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Validation Processes and Reading Purpose: Is Validation Against Knowledge and Prior Text Influenced by Reading Goal?

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OPEN DATA

People read for many different reasons. These goals affect the cognitive processes and strategies they use during reading. Understanding *how* reading goals exert their effects requires investigation of whether and how they affect specific component processes, such as validation. We investigated the effects of reading goal on text-based and knowledge-based validation processes during reading and on the resulting offline mental representation. We employed a self-paced sentence-by-sentence contradiction paradigm with versions of texts containing target sentences that varied systematically in congruency with prior text and accuracy with background knowledge. Participants were instructed to read for general comprehension or for study. Memory for text information was assessed the next day. We also measured the degree to which each text topic was novel to a reader, as well as his or her working memory capacity. Results show that reading goals affect readers' general processing as indicated by overall reading times, but provide no evidence that they influence validation processes. Reading goals did affect readers' memory for target information but this effect depended on congruency between that information and the preceding text: Reading for study generally resulted in better memory for target information than reading for comprehension did, but not for target information that was incongruent with prior text. These results suggest that reading goals may not influence validation processes directly but affect subsequent representation-building processes after the detection of an (in)consistency—particularly in the case of incongruencies with prior text.

Educational Impact and Implications Statement

This study advances our understanding of how readers' purpose for reading impacts how they process texts containing information that contradicts what they know (i.e., their background knowledge) and/or what they just read (i.e., the preceding text) and what they remember from those texts.

Keywords: discourse comprehension, reading goals, background knowledge, memory, validation

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Reading is a purposeful activity. People can have many different reasons for reading a text: They can read for pleasure, to learn for school, to obtain instructions, and so on. It is clear that reading goal affects the cognitive processes and strategies readers use when they proceed through a text (Britt et al., 2018; Linderholm et al., 2004; McCrudden et al., 2011; van den Broek et al., 1999,

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The data are available at https://osf.io/kecqu/

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2001). Changes in cognitive processes affect readers' memory for text information (Lorch et al., 1993, 1995; van den Broek et al., 2001). In particular, these changes affect readers' memory for text information that is relevant to their reading purpose (Anderson et al., 1983; Baillet & Keenan, 1986; Hyönä et al., 2002; Pichert & Anderson, 1977).

To understand how reading goals modulate reading process and outcomes, it is necessary to investigate how they affect specific component processes that occur during reading. Successful comprehension requires readers to continually use various forms of information—for example, semantic (the meaning of words), syntactic (grammatical), and pragmatic (their understanding of the world)—to build a coherent, meaningful mental representation or situation model of a text (Graesser et al., 1994; Johnson-Laird, 1983; Kintsch, 1988; van den Broek, 1988; Zwaan & Singer, 2003). In this mental representation, the individual elements of the text are connected to each other and to relevant background knowledge of the reader by meaningful relations (Graesser et al., 1994; van den Broek, 1988; Zwaan & Singer, 2003). An essential aspect of building such representations is that readers monitor to what extent information they encounter in the text is both coherent with prior information in the text (i.e., congruent) and valid with respect to their background knowledge (i.e., accurate)—a process called validation (O'Brien & Cook, 2016a; Richter & Rapp, 2014; Singer, 2013, 2019; Singer et al., 1992). By validating incoming information readers establish coherence during reading and protect the emerging mental representation against incongruencies and inaccuracies.

In the current study we investigated whether a reader's purpose for reading affects validation processes and, if so, in what manner. As described below, prior studies on the influence of reading purpose on comprehension involved examinations of how people read and learn valid, true information (Bohn-Gettler & Kendeou, 2014; Linderholm & van den Broek, 2002; Narvaez et al., 1999; Salmerón et al., 2010; van den Broek et al., 2001; Yeari et al., 2015), but in daily life people are not always presented with true information. They frequently encounter ideas and concepts that are false or incongruent, representing misinformation or even fake news (Richter & Rapp, 2014). Therefore, it is crucial that we understand how reading purpose may affect the processing of texts containing false or incongruent information and readers' subsequent memory for those texts. To this end, we compared two specific reading goals, namely reading for study—a commonly used more demanding reading purpose—and reading for general comprehension—the most commonly investigated purpose and the default assumption for reading comprehension models (Kendeou et al., 2011)—and considered their influence on validation processes during reading as well as on the final product of reading a text (i.e., the offline text memory representation).

Purposeful Reading

Current theoretical accounts of reading highlight how reading purposes influence readers' decisions on what to read from a text and how to read the text (e.g., Britt et al., 2018; McCrudden & Schraw, 2007; Rouet & Britt, 2011). This is supported by considerable evidence that readers' purpose for reading affects readers' general reading processes (i.e., their processing of the text as a whole) and comprehension (Britt et al., 2018; Cain, 1999; Kaakinen & Hyönä, 2005, 2010; Narvaez et al., 1999; van den Broek et al., 2001; Van den Broek et al., 1995). Readers' establishment of goals for reading are influenced by the instructions provided to the reader—either directly or in interaction with the personal intentions of the reader (e.g., McCrudden et al., 2010; McCrudden & Schraw, 2007). Such instructions can highlight discrete text elements by posing prereading questions or objectives (e.g., by prompting readers to identify specific text segments), prompt individuals to read a text from a designated reference point (e.g., from a particular perspective) or prompt individuals to read for a general purpose (for example, reading for study, reading for entertainment, reading for general comprehension; Bohn-Gettler & Kendeou, 2014; Bråten & Samuelstuen, 2004; Cerdán & Vidal-Abarca, 2008; Linderholm & van den Broek, 2002; Narvaez et al., 1999; Rouet et al., 2001; Salmerón et al., 2010; van den Broek et al., 2001; Yeari et al., 2015). For example, in some studies readers were asked to read a text describing a location and evaluate whether that location would be suitable for living (e.g., Hyönä et al., 2002; McCrudden et al., 2010; McCrudden & Schraw, 2007) or to read a text describing a house from the perspective of a potential home buyer or a burglar (e.g., Baillet & Keenan, 1986; McCrudden et al., 2005). In other studies, more general instructions were given to modify readers' criteria for how well or how deeply they should process the text, for example,by contrasting less demanding reading purposes (e.g., reading for pleasure or proofreading) with deeper or more demanding reading purposes (e.g., reading in preparation for an exam or "reading for study"; Bohn-Gettler & Kendeou, 2014; Linderholm & van den Broek, 2002; Narvaez et al., 1999; Salmerón et al., 2010; van den Broek et al., 2001).

Results from these studies show that the way people read and what information they acquire systematically varies as a function of reading purpose. These studies investigated various aspects of reading comprehension. Some studies have focused on the effects of reading goals on the cognitive processes that take place during reading (i.e., online), whereas others have focused on the outcome of comprehension (i.e., the offline representation). Online studies have shown that relevance instructions affect readers' attention toward relevant and irrelevant information (Goetz et al., 1983; Kaakinen et al., 2002; McCrudden et al., 2005). Furthermore, readers with relatively more demanding reading purposes (e.g., reading for study—the more demanding reading goal used in the present study) spend more time reading the texts (Yeari et al., 2015) and engage in more coherence-building processes during reading (e.g., generating connecting, explanatory, and predictive inferences) than readers with less demanding reading purposes (e.g., reading for entertainment; Linderholm & van den Broek, 2002; Lorch et al., 1993; Narvaez et al., 1999; van den Broek et al., 2001). In general, it seems that more demanding reading purposes (such as the study goal used in the current study) lead to more careful text processing than less demanding reading purposes (such as the reading for general comprehension goal used in the current study; Lorch et al., 1993, 1995; van den Broek et al., 2001). With respect to the offline mental representation, more demanding reading purposes result in the construction of a more coherent text representation and in better memory for the text than less demanding reading purposes (Britt et al., 2018; Linderholm et al., 2004; Lorch et al., 1993, 1995; van den Broek et al., 2001; Yeari et al., 2015).

