovering?

- o Yes, the recovery follows a steady and predictable course, with symptoms steadily disappearing without significant setbacks.   1 / 6%

- o No, the recovery is inconsistent and unpredictable, with symptoms fluctuating and varying over time including regular setbacks.   8 / 44%

- o I don't know   9 / 50%

Q11 Which of the symptoms listed do you believe are associated with post-COVID syndrome?

Note: In bold is NOT mentioned in the free recall question.

- o Fatigue   11 / 61%

- o Concentration problems   8 / 44%

- o Condition loss   9 / 50%

- o Memory loss/forgetfulness   5 / 28%

- o **Wordfinding problems**   4 / 22%

- o **Oversensitivity for light and sounds**   5 / 28%

- o Shortness of breath during exertion   12 / 67%

- o Depressive feelings   9 / 50%

- o   Headache — 8 / 44%
- o   Gloominess/irritability — 3 / 17%
- o   Sleeping problems — 7 / 39%
- o   Muscle weakness — 8 / 44%
- o   **Sore muscles** — 5 / 28%
- o   **Dizziness** — 4 / 22%
- o   Confusion — 5 / 28%
- o   Shortness of breath during rest — 8 / 44%
- o   Pressure on the chest — 3 / 17%
- o   Anxiety — 7 / 39%
- o   **Tinnitus** — 2 / 11%
- o   **Heart palpitations** — 5 / 28%
- o   **Variations in temperature** — 1 / 6%
- o   **Joint pain** — 4 / 22%
- o   **Vision problems** — 3 / 17%
- o   **Abdominal complaints** — 0
- o   **(Night) sweating** — 3 / 17%
- o   Less or no sense of smell — 7 / 39%
- o   Less or no sense of taste — 7 / 39%
- o   **Coughing** — 6 / 33%
- o   **Skin problems** — 0
- o   **Sore throat** — 3 / 17%
- o   **Recurring infections** — 2 / 11%
- o   **Hair loss** — 2 / 11%
- o   **Decreased appetite** — 5 / 28%

Debriefing

Thank you again for your participation in our pre-test. We aimed to examine the knowledge of the post-covid syndrome. All information is derived from C-support. Please note that the question '*Which of the following factors do you think will increase the likelihood of someone developing post-covid syndrome? Multiple answers are correct*' contained some false answers, which were: 1. Being a man 2. People who are below the age of 10 and over the age of 70 years old 3. People with a history of migraines 4. People who are fully vaccinated. 5. People with Alzheimer's disease 6. People with dyslexia. If you have any questions about the pre-test, please feel free to contact Eefje van Moorsel, e.a.m.vanmoorsel@tilburguniversity.edu.

Appendix B

Information letter and informed consent

Information letter

Dear Respondent,

- This study is part of our Master's program in Communication and Information Sciences at Tilburg University.

- Its purpose is to investigate how the strengths of individuals with dyslexia can be better utilized.

- During this study, a text will be provided, and afterward, you will be asked to take a test based on the given text. The results of this test will have no impact on your professional career or your studies and will only be used for research purposes. To ensure the validity of the research, the specific purpose and form of the study cannot be disclosed in advance.

- **For this research, it is essential that you have been diagnosed with dyslexia by a professional and are at least 18 years old.**

- The study will take approximately 20 minutes and has been approved by the Ethics Committee of the Tilburg School of Humanities and Digital Sciences. There are no physical or mental risks associated with the study. However, the subject of the text you will be presented with is 'long COVID.' Personal experiences or experiences of people in your surroundings with long COVID may evoke unpleasant feelings or memories during the study. If this happens, please feel free to discontinue the study immediately with no consequences. You can also seek information or support from C-support (www.c-support.nu), an organization specializing in supporting individuals with long-lasting COVID symptoms.

- For any complaints, you can contact the Ethics Committee of the Tilburg School of Humanities and Digital Sciences at tshd.redc@tilburguniversity.edu. We request information about your

gender, age, level of education, English proficiency, and general knowledge of long COVID. We collect this data to describe the characteristics of our participant group and identify general patterns.

- Outside of this research, we will not use your personal information. We treat your data confidentially, and your personal information is not directly linked to you. We do not store your email address. Your data will be retained for a maximum of 10 years unless you object at a later time. During these 10 years, the data will only be shared with other researchers with permission of the main applicant; this sharing will take place in a safe environment in which the data will be encrypted. Your participation is entirely voluntary, and you can end your participation in the survey at any time, for any reason, by closing the survey. Participants through the Human Subject Pool will receive 0.5 credits for their participation in this study.

- If you have any questions, please feel free to send an email to one of the researchers: Eefje van Moorsel (e.a.m.vanmoorsel@tilburguniversity.edu) or Judith Novia Tanta (JudithNoviaTanta@tilburguniversity.edu).

Informed Consent:

By clicking the "Yes, I agree to participate" button, you give your consent to participate in this research. You acknowledge that:

You have read the information above and had the opportunity to ask questions about the study beforehand.

You also acknowledge that you have been formally diagnosed with dyslexia by a professional and are at least 18 years old.

You recognize that your participation in this study is voluntary and that you can terminate it at any time, without any consequences and without the need to provide a reason.

You consent to the collection of the mentioned demographic data, which will be processed and treated in a completely anonymous and confidential manner.

You consent to the storage of research data for a period of ten years.

You consent to letting the main applicant decide if the data can be shared with other researchers.

Thank you in advance,

Eefje van Moorsel (e.a.m.vanmoorsel@tilburguniversity.edu)

Judith Novia Tanta (JudithNoviaTanta@tilburguniversity.edu)

If you do not agree, please close this window.

- o   Yes I agree to participate

Appendix C

Survey

Pre-liminary questions

Thank you for participating.

- Let's begin with some questions about you:

<u>Q1 What is your age?</u>

- o Under 18 years old

- o 18-24 years old

- o 25-34 years old

- o 35-44 years old

- o 45-54 years old

- o 55-64 years old

- o 65-74 years old

- o 75 years and older

<u>Q2 Have you ever received a formal diagnosis of dyslexia from a qualified healthcare professional?</u>

- o Yes

- o No

Demographic questions

<u>Q3 What is your gender?</u>

- o Male

- o Female

- o Non-binary-third gender

- o Other:

- o Prefer not say

<u>Q4 What is the highest level of education you have completed?</u>

If you do not reside in the Netherlands, you can disregard the information within the brackets.

- o   No formal education

- o   High school diploma (VMBO, HAVO, VWO)

- o   Vocational training (MBO)

- o   Bachelor's degree (HBO/WO)

- o   Master's degree (HBO/WO)

- o   Doctorate degree

Q5 Please select the category that best describes your level of English reading:

- o   Basic

- o   Intermediate

- o   Fluent

Pre-test familiarity long COVID

Q6 Are you familiar with the term long COVID?

- o   Yes

- o   No

Q7 Do/did you experience long COVID yourself?

- o   Yes

- o   No

Q8 Does/did someone who is close to you experience long COVID?

- o   Yes

- o   No

Q9 Have you ever investigated what long COVID is?

- o   Yes

- o   No

Pre-test test anxiety

Q10 Now, we would like to know to what extent you feel anxious when you are about to take a test.

Please indicate below to which extent you agree with the following statements about yourself. Please

do this honestly, there are no right or wrong answers.

   a.   When I take a test I think about how poorly I am doing compared with other students.

   b.   When I take a test I think about items on other parts of the test I can't answer.

   c.   When I take tests I think of the consequences of failing.

   d.   I have an uneasy, upset feeling when I take an exam.

   e.   I feel my heart beating fast when I take an exam.