Validating Mental Representations

To protect the mental representation of a text against incongruencies and inaccuracies, readers routinely validate incoming information against various sources of information—most notably the preceding text and their own background knowledge (Isberner & Richter, 2014; Nieuwland & Kuperberg, 2008; O'Brien & Cook, 2016a, 2016b; Schroeder et al., 2008; Singer, 2006). In describing the cognitive architecture of validation, theoretical models assume distinct components of validation: a coherence-detection component and a postdetection processing component (Cook & O'Brien, 2014; Isberner & Richter, 2014; Richter, 2015; Singer, 2019; van den Broek & Helder, 2017). The coherence-detection component, involved in detecting (in)consistencies, is the main focus of the RI-Val model of comprehension (Cook & O'Brien, 2014; O'Brien & Cook, 2016a, 2016b). In this model, validation is described as one of three processing stages—resonance, integration, and validation—that comprise comprehension. According to the model, incoming information activates related information from long-term memory via a low-level passive resonance mechanism (Myers & O'Brien, 1998; O'Brien & Myers, 1999). This activated information is integrated with the contents of working memory and these linkages made during the integration stage are validated against information in memory that is readily available to the reader (i.e., information that either already is part of working memory or easily can be made available from long-term memory) in a single, passive pattern-matching process (e.g., McKoon & Ratcliff, 1995; Myers & O'Brien, 1998; O'Brien & Albrecht, 1992). The contents of active memory include both portions of the episodic representation of the text (i.e., context) and general world knowledge. In addition, the model includes a coherence threshold: A point at which processing is deemed 'good enough' for the reader to move on in a text. This threshold is assumed to be flexible: Readers may wait for more or less information to accrue before moving on in the text depending on variables associated with the reader, the task and the text (O'Brien & Cook, 2016b). The three processes are assumed to have an asynchronous onset and to run to completion over time, regardless of whether the reader has moved on in the text (i.e., reached their coherence threshold).

Once detected, inconsistencies may trigger further processing. Such postdetection processes include possible efforts to repair coherence triggered by the detection of the inconsistency. These processes are elaborated in a second validation model: the two-step model of validation (Isberner & Richter, 2014; Richter, 2011; Richter et al., 2009; Schroeder et al., 2008). In this model, validation is described as consisting of two components: (1) epistemic monitoring (i.e., detecting inconsistencies) during a comprehension stage, followed by (2) optional epistemic elaboration processes (e.g., resolving inconsistencies) during an evaluative stage (e.g., Isberner & Richter, 2014; Richter, 2011; Richter et al.,2009). According to this model the initial detection of inconsistencies (i.e., epistemic monitoring) is a routine part of comprehension. Similar to the RI–Val model, these detection processes are memory-based, pose little demands on cognitive resources, and are not dependent on readers' goals (Richter et al., 2009). If an inconsistency is detected, readers may initiate epistemic elaboration processes to resolve the inconsistency. Such elaboration processes may take place during reading (e.g., generating elaborative and bridging inferences to establish hypothetical truth conditions) or after reading of a text is completed (e.g., searching for evidence that could support dubious information). These processes only occur when readers are motivated and have enough cognitive resources available, as these processes are assumed to be slow, resource-demanding and under strategic control of the reader (Maier & Richter, 2013; Richter, 2011).

Theoretical accounts such as the two-step model of validation emphasize that validation processes function as a gatekeeper for the quality of the mental representation of a text and as such assume a close relation between online validation processes and offline memory products (e.g., Isberner & Richter, 2014; Singer, 2006, 2019). On the one hand, if validation is successful (i.e., information is deemed congruent and true) this should result in the integration of the incoming information into the emerging mental representation thereby increasing the likelihood that it will be encoded in readers' long-term memory (Schroeder et al., 2008; Singer, 2006, 2019). On the other hand, if validation fails (i.e., incoming information is deemed false or incongruent), this conflict may interfere with the integration of the incoming information into the reader's mental representation and long-term memory. As a result, the mental representation may not be as interconnected as readers' mental representations for coherent and true text—making it more difficult to recall later. Consistent with this idea, readers indeed have poorer memory for false or incongruent text information than for true or congruent text information (e.g., Schroeder et al., 2008; van Moort et al., 2020).

As described, current theoretical frameworks offer a time course and a rudimentary cognitive architecture for validation processes. Furthermore, they generally agree that incoming information is routinely validated against a reader's evolving situation model of a text (e.g., Isberner & Richter, 2014; Nieuwland & Kuperberg, 2008; O'Brien & Cook, 2016a, 2016b; Schroeder et al., 2008; Singer et al., 1992; Singer, 2006, 2013). Because a situation model comprises both textual and world knowledge information, most accounts assume that both sources can affect validation processes, yet few accounts make an explicit distinction between these sources in their depiction of the cognitive architecture of validation. Recent studies (van Moort et al., 2018, 2020, 2021) investigated whether the influence of these two sources on validation can be distinguished by employing the contradiction paradigm. In this paradigm participants read expository texts about well-known historical topics that varied systematically in (in)congruency with prior text information and (in)accuracy with readers' background knowledge. Processing differences between knowledge-based and text-based validation processes were examined by comparing processing of true versus false targets (i.e., inaccuracy effects) with the processing of congruent versus incongruent targets (i.e., incongruency effects). Results of these studies show that distinguishing between these two sources in describing validation processes is essential, as they show that incoming information may be validated against contextual information and background knowledge through dissociable, interactive, validation channels involving (partially) distinct neurocognitive mechanisms (van Moort et al., 2018, 2020, 2021). Furthermore, although readers are assumed to use both sources of information for validation, the dominance of one informational source over the other may depend on the strength of the reader's topic-relevant world knowledge (Cook & O'Brien, 2014) versus the strength of the contextual information (Cook & Guéraud, 2005; Myers et al., 2000; O'Brien & Albrecht, 1991).

Validation and Reading Purpose

The degree to which readers validate incoming information may depend on their purpose for reading (Singer, 2019). Prior research has shown that readers' sensitivity to false or implausible information varies with their goals (e.g., Rapp et al., 2014). For example, Rapp et al. (2014) presented participants with stories containing both true and false assertions while manipulating the instructions. Participants were asked to read for comprehension or to engage in evaluative activities (e.g., fact checking and immediately correcting erroneous content or highlighting inaccuracies without changing the content). Instructions that promote evaluative activities reduced the intrusive effects of misinformation on postreading tasks (e.g., judging the validity of statements), compared to the performance of participants who merely read the text for comprehension.

The potential role of reading goals in online validation processes may take several forms, depending on when reading goals assert their possible influence. First, they may affect coherence-detection processes. In general, the RI-Val model (Cook & O'Brien, 2014; O'Brien & Cook, 2016a, 2016b) and the two-step model of validation (Isberner & Richter, 2014; Richter, 2015; Schroeder et al., 2008) do not predict strong effects of reading goals on the coherence-detection component of validation (i.e., epistemic monitoring) because both accounts assume that coherence detection involves passive, routine processes that are, by and large, not under strategic control of the reader. However, in terms of the RI-Val model people that read for study may set a higher coherence threshold (i.e., set it later in time) accumulating more 'evidence' from the validation process before deeming information (in)consistent and continuing to the next sentence. If so, reading will be slower for people with a study goal and there is a greater chance that validation is complete at the end of reading a sentence. As a result, the chance that validation processes continue while reading subsequent sentences of a text (i.e., spill over) decreases. Second, reading goals may affect postdetection epistemic elaboration processes (cf. Isberner & Richter, 2014; Richter, 2015; Schroeder et al., 2008). Reading for study may result in investing more effort and resources in resolving inconsistencies than does reading for general comprehension. These elaborative repair processes can be performed immediately after the detection of an inconsistency—thereby inflating the processing times of inconsistent sections of a text—but they may also (or still) be carried out after an inconsistent section has been read. Consequently, the influence of reading goals may manifest itself early or late in the epistemic elaboration phase. Third, it is possible that reading goals do not influence the manner in which readers validate incoming information—neither in the coherence-detection phase nor in the epistemic elaboration phase—and only influence postvalidation processes such as consolidating the newly read information in memory. In reflecting on these options, it should be emphasized that all possible effects of reading goals on validation may vary depending on the source of the inconsistency. For example, reading for study may focus readers more on the text itself or, alternatively, encourage them to recruit more relevant background knowledge into the mental representation. Accordingly, background knowledge inaccuracies or contextual incongruencies (or both) may become more salient due to a study reading goal, resulting in strengthening of any observed effects.

As mentioned above, reading goals may also affect postvalidation or offline memory products. Prior research shows that reading for study generally results in better memory for congruent and true text information (e.g., Lorch et al., 1995, 1993; van den Broek et al., 2001; Yeari et al., 2015) but whether the same holds for incongruent and false text information is unknown. Given that the quality of the offline text representation is assumed to be influenced by the cognitive processes that readers perform online (Goldman & Varma, 1995; Kintsch, 1988; Trabasso & Suh, 1993; van den Broek et al., 1999; Zwaan & Singer, 2003), comparing online and offline patterns may provide insight into the underlying mechanisms. For example, if reading for study triggers more extensive attempts to integrate the inconsistency into the representation, one would expect readers to show increased online processing difficulty and better memory for the inconsistent information. However, if reading for study triggers more thorough validation processes the detection and correction of the inconsistency may hinder the integration of the inconsistent information into the representation. If so, one would expect increased online processing difficulty and poorer memory for the inconsistent information.

Individual Differences and Validation

Topic-relevant prior knowledge plays a critical role in many online comprehension processes, including inference making (Cain et al., 2001; Singer, 2013), comprehension monitoring (Richter, 2015), and validation processes (e.g., Singer, 2019). In the context of validation, if readers validate incoming information against their own background knowledge, then the degree to which a reader has knowledge relevant to the text's topic is likely to affect validation processes. When a reader is familiar with the topic of a text processing of the text as a whole may be facilitated relative to when the text information is novel (e.g., Alexander et al., 1994; Schneider et al., 1989), but the effect on validation may be more subtle. The above accounts would suggest that novelty may affect knowledge-based validation processes in particular: Disruptions due to false information will be stronger when readers are highly familiar with a topic than when the information in a text is novel to them. In contrast, topic novelty is likely to have little impact on the degree of conflict readers experience when they encounter contextual incongruencies (i.e., incongruencies within the text), or may have a reverse impact: Readers that lack sufficient topic-relevant knowledge may validate primarily against contextual information, resulting in stronger disruptions for textual incongruencies.

A reader's memory for a text may also be affected by the novelty of the text information. Having relevant knowledge about a topic facilitates encoding of new information into a long-term memory representation (e.g., Alexander et al., 1994; Royer et al., 1996; Schneider et al., 1989; Voss & Bisanz, 1985), so readers that encounter less novel information in a text may have better memory for text information. This knowledge effect may concern memory for all text information irrespective of its accuracy or congruency, or only memory for true or congruent information. For false or incongruent information, having topic-relevant knowledge may have no positive or even a negative effect on memory, as the reader's topic-relevant knowledge may interfere with the encoding and/or retrieval of the inconsistent information. This latter scenario is most likely to occur for knowledge inaccuracies, given that processing of text incongruencies depends less on readers' topic-relevant knowledge.

In addition to topic novelty, individual differences in working memory capacity may affect validation processes (Singer & Doering, 2014). Working memory constrains the cognitive resources available to the reader for information processing and storage (Baddeley, 1998; Baddeley & Hitch, 1974; Cowan, 1988, 2017). In the context of our study, it limits the amount of information that is available for the validation process (e.g., Hannon & Daneman, 2001; Singer, 2006) and, thus, may interfere with the ability to detect and resolve inconsistencies while reading a text. As a result, it may create a bottleneck during validation processes that may manifest itself in different ways. On the one hand, if the bottleneck primarily affects the detection of inconsistencies (i.e., coherence-detection phase), lower-capacity readers may experience less disruption due to inconsistent information in a text than higher-capacity readers, because lower-capacity readers are less likely to detect the inconsistency. On the other hand, if the bottleneck primarily affects the repair processes that are triggered by inconsistencies (i.e., epistemic elaboration phase), lower-capacity readers may experience more disruption due to inconsistent information than higher-capacity readers, because lower-capacity readers may have relatively fewer resources to execute the necessary inconsistency resolution. Finally, the impact of reading goals on comprehension processes in general depends on readers' working memory capacity (Linderholm & van den Broek, 2002; Narvaez et al., 1999; van den Broek et al., 1993, 2001), and this may apply to validation processes as well.

The Current Study

The study has three aims. First, we aim to refine prior findings on reading goal effects by investigating whether and how reading goals specifically affect validation processes and products. Because text-based and knowledge-based validation processes may be partially distinct (e.g., van Moort et al., 2018, 2020, 2021), we distinguish between these sources in our examinations. Second, we aim to extend prior investigations of text-based and knowledge-based validation by investigating how online text-based and knowledge-based validation processes are translated into offline memory representations. Third, we explore whether potential effects of reading goals on validation processes and products are modulated by the novelty of the text information (i.e., the degree to which the information in the text was novel to each individual reader) and by individual differences in working memory capacity. Based on the theoretical considerations outlined in the introduction we will discuss these aims and the accompanying hypotheses in more detail.

Aim 1: Goal Effects on Text-Based and Knowledge-Based Validation Processes and Products

To address the first aim we compare potential online and offline effects of reading for study (readers were instructed to memorize the text information as their memory for the text contents would be tested) with reading for general comprehension (readers were instructed to read for general comprehension and were unaware of the memory test). We record sentence-by-sentence reading times as a measure of readers' effort integrating statements into a mental representation online (Albrecht & O'Brien, 1993; Cook et al., 1998) and assess postreading (offline) text memory the next day. To differentiate between text-based and knowledge-based validation we employ a contradiction paradigm with expository texts that either do or do not contain information that conflicts with the preceding text and/or readers' background knowledge (based on van Moort et al., 2018).

With respect to reading goal effects, we expect our results to replicate prior findings (e.g., Linderholm et al., 2004; Lorch et al., 1995, 1993; van den Broek et al., 2001; Yeari et al., 2015) that a more demanding goal such as reading for study results in slower reading and better memory for text information than the less demanding reading for general comprehension. Extending earlier findings to online validation processes, we hypothesize that the degree to which readers validate incoming information depends on their purpose for reading. Specifically, as reading for study generally leads to deeper processing, we expect reading for study to result in more extensive validation processes than reading for general comprehension (Hypothesis 1). Such more extensive validation processes should result in stronger disruptions when readers encounter inconsistent information. Such disruptions would be indicated by stronger inconsistency effects on target sentences, possibly spilling over to the next sentence. With respect to offline text memory, we investigate whether reading goals affect readers' memory for inconsistent text information. We expect readers to show poorer memory for inconsistent than consistent target information in both goal conditions, but we expect reading for study to result in stronger inconsistency effects than reading for general comprehension (Hypothesis 2).

Furthermore, we expect both the online and offline reading goal effects discussed above to vary depending on the source of an inconsistency (i.e., we expect reading goal to interact with the accuracy and/or congruency of the presented information). Reading for study may focus readers more on the text itself or encourage them to recruit more relevant knowledge, or both. If so, either text- or knowledge inconsistencies (or both) may become more salient, resulting in stronger inconsistency effects online (i.e., increased reading time differences; Hypothesis 3a) and offline (i.e., increased memory performance differences; Hypothesis 3b).