Answer options: 1. Strongly disagree, 2. Disagree, 3. Somewhat disagree, 4. Neither agree nor

disagree, 5. Somewhat agree, 6. Agree 7. Strongly agree

(Stimuli)

Self-efficacy

Q11 As mentioned before, you are about to take a test about the just provided information. Now, you

are presented with some statements regarding your beliefs to successfully take this test. **The**

statements below refer to this upcoming test.

- Please indicate below to which extent you agree with the following statements about yourself.

Please do this honestly. There are no right or wrong answers.

   a.   I Believe I will receive an excellent grade in this test

   b.   I'm certain I can understand the most difficult material presented in the reading

   c.   I'm confident I can understand the basic concepts that were taught in this text

    d.   I'm confident I can do an excellent job on the test

    e.   I expect to do well in this test

    f.   I'm certain I can master the knowledge that was taught in this text

    g.   Considering the difficulty of this text, and my skills, I think I will do well in this test

Answer options: 1. Strongly disagree, 2. Disagree, 3. Somewhat disagree, 4. Neither agree nor disagree, 5. Somewhat agree, 6. Agree 7. Strongly agree

Post-test test anxiety

Q12 Now you are presented with some statements regarding your test anxiety level again. As mentioned before, you will take a test about the just provided information later on. **The statements below refer to this upcoming test.**

- Please indicate below to which extent you agree with the following statements about yourself. Please do this honestly. There are no right or wrong answers.

    a.   Now I have to take this test, I think about how poorly I will do compared with other students.

    b.   When I take this test, I will think about items on other parts of the test I can't answer.

    c.   When I take this test, I think of the consequences of failing.

    d.   I have an uneasy, upset feeling now I have to take this test.

    e.   I feel my heart beating fast now I will take this exam.

Answer options: 1. Strongly disagree, 2. Disagree, 3. Somewhat disagree, 4. Neither agree nor disagree, 5. Somewhat agree, 6. Agree 7. Strongly agree

Reading comprehension

It is time for the test. In this section, you will be asked some questions about long COVID based on the text you just read.

Please read these questions carefully. The answers cannot be edited once you move to the next page. Only one answer is correct.

Q 13 According to the text, what is long COVID?

- o   A condition that occurs during the COVID-19 infection

- o   **A condition where people experience symptoms long after being infected with COVID-19**

- o   A condition where people experience lung-related symptoms after being infected with COVID-19

- o   A state of prolonged contagiousness after recovering from COVID-19

Q14 According to the text, what is one of the common symptoms of long COVID?

- o   **Forgetfulness**

- o   Nausea

- o   Joint pain

- o   Rashes

Q15 What is a known cause of long COVID according to the text?

- o   A genetic problem

- o   Low blood pressure

- o   Inactive immune system

- o   **There is no known cause yet**

Q16 What does the text say about the possible cause of long COVID related to the immune system?

The immune system….

- o   Becomes slow, leading to increased vulnerability to outside infections

o   Is ineffective in responding to infections

o   **Is overactive**

o   Heightens the response to pollen leading to hay fever

Q17 According to the text, what happens to the walls of blood vessels in the theory of causes of long

COVID? These walls become…

o   **Inflamed**

o   Swollen

o   Smaller

o   Unaffected

Q18 What are some risk factors for long COVID as mentioned in the text?

o   Diabetes type I

o   Being a man

o   **Having an autoimmune disease**

o   History of infections

Q19 Which statement below is true:

I. Long COVID symptoms primary cause is well-established

II. Overworking after being infected with COVID increases the risk of developing long COVID.

o   Statement 1 is true, statement 2 is false

o   **Statement 1 is false, statement 2 is true**

o   Both are false

o   Both are true

Q20 Which statement below is true:

The text mentioned…

1. word finding problems are rare in long COVID patients.

2. chest pain as one of the symptoms

- o Statement 1 is true, statement 2 is false

- o Statement 1 is false, statement 2 is true

- o **Both are false**

- o Both are true

Q21 From the information provided about the theories concerning the causes of long COVID, what can be said about the potential impact of long COVID on the immune system?

- o The disrupted immune system in Long COVID patients might not reactivate any underlying diseases.