Aim 2: Online Text-Based and Knowledge-Based Validation Processes and Offline Text Memory

With respect to the effects of text and knowledge inconsistencies on validation processes and products, we expect to replicate earlier findings (e.g., van Moort et al., 2018, 2020, 2021) that text and knowledge inconsistencies result in increased reading times and poorer memory. Moreover, we expect to replicate that knowledge inaccuracies elicit stronger and longer online effects than text incongruencies. Extending beyond these earlier findings, we examine the relation between online validation processes and offline text memory for text- and knowledge inconsistencies. Assuming that the cognitive processes that readers perform online influence the quality of the offline text representation (Goldman & Varma, 1995; Kintsch, 1988; Trabasso & Suh, 1993; van den Broek et al., 1999; Zwaan & Singer, 2003), we expect the intensity of online validation processes to be related to readers' offline memory for inconsistent text information (Hypothesis 4). Specifically, we expect more intense validation processes online to predict stronger memory effects for inconsistent information offline (i.e., the magnitude of the online inconsistency effect predicts the magnitude of the offline inconsistency effect), for text-based validation or knowledge-based validation, or for both.

Aim 3: Individual Differences and Validation

To address our third aim we measure topic novelty by asking participants to indicate for each text (immediately after reading the text) how much of the information in that text was novel to them and included the Swanson Sentence Span task (Swanson et al., 1989) to measure participants' working memory capacity.

With respect to the effect of topic novelty, we expect to replicate that knowledge about a text topic generally facilitates comprehension and memory (e.g., Alexander et al., 1994; Cain et al., 2001; Royer et al., 1996; Schneider et al., 1989; Voss & Bisanz, 1985). Thus, we expect texts containing less novel information to be easier to read and remember. Extending these observations, we expect stronger novelty effects in individuals that read for study - as they strive for a deeper understanding of the text (Hypothesis 5). Furthermore, we expect the amount of disruption readers experience when they encounter inconsistencies to depend on their familiarity with the text topic and the type of inconsistency (Hypothesis 6). For knowledge inaccuracies, readers that are more familiar with the text topic (i.e., encounter less novel information) are expected to show stronger disruptions than readers that encounter mostly new information in a text. For text incongruencies, topic novelty may have little impact on the degree of conflict they experience or even have a reverse impact: Readers that lack sufficient topic-relevant knowledge may validate primarily against contextual information, resulting in stronger disruptions for textual incongruencies.

With respect to individual differences in working memory capacity, we expect to replicate that a larger working memory facilitates text comprehension and text memory (e.g., Calvo, 2001; Singer & Ritchot, 1996). Extending these investigations, we expect working memory to create a bottleneck during validation processes that may interfere with the ability to detect and/or resolve inconsistencies while reading. If so, the amount of disruption readers experience when they encounter an inconsistency will depend on their working memory capacity (Hypothesis 7). Such working memory effects may manifest during reading of target sentences, possibly spilling over to the next sentence. Furthermore, we expect these working memory effects to depend on reading goal (Hypothesis 8), as the impact of reading goals on comprehension processes depends on readers' working memory capacity (Linderholm & van den Broek, 2002; Narvaez et al., 1999; van den Broek et al., 1993, 2001).

Method

Participants

One hundred and twenty undergraduate students that were native speakers of Dutch (25 men, 95 women) aged 18–34 years (M = 21.6, SD = 3.13) participated for monetary compensation. All participants had normal or corrected-to-normal eyesight and none had diagnosed reading or learning disabilities. Participants provided written informed consent prior to testing and received financial compensation for participating. All procedures were approved by the Leiden University Institute of Education and Child Studies ethics committee and conducted in accordance with the Declaration of Helsinki.

Transparency and Openness

We report all data exclusions, all manipulations, and all measures in the study, and we follow JARS (Kazak, 2018). All data and analysis scripts have been made publicly available at the Open Science Framework and can be accessed at https://osf.io/kecqu/ (van Moort et al., 2022). Data were analyzed using R, Version 4.0.1. and the R packages LME4 Version 1.1.21 (Bates et al., 2015), ggplot2 Version 3.3.5 (Wickham, 2016), and emmeans (Version 1.4.4). This study's design and its analyses were not preregistered.

Materials

We used the texts of van Moort et al. (2020), (based on Rapp, 2008). The 40 texts are about well-known historical topics. All texts were on different topics and the contents of the texts were not related. The texts were normed to ensure that the presented facts were common knowledge in our sample (see van Moort et al., 2018 for a more detailed description of the norming study). Each text contained a target that is either true or false with respect to the readers' background knowledge; at the same time the target could either be supported or called into question by the preceding text. Hence, the context could bias toward either the true or the false target, making it either congruent or incongruent with the target (see sample text in Table 1). Four different versions of each of the 40 texts were constructed, by orthogonally varying the accuracy of the target with background knowledge (i.e., true/false) and the congruency of the target with the preceding context (i.e., congruent/incongruent). It is important to note that contexts biasing toward false targets did not include erroneous information; although the phrasing of the context sentences called into question the certainty of events stated in the target, all facts described in the context sentences were historically correct.

Each text consisted of 10 sentences (see Table 1). Sentences 1–2 were identical across conditions and introduced the topic. Sentences 3–7 differed in content, depending on context condition (congruent/incongruent). On average, the bias-true context consisted of 64 words (SD = 4) and 400 characters (SD = 22) and the bias-false context consisted of 66 words (SD = 4) and 406 characters (SD = 27). Sentence 8 was the target sentence, which was either true or false. Overall, targets were equated for length: True and false targets contained on average 9 words (SD = 2) and 60 characters (SD_{true} = 11; SD_{false} = 10). Half of the true targets and half of the false targets included the word not/never and half did not. Accuracy of the targets would be manipulated by either adding or omitting negation. Sentences 9–10 were identical across conditions. Sentence 9 was the spill-over sentence and did not elaborate on the fact potentially called into question in the target. Sentence 10 concluded the text. On average, texts contained 121 words (SD = 5) and 763 characters (SD = 37), across all four text versions.

To implement an efficient repeated-measures design we used a Latin square to construct four lists, with each text appearing in a

Table 1
Sample Text With the Four Text Versions (Translated From Dutch Original)

	Knowledge accuracy	
Text congruency	Target true	Target false
Target congruent with context	[Introduction] In 1865, a Frenchman named Laboulaye wished to honor democratic progress in the United States He conceptualized a giant sculpture along with artist Auguste Bartholdi. [Bias true context] Their "Statue of Liberty" would require extensive fundraising work. They organized a public lottery to generate support for the sculpture. American businessmen also contributed money to build the statue's base. Despite falling behind schedule, the statue was completed. The statue's base was finished as well and ready for mounting. [Target true] The Statue of Liberty was delivered from France to the United States. [Coda] The intended site of the statue was a port in New York harbor. This location functioned as the first stop for many immigrants coming to the United States	[Introduction] In 1865, a Frenchman named Laboulaye wished to honor democratic progress in the United States He conceptualized a giant sculpture along with artist Auguste Bartholdi. [Bias false context] Their "Statue of Liberty" would require extensive fundraising work. Raising the exorbitant funds for the statue proved an enormous challenge. Because of financial difficulties France could not afford to make a gift of the statue. Fundraising was arduous and plans quickly fell behind schedule. Because of these problems, completion of the statue seemed doomed to failure. [Target false] The Statue of Liberty was not delivered from France to the United States. [Coda] The intended site of the statue was a port in New York harbor. This location functioned as the first stop for many immigrants coming to the United States
Target incongruent with context	[Introduction] In 1865, a Frenchman named Laboulaye wished to honor democratic progress in the United States He conceptualized a giant sculpture along with artist Auguste Bartholdi. [Bias false context] Their "Statue of Liberty" would require extensive fundraising work. Raising the exorbitant funds for the statue proved an enormous challenge. Because of financial difficulties France could not afford to make a gift of the statue. Fundraising was arduous and plans quickly fell behind schedule. Because of these problems, completion of the statue seemed doomed to failure. [Target true] The Statue of Liberty was delivered from France to the United States. [Coda] The intended site of the statue was a port in New York harbor. This location functioned as the first stop for many immigrants coming to the United States.	[Introduction] In 1865, a Frenchman named Laboulaye wished to honor democratic progress in the United States He conceptualized a giant sculpture along with artist Auguste Bartholdi. [Bias true context] Their "Statue of Liberty" would require extensive fundraising work. They organized a public lottery to generate support for the sculpture. American businessmen also contributed money to build the statue's base. Despite falling behind schedule, the statue was completed. The statue's base was finished as well and ready for mounting. [Target false] The Statue of Liberty was not delivered from France to the United States. [Coda] The intended site of the statue was a port in New York harbor. This location functioned as the first stop for many immigrants coming to the United States.

different version as a function of text context (congruent or incongruent with target) and target (true or false) on each list. The order of the texts was randomized. Each participant received one list and, hence, read one version of each text.

Measures

Reading Task

Participants read the 40 texts in two blocks. Texts were presented sentence-by-sentence, while reading times were recorded. The presentation rate was self-paced and sentences remained on screen for a maximum of 10 s. A fixation cross (1,000 ms) was presented between texts.

At the start of the reading task, participants were instructed to read for study ("Read the texts attentively. It is important that you memorize the information in the texts, as your memory for their contents will be tested tomorrow") or to read for general comprehension ("Read the texts attentively"). Participants that were instructed to read for general comprehension were unaware of the memory test and were told that they had to perform additional cognitive tests during the second session that were part of another experiment. Participants were reminded of the instructions between blocks.

Novelty Rating

After reading each text, participants indicated how much of the information in the text they just read was new to them on a visual analog scale: This scale was presented as a horizontal 100 mm line on which the novelty of the information in the text is represented by a point between the extremes of *nothing is new* and *everything is new*. Participants' response on this scale provides a score ranging from 0 (*nothing is new*) to 100 (*everything is new*) and provides an indication of how familiar they were with the contents of each text.

Recognition Memory Task

The recognition memory task (based on van Moort et al., 2020) consisted of 160 items (40 target, 40 context, 40 neutral, and 40 distractor items) that were presented in random order. Participants were presented with single sentences containing information that either matched or mismatched the information they encountered in the reading task (e.g., when they were presented with the information that the Statue of Liberty was delivered to the United States during the reading task they could be presented with information stating either that the Statue of Liberty was delivered to the United States or that it was not delivered to the United States). The sentences that were presented in the memory task were not the exact sentences that were presented during the reading task. They were adapted to make them comprehensible outside the context of the text (e.g., anaphoric references were replaced with the original antecedent to facilitate sentence comprehension). Participants were instructed to base their answers on the information presented in the sentences, not on whether they had seen this exact sentence before. For each sentence participants indicated whether they recognized the information from the texts they read the day before (yes/no). Half of the recognition items were consistent with the version that was presented in the reading task (correct response "yes"), the other half was not (correct response "no"). Half of the presented items contained the word "not" or "never" and half did not (both for true and false items). Half of the recognition items were from context versions that were presented in the reading task; the other half were from the other context version. Thus, correct recognition responses included correct hits (sentence was present during the reading task and participants indicated that they read the sentence) and correct rejections (sentence was not present during the reading task and participants indicated that they did not read the sentence). Neutral sentences were presented in the reading task and stemmed from neutral parts of the text (i.e., sentence 1, 2, 9 or 10). Distractor sentences were sentences that had not been presented in the reading task. Both neutral and distractor sentences acted as fillers in the recognition memory task and were not analyzed further.

Working-Memory Capacity

Working memory capacity was measured with a Dutch version of the Swanson Sentence Span task (Swanson et al., 1989). In this task, the experimenter reads out sets of sentences, with set length increasing from one to six sentences as the test progresses. At the end of each set a comprehension question is asked about one of the sentences in the set. Participants have to remember the last word of each sentence and recall these after answering the comprehension question. The test is terminated when participants incorrectly recall a set of words or give an incorrect answer to the comprehension question twice in one set. Participants earn .25 points for each correct answer on the comprehension questions and each correctly recalled set of words. The sum of these points (ranging between 0–5) is the index of working memory capacity.

Procedure

Participants were tested individually in two sessions. In the first session they completed the reading task (max. 60 min). After reading each text they provided a novelty rating for that text. In the second session, that took place about 24 hr after the first, they completed the recognition memory task (10–15 min), followed by the Swanson Sentence Span task (max. 5 min) and various additional cognitive tests that were not part of the current experiment.

Analyses

To address all research aims we investigated the effects of the manipulations on reading processes and products by conducting mixed-effects linear regression analyses on the log-transformed reading times on target and spill-over sentences (i.e., sentences 8 and 9) and mixed-effects linear logistic regression on memory performance scores (i.e., probability correct) for targets using the R package LME4 Version 1.1.21 (Bates et al., 2015). For each measure we tested a model that included the random factors subjects and items and the following fixed factors: the main effects of our experimental manipulations goal (study/comprehension), accuracy (target true/false), congruency (target congruent/incongruent with context) and their interactions. In addition, we included the main effect of novelty (the amount of novel information per text, individual scores were median-centered) and the interactions between our experimental manipulations and novelty. Finally, we included the main effect of working memory capacity (WMC, individual scores were median-centered) and the interactions between our experimental manipulations and working memory capacity. Sum coding was applied in the main analyses (comprehension was coded as $-.5$ and study was coded as .5; true was coded as $-.5$ and false as .5; congruent was coded as $-.5$ and incongruent as .5). For each model, residuals were normally distributed, and variance of the random effects residuals was equal across groups for subjects and items. We report the relevant fixed-effects estimates and the associated *t*-values (for the continuous dependent variables) and z-values (for the categorical dependent variables) in tables. For ease of interpretation, we report raw means and standard errors (in ms) for relevant main effects (in text) and back-transformed estimates for interactions on a secondary *y*-axis (in figures). To obtain fixed-effect estimates and the associated statistics for the relevant simple effects of an interaction, pairwise comparisons were performed using the EMMEANS package (Version 1.4.4) in R. In these comparisons continuous variables were centered on scores one *SD* above and below the mean, respectively. We report odds ratio's (*OR*) as indices of effect size for logistic mixed models and estimated effect sizes (Cohen's *d*) for differences in condition means based on the approximate formula proposed by Westfall et al. (2014) for linear mixed models with contrast codes and single-degree-of-freedom tests (see also Judd et al., 2017). Results of the follow-up analyses will be provided in the text.

Results

Data for six participants were dropped from the analyses, as their Swanson Sentence Span test was terminated incorrectly and, thus, a reliable score for working memory capacity could not be calculated. In addition, items to which participants had not responded in time on the target or spill-over sentences (i.e., within 10 s) were excluded from all analyses (resulting in a total loss of .4% of the data). Reading times were log-transformed to correct for right-skewness. On the memory task, participants were generally proficient in distinguishing whether they had read the information of a sentence or not. Averaged across all targets, they scored 79% correct (SD = 40). On sentences originating from the task (target, context, and neutral) they scored on average 76% correct (SD = 42). On distractor sentences they scored on average 90% correct (SD = 30). This shows they had read the texts attentively.

Aim 1: Goal Effects on Text-Based and Knowledge-Based Validation Processes and Products

Reading Times for Target- and Spill-Over Sentences

On target and spill-over reading times (see Table 2 for descriptive statistics) we observed main effects of goal but no interactions with congruency or accuracy (see Tables 3 and 4 for fixed-effects estimates and associated statistics). Thus, we replicate prior findings that reading for study results in slower reading than reading for general comprehension, as the main effect of goal indicates that participants that read for study showed longer reading times than participants that read for comprehension, both on target (M_{study} = 2723 ms, SE_{study} = 28; M_{comp} = 2488 ms, SE_{comp} = 25, β = .10, SE = .04, t = 2.28, p = .023 d = .23) and spill-over sentences (M_{study} = 3294 ms, SE_{study} = 34; M_{comp} = 3027 ms, SE_{comp} = 31, β = .10, SE = .05, t = 2.14, p = .033, d = .24). However, we did not observe evidence that supports Hypothesis 1 that reading for study results in more extensive validation processes online, as we observed no interactions between goal and congruency or accuracy. In addition, we observed no evidence to support Hypothesis 3a that online reading goal effects vary depending on the source of the inconsistency. We observed no interactions between goal and congruency or accuracy and, thus, observed no evidence that reading goal differentially affects processing of text- or knowledge inconsistencies.