- o Long COVID causes the immune system to function more effectively against the virus even after it has left the body.

- o **The disrupted immune system in long COVID patients can potentially reactivate old diseases, complicating the condition further.**

- o Long COVID patients' immune systems remain unaffected by the virus post-recovery.

Q22 Based on your understanding of the text, which statement below is true?

1. The unknown cause makes it challenging to determine appropriate treatments for long COVID.

2. Long COVID treatment is exclusively reliant on antiviral medication.

- o **Statement 1 is true, statement 2 is false**

- o Statement 1 is false, statement 2 is true

- o Both are false

- o Both are true

Narrative reasoning

Now you are presented with some statements regarding your preferences in information processing.

Please indicate below to which extent you agree with the following statements about the text. Please do this honestly. There are no right or wrong answers.

1. When I am trying to learn a new concept, I prefer my instructor to start with a story, case, or example, rather than to start with a precise definition.

2. I typically reason, remember, and learn better using stories, cases, or examples, rather than abstract concepts or definitions.

3. I often need to memorize rote information (naked facts or lists), like making up a story, song or rhyme about them.

4. If someone asked me to think about an abstract term like justice, I'd usually think first about stories or images or examples of behaviour, rather than abstract definitions of justice.

5. When I think of historical events, I see scenes in my mind, rather than just verbal descriptions.

Answer options: 1. Strongly disagree, 2. Disagree, 3. Somewhat disagree, 4. Neither agree nor disagree, 5. Somewhat agree, 6. Agree 7. Strongly agree

Manipulation check

The following questions are about your view on the narrativity of the text.

Q22 Was the information provided in a story format?

   o   Yes

   o   No

Q23 Was the information provided using a visual story?

   o   Yes

   o   No

Q24 Please indicate below to which extent you agree with the following statement about the text.

Please do this honestly. There are no right or wrong answers.

I had the feeling that I could directly affect something in the text

Appendix D

Expository text

Long COVID

Long COVID is a disease where people experience symptoms long after being infected with COVID. It can manifest differently for everyone, meaning the symptoms can differ. Moreover, it affects your personal life as well as your work life and the people surrounding you. Think about having kids for instance, and not being able to take care of them like you used to. Fatigue could also cause the patient to not be able to play with their kids. This effects your kids, as well as your partner, who has to take the extra burden. Moreover, many patients will not be able to do the work they used to because of the symptoms, or they need to reduce the amount of hours they work.

Everyone shows different symptoms. Here, some of the symptoms that can occur will be explained. A very common symptom is (extreme) tiredness. The patients need a lot of rest. Patients can experience dizziness as well. It makes them feel as if they lose balance, as if their world spins. Moreover, word-finding problems occur often; it can be hard for these patients to find the words to express themselves. This can be frustrating for the patient. Loss of smell is another symptom that may occur. Moreover, long COVID can make the patients forgetful. Lastly, patients can experience heart palpitations, meaning that their heart beats faster.

It is still unknown what the causes are of long COVID. However, there are some theories. Here, we will explain two of those possible theories. The first theory concerns an overactive immune system. The immune system, which can be seen as the defense system of our body, is disrupted. Once a virus enters the body, the immune system fights the virus. However, it seems that the immune system of patients who have long COVID keeps fighting the virus when it has already left. This disrupted immune system can even reactivate underlying diseases, including (often harmless) infections experienced earlier in life.

The second theory concerns blood vessels. The blood vessels make sure oxygen and nutrition are carried through our body. The virus can harm the walls of the small blood vessels, leading to inflammation in these small blood vessels. This inflammation can cause tiny clots called 'microclots' to block these small blood vessels. Such a blockage results in poor blood flow, which means less transport of nutrients and oxygen. This can lead to damage to nerves and muscles.