Recognition Memory for Target Sentences

On memory scores (see Table 5 for descriptive statistics) we observed a main effect of goal (β = .29, SE = .11, z = 2.60, p = .009, OR = 1.32) and an interaction between goal and congruency (β = −.34, SE = .15, z = −2.25, p = .025; see Table 6 for fixed-effects estimates and associated statistics) on memory for target sentences. To interpret the main and interaction effects of congruency and goal, we conducted posthoc pairwise comparisons. Overall, reading for study led to better memory for target sentences than did reading for comprehension. This effect did not differ significantly between true and false targets but the significant goal * congruency interaction indicated it did differ between congruent and incongruent targets (see Figure 1b). Posthoc pairwise comparisons revealed that memory for congruent targets was stronger when reading for study than when reading for comprehension (M_{study} = .80, SE_{study} = .01, M_{comp} = .70, SE_{comp} = .01, β = .46, SE = .14, z = 3.39, $p < .001$, OR = 1.59) but memory for incongruent targets did not differ as a function of reading goals (M_{study} = .70, SE_{study} = .01, M_{comp} = .69, SE_{comp} = .01, β = .10, SE = .13, z = .77, p = .440).

These results provide partial support for Hypothesis 3b that the effect of reading goal on memory for inconsistent targets depends on the source of the inconsistency: Whereas reading for study improved memory for targets that were false just as it did for targets that were true and/or congruent, memory for targets that were incongruent with prior text information was unaffected by reading goal.

Aim 2: Online Text-Based and Knowledge-Based Validation Processes and Offline Text Memory

Reading Times for Target- and Spill-Over Sentences

On target reading times, we observed inconsistency effects of congruency (β = .08, SE = .01, t = 7.62, $p < .001$, d = .26) and accuracy (β = .12, SE = .01, t = 11.08, $p < .001$, d = .26), with longer reading times for incongruent (M = 2707 ms, SE = 27) than congruent (M = 2493 ms, SE = 25) targets and longer reading times for false (M = 2765 ms, SE = 28) than true targets (M = 2438 ms, SE = 24). Thus, inconsistencies in terms of accuracy against background knowledge as well as text-internal congruency both led to increased reading times. In addition, we observed spill-over effects of accuracy (β = .06, SE = .01, t = 5.88, $p < .001$, d = .13), with longer reading times on spill-over sentences following

Table 2
Mean Reading Times at the Regions of Interest and Standard Deviations (in Milliseconds) and Mean Novelty Scores and Standard Deviations for the Experimental Manipulations

			Target		Spill-over		Novelty	
Reading goal	Accuracy	Congruency	*M*	*SD*	*M*	*SD*	*M*	*SD*
Comprehension	True	Congruent	2266	1009	2890	1353	32.10	25.81
		Incongruent	2421	1137	2953	1395	34.52	26.86
	False	Congruent	2523	1206	3095	1572	39.66	26.77
		Incongruent	2747	1323	3174	1530	38.45	26.89
Study	True	Congruent	2440	1126	3172	1505	35.07	24.82
		Incongruent	2646	1176	3213	1418	35.34	24.90
	False	Congruent	2770	1336	3348	1579	39.09	24.40
		Incongruent	3045	1333	3446	1587	38.60	23.74

Table 3

Fixed Effects Estimates and the Associated Statistics of the Sum-Coded Models Fitted for Log-Transformed Reading Times on Target Sentences

Fixed effect	β	*SE*	*t*	*p*
Intercept	7.77	0.03	247.37	<.001
Reading goal	0.10	0.04	2.28	.023
Accuracy	0.12	0.01	11.08	<.001
Congruency	0.08	0.01	7.62	<.001
Novelty	0.001	0.00	3.72	<.001
WMC	−0.03	0.03	−0.99	.323
Reading Goal × Accuracy	0.04	0.02	1.83	.067
Reading Goal × Congruency	0.02	0.02	1.12	.264
Accuracy × Congruency	0.02	0.02	0.72	.474
Reading Goal × Novelty	0.00	0.00	0.73	.467
Accuracy × Novelty	−0.001	0.00	−2.44	.015
Congruency × Novelty	−0.00	0.00	−0.67	.505
Reading Goal × WMC	0.01	0.06	0.23	.816
Accuracy × WMC	0.01	0.01	0.39	.696
Congruency × WMC	0.02	0.01	1.03	.302
Reading Goal × Accuracy × Congruency	−0.003	0.04	−0.06	.950
Reading Goal × Accuracy × Novelty	−0.00	0.001	−0.10	.917
Reading Goal × Congruency × Novelty	0.00	0.001	0.49	.625
Accuracy × Congruency × Novelty	0.001	0.001	1.77	.076
Reading Goal × Accuracy × WMC	0.05	0.03	1.64	.102
Reading Goal × Congruency × WMC	0.04	0.03	1.54	.124
Accuracy × Congruency × WMC	−0.03	0.03	−0.95	.342
Reading Goal × Accuracy × Congruency × Novelty	−0.00	0.002	−0.26	.799
Reading Goal × Accuracy × Congruency × WMC	−0.05	0.06	−0.86	.393

Note. WMC = working memory capacity. The following R code was used: Reading times ~1 + Reading Goal × Accuracy × Congruency × Novelty + Reading Goal × Accuracy × Congruency × WMC + (1 | subject) + (1 | item).

false (M = 3260 ms, SE = 34) than true targets (M = 3051 ms, SE = 30). Taken together, these results replicate prior findings that text- and knowledge inconsistencies elicit inconsistency effects and that knowledge inaccuracies elicit prolonged disruptions of the reading process. However, in contrast to prior findings, we also observed spill-over effects of congruency (β = .03, SE = .01, t = 2.51, p = .012, d = .06) with longer reading times on spill-over sentences following incongruent (M = 3190 ms, SE = 32) than congruent targets (M = 3119 ms, SE = 32), suggesting that text incongruencies also elicit prolonged disruptions of the reading process.

Recognition Memory

On readers' memory for textual information, we replicate prior studies showing that incongruent or false information is remembered more poorly than congruent or true information, as we observed inconsistency effects of both text and knowledge inconsistencies. On memory for target information, we observed main effects of accuracy (β = −.95, SE = .08, z = −12.49, p < .001, OR = 2.53) and congruency (β = −.37, SE = .08, z = −4.90, p < .001, OR = 1.46): True targets (M = .81, SE = .01) were remembered better than false targets (M = .65, SE = .01) and congruent targets (M = .76, SE = .01) were remembered better than incongruent targets (M = .70, SE = .01; Figures 1a and 1b).