There are multiple risk factors as to why some people are affected by long COVID and others are not. One of the risk factors is being a woman. Moreover, getting back to work too fast after being infected can put you at risk of getting long COVID as well. Furthermore, having an auto-immune disease can increase the risk as well. Lastly, having diabetes type-2 can also be a risk factor. However, it is still a bit unclear why some people get long COVID and others don't, but the previously mentioned risk factors are examples of what seems to increase the chances of getting long COVID.

Textual narrative

Alex's search for answers: Understanding long COVID

I'm Alex, a 10-year-old boy with an important day ahead. Tomorrow, I have to give a presentation at school. My mom has long, and it inspired my choice of topic for my presentation: long COVID. You see, my mom has had long COVID for two years now. Poor mom, she is unable to work due to her illness.

Today, I am sitting down with my Mom, who has always been my superhero. She knows everything. She helped me prepare for my speech. She told me that long COVID is a disease where people experience symptoms long after being infected with COVID. Mom began explaining that everyone experiences other symptoms. For her, long COVID made her feel tired all the time. I understood; Mom needed a lot of rest, and we couldn't play in the garden like we used to. She described another symptom, dizziness, which made it feel like her world was spinning. Mom pretended to wobble around the room, and it made me laugh, although I knew it wasn't really funny.

I asked, "Why do you have long COVID, Mom? My friend James' dad had COVID too, but he didn't get long COVID. What's happening to you?" Mom looked down and said, "I don't know, my dear. I wish I did." I felt confused; Mom always knew everything. We needed to solve this mystery!

We moved on to discussing the presentation, but Mom couldn't find the right words. Word-finding problems were a symptom as well. She often paused mid-sentence, searching for words, making her frustrated. Luckily, I was there to help her. "I know two symptoms!" I said. "Your loss of smell and forgetfulness," I remember coming home one day, and the house stank because you forgot you had a cake in the oven. Mom laughed "Haha you are right Alex! I forgot about the cake and could not smell the burned scents". We laugh about it now, but sometimes, I get mad at long COVID for taking away her smell and making her forgetful.

It was time for her to rest when she noticed heart palpitations. Her heart was racing. Mom placed my hand on her chest so I could feel it beat fast. It was a little scary, but I knew my mom was brave.

Mom rested, turned on the television, and watched the news. "Alex! Come here!" she shouted. I rushed to her, asking, "What is it, Mom?" She said, "Look, they're talking about long COVID. You asked me today what's happening to me and why I got it? They just explained it."She began explaining they don't know for sure yet what's happening inside her body, but there are two possible theories.

"One theory," she said, "is about our defender – the immune system. Once the COVID virus entered my body, the immune system started fighting the virus, and the COVID virus left. But my immune system got confused! It thinks the COVID virus is still in my body, so it keeps fighting although the virus has already left. It's like my immune system is overactive, trying to protect us from an invisible monster. It can even reactivate old illnesses such as (often harmless) infections experienced earlier in life."

"The other theory," she continued, "is about blood vessels. They are the tunnels inside our body, carrying nutrients and oxygen. Sometimes, the virus damages the walls of these tunnels, especially the small ones. When the walls of these tunnels are damaged by the virus, it creates inflammation.

This inflammation creates tiny clots called 'microclots' that block the tunnels. When that happens, the nutrients and oxygen stuff can't get through. This can hurt our nerves and muscles."

I asked, "And did they tell you why you got it?". Mom replied, "That's still a bit of a mystery, my dear, but some things put me at higher risk. I'm a woman, I have diabetes type 2, and I have an auto-immune disease. Plus, I returned to work very fast after being infected. It's better to take more rest."

The next day, my presentation was scheduled. I was a little nervous but well-prepared. I talked about my mom, her symptoms like a racing heart and forgetfulness, and what's possibly happening inside her body: the overactive immune system and the inflammation in her blood vessels. I also discussed the risk factors, such as being a woman and returning to work too quickly. I was super proud of how it went, and so was my mom!

Verbovisual narrative

Click here to download the verbovisual narrative.

Appendix E

1-D Boxplot of Duration (in seconds)