Relation Between Validation Processes and Text Memory

To test Hypothesis 4 that the intensity of online validation processes is causally related to readers' offline memory for inconsistent text information, we investigated whether the effects we observed of congruency and accuracy on readers' memory for target information were mediated by their reading times on targets using multilevel structural equation modeling (MSEM) in Mplus (Version 7.31; Muthén & Muthén, 1998–2012). We specified our MSEM consistent with the recommendations of Preacher et al. (2010) for modeling multilevel mediation when all variables contain both level 1 (within-person) and level 2 (between-person) variance (i.e., 1-1-1 mediation). Mediation analysis was performed separately for congruency and accuracy. For both manipulations we tested a 1-1-1 mediation model with a cross-classified structure with random effects for subjects and items that included either congruency (congruent/incongruent) or accuracy (true/false) as a level 1 predictor, (log-transformed) reading times on targets as mediator (level 1) and memory performance scores on targets as dependent variable (level 1). For the estimation, a Bayesian procedure (BAYES estimator in Mplus) was used. In line with Hypothesis 4 that readers' text memory for inconsistent information is primarily influenced by online validation processes, results showed that the within indirect effect of congruency on memory performance through reading times was significant (β = −.003, SD = .002, p = .033, 95% CI [−.006, .000]); Longer reading times on incongruent targets (i.e., a larger online incongruency effect) were associated with poorer memory for those targets (i.e., a larger offline incongruency effect). These results suggest that for text incongruencies the intensity of online validation processes is causally related to readers' offline memory for incongruent information. However, we observed no such effect for knowledge inaccuracies, as the within indirect effect of accuracy on memory performance scores was not mediated by target reading times (β = .001, SD = .002, p = .393, 95% CI [−.004, .005]),

Table 4

Fixed Effects Estimates and the Associated Statistics of the Sum-Coded Models Fitted for Log-Transformed Reading Times on Spill-Over Sentences

Fixed effect	β	*SE*	*t*	*p*
Intercept	7.96	0.04	225.17	<.001
Reading goal	0.10	0.05	2.14	.033
Accuracy	0.06	0.01	5.88	<.001
Congruency	0.03	0.01	2.51	.012
Novelty	0.001	0.00	3.92	<.001
WMC	−0.03	0.03	−0.94	.347
Reading Goal × Accuracy	0.00	0.02	0.01	.991
Reading Goal × Congruency	−0.01	0.02	−0.22	.824
Accuracy × Congruency	0.01	0.02	0.57	.572
Reading Goal × Novelty	0.001	0.00	2.47	.013
Accuracy × Novelty	−0.001	0.00	−1.58	.115
Congruency × Novelty	0.00	0.00	0.55	.582
Reading Goal × WMC	−0.01	0.06	−0.12	.907
Accuracy × WMC	−0.004	0.01	−0.29	.775
Congruency × WMC	0.01	0.01	0.72	.471
Reading Goal × Accuracy × Congruency	−0.01	0.04	−0.19	.848
Reading Goal × Accuracy × Novelty	−0.001	0.001	−1.18	.237
Reading Goal × Congruency × Novelty	0.001	0.001	1.61	.107
Accuracy × Congruency × Novelty	−0.00	0.001	−0.48	.632
Reading Goal × Accuracy × WMC	0.01	0.03	0.51	.608
Reading Goal × Congruency × WMC	−0.01	0.03	−0.44	.657
Accuracy × Congruency × WMC	−0.04	0.03	−1.42	.156
Reading Goal × Accuracy × Congruency × Novelty	−0.00	0.002	−0.05	.958
Reading Goal × Accuracy × Congruency × WMC	0.11	0.06	2.08	.038

Note. WMC = working memory capacity. The following R code was used: Reading times ~1 + Reading Goal × Accuracy × Congruency × Novelty + Reading Goal × Accuracy × Congruency × WMC + (1 | subject) + (1 | item).

providing no evidence of a no causal relation between online knowledge-based validation processes and offline text memory for knowledge inaccuracies. Taken together, these results support Hypothesis 4 that the intensity of online validation processes is causally related to readers' offline memory for inconsistent text information. But they paint a more nuanced picture, as they indicate that the relation between online validation processes and offline text memory differs depending on the type of inconsistency: More intense validation processes online predict stronger inconsistency effects in offline memory for text incongruencies, but not knowledge inaccuracies.

Aim 3: Individual Differences and Validation

Reading Times for Target- and Spill-Over Sentences

With respect to the effect of topic novelty, we observed main effects on both target and spill-over reading times (see Tables 3 and 4 for fixed-effect estimates and associated statistics): Reading times increased when the novelty of information that participants encountered increased, supporting the notion that knowledge about a text topic facilitates comprehension. In addition, we observed an interaction between goal and novelty on spill-over reading times and an interaction between accuracy and novelty on target reading times.

To interpret these interactions, we conducted posthoc comparisons by centering the model on the novelty ratings on one standard deviation below (11) and above (62) the mean, respectively. As illustrated in Figure 2, posthoc pairwise comparisons for the spill-over sentences revealed that reading times were longer for participants that read for study than for participants that read for comprehension. This effect of goal was more prominent if the information in the texts was more novel information for participants ($\beta = .14$, $SE = .05$, $t = 2.76$, $p = .006$, $d = .30$) and diminished when the information in the texts was less novel information, to such an extent that for texts with lower novelty ratings no reliable differences between reading times were observed for different reading goals ($\beta = .08$, $SE = .05$, $t = 1.60$, $p = .109$). This modulation of the effect of goal emerged because participants that read for study showed increased reading times as the novelty of textual information increased ($\beta = .002$, $SE = .0003$; $t = 4.40$, $p < .001$), whereas participants that read for comprehension showed

Table 5

Mean Memory Performance Scores on Targets (in % Correct) and Standard Deviations for the Experimental Manipulations Reading Goal, Congruency With Text, and Accuracy With Background Knowledge

			Memory	
Reading goal	Accuracy	Congruency	*M*	*SD*
Comprehension	True	Congruent	81	39
		Incongruent	77	42
	False	Congruent	64	48
		Incongruent	61	49
Study	True	Congruent	88	33
		Incongruent	80	40
	False	Congruent	72	45
		Incongruent	61	49

Table 6
Fixed Effects Estimates and the Associated Statistics of the Sum-Coded Models Fitted for Memory Scores on Targets

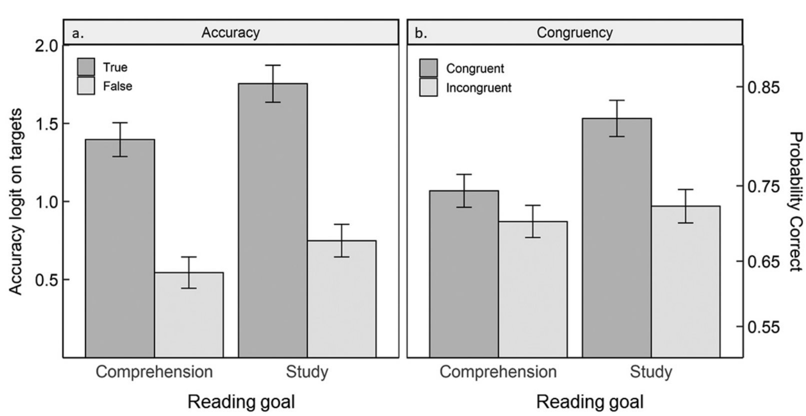
Fixed effect	β	*SE*	*z*	*p*
Intercept	1.11	0.08	14.47	<.001
Reading goal	0.29	0.11	2.60	.009
Accuracy	−0.95	0.08	−12.49	<.001
Congruency	−0.37	0.08	−4.90	<.001
Novelty	−0.001	0.002	−0.40	.691
WMC	0.002	0.07	0.03	.976
Reading Goal × Accuracy	−0.14	0.15	−0.91	.362
Reading Goal × Congruency	−0.34	0.15	−2.25	.025
Accuracy × Congruency	0.14	0.15	0.95	.342
Reading Goal × Novelty	−0.002	0.003	−0.81	.418
Accuracy × Novelty	0.01	0.003	1.93	.054
Congruency × Novelty	−0.002	0.003	−0.59	.554
Reading Goal × WMC	0.23	0.15	1.59	.112
Accuracy × WMC	−0.10	0.10	−1.01	.312
Congruency × WMC	0.01	0.10	0.14	.886
Reading Goal × Accuracy × Congruency	−0.08	0.30	−0.27	.791
Reading Goal × Accuracy × Novelty	−0.002	0.01	−0.38	.691
Reading Goal × Congruency × Novelty	−0.01	0.01	−0.82	.411
Accuracy × Congruency × Novelty	−0.01	0.01	−1.07	.286
Reading Goal × Accuracy × WMC	−0.25	0.20	−1.24	.216
Reading Goal × Congruency × WMC	−0.12	0.20	−0.59	.552
Accuracy × Congruency × WMC	−0.001	0.20	−0.01	.995
Reading Goal × Accuracy × Congruency × Novelty	0.01	0.01	0.89	.372
Reading Goal × Accuracy × Congruency × WMC	−0.18	0.40	−0.46	.646

Note. WMC = working memory capacity. The following R code was used: Memory Performance ∼1 + Reading Goal × Accuracy × Congruency × Novelty + Reading Goal × Accuracy × Congruency × WMC + (1 | subject) + (1 | item).

no such effect of novelty (β = .0004; *SE* = .0003; *t* = 1.28, *p* = .202). Thus, in line with Hypothesis 5, novelty effects are particularly prominent when reading for study.

Finally, results support Hypothesis 6 that the amount of disruption readers experience when they encounter inconsistencies depends on their familiarity with the text topic and the type of inconsistency. As illustrated in Figure 3, comparisons for the target sentences revealed that readers generally showed inaccuracy effects: Reading times were generally longer for false targets (*M* = 2765 ms, *SE* = 28) than for true targets (*M* = 2438 ms, *SE* = 24). This inaccuracy effect (i.e., the reading time difference between true and false targets) was most prominent in texts that contained the least novel information for participants (β = .14, *SE* = .02, *t* = 9.27, $p < .001$, *d* = .33), but decreased when novelty increased

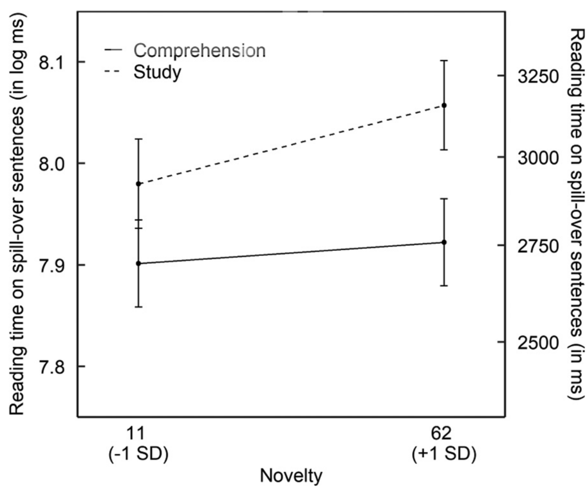
Figure 1
Fixed Effect Estimates of Memory Performance Scores on (a) True and False Targets and (b) Congruent and Incongruent Targets as a Function of Reading Goal



Note. Scales of exponentiated log-values (i.e., approximating untransformed values) are provided as secondary *y*-axis on the right side of the graph.

Figure 2

Fixed Effect Estimates of Reading Times on Spill-Over Sentences (in log ms) for Participants That Read for Study and Participants That Read for Comprehension as a Function of Novelty (i.e., Participants Ratings of How Much of the Information They Encountered in the Text Was Novel to Them)



Note. Error bars represent the standard error of the mean at novelty ratings one standard deviation above (62) and below (11) the mean. Participants rated the novelty of the information they encountered in the text on a scale from 0 (nothing is new) to 100 (everything is new). Scales of exponentiated log-values (i.e., approximating untransformed values) are provided as secondary *y*-axes on the right side of the graphs.

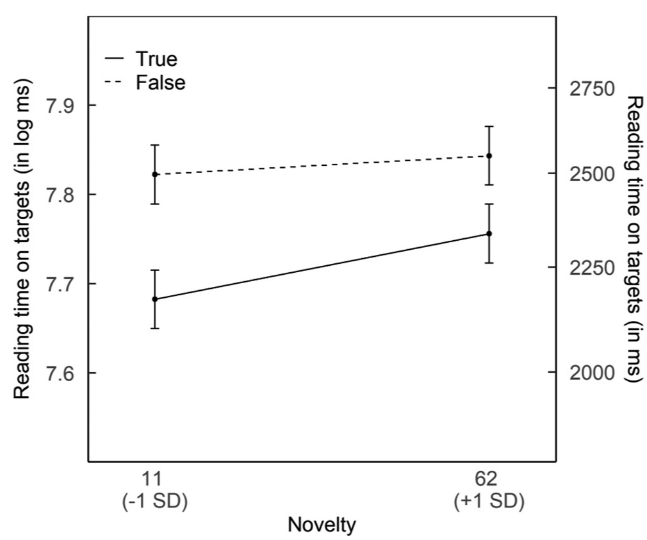
(β = .09, *SE* = .02, *t* = 5.84, $p < .001$, *d* = .20). These reduced inaccuracy effects emerged because true targets of texts with low novelty scores were read faster than true targets of texts with high novelty scores (β = .001, *SE* = .0003; *t* = 4.47, $p < .001$), yet no reliable simple main effect of novelty was observed for false targets (β = .0004; *SE* = .0003; *t* = 1.25, *p* = .212). In contrast, we observed no evidence that novelty affects the degree of conflict readers experience when they encounter textual incongruencies, as we observed no interactions between novelty and congruency. Thus, in line with our expectations, these results show that the amount of conflict a reader experiences when they encounter a knowledge inaccuracy diminishes when readers had less knowledge of the topic (i.e., the topic had greater novelty), but that topic novelty has little impact on the degree of conflict readers experience when they encounter textual incongruencies.

With respect to individual differences in working memory capacity, the results were counter to our expectations, as we observed no effects of working memory capacity on processing. We only observed a four-way interaction between goal, congruency, accuracy and working memory capacity on spill-over sentence reading times (see Figure 4). To understand this four-way interaction we ran separate linear models (including the full factorial interactions between the fixed factors congruency, accuracy and working memory capacity) for participants that read for study and participants that read for comprehension. We observed a main effect of accuracy in both models: Longer reading times on spill-over sentences following false targets (M_{study} = 3397 ms, SE_{study} = 49; M_{comp} = 3134 ms, SE_{comp} = 46) than on spill-over sentences following true targets (M_{study} = 3193 ms, SE_{study} = 45; M_{comp} = 2922 ms, SE_{comp} = 41) both when participants read for study (β = .06, *SE* = .02, *t* = 3.91, $p < .001$, *d* = .13) and when they read for comprehension (β = .06, *SE* = .01, *t* = 4.63, $p < .001$, *d* = .14). However, the two models also showed an important difference: In addition to the main effect of accuracy, participants that read for comprehension showed a three-way interaction between accuracy, congruency and WMC (β = −.09, *SE* = .04, *p* = .030, *t* = −2.17), whereas participants that read for study showed no other main effects or interaction effects (see Figure 4).

To further characterize the three-way interaction in the reading for general comprehension condition, we conducted posthoc pairwise comparisons separately for lower-capacity readers and higher-capacity readers by centering the model on working memory scores one *SD* below (1.5) and above (3.0) the mean (*M* = 2.25, *SD* = .75), respectively. In comparison to the spill-over sentences in the true-congruent condition, lower-capacity readers show longer reading times for sentences following false-incongruent targets (β = .08, *SE* = .03, *t* = 2.89, *d* = .20), but not for sentences following true-incongruent targets (β = .03, *SE* = .03, *t* = .95) and false-congruent targets (β = .03, *SE* = .03, *t* = .91; see Figure 4, left side). For higher-capacity readers a different pattern is observed. In comparison to the spill-over sentences in the true-congruent condition, higher-capacity readers show longer reading times for sentences following false-congruent targets (β = .08, *SE* = .03, *t* = 2.67, *d* = .18), true-incongruent targets (β = .07, *SE* = .03, *t* = 2.23, *d* = .15), and false-incongruent targets (β = .09, *SE* = .03, *t* = 2.97, *d* = .20; see Figure 4, right side).

Figure 3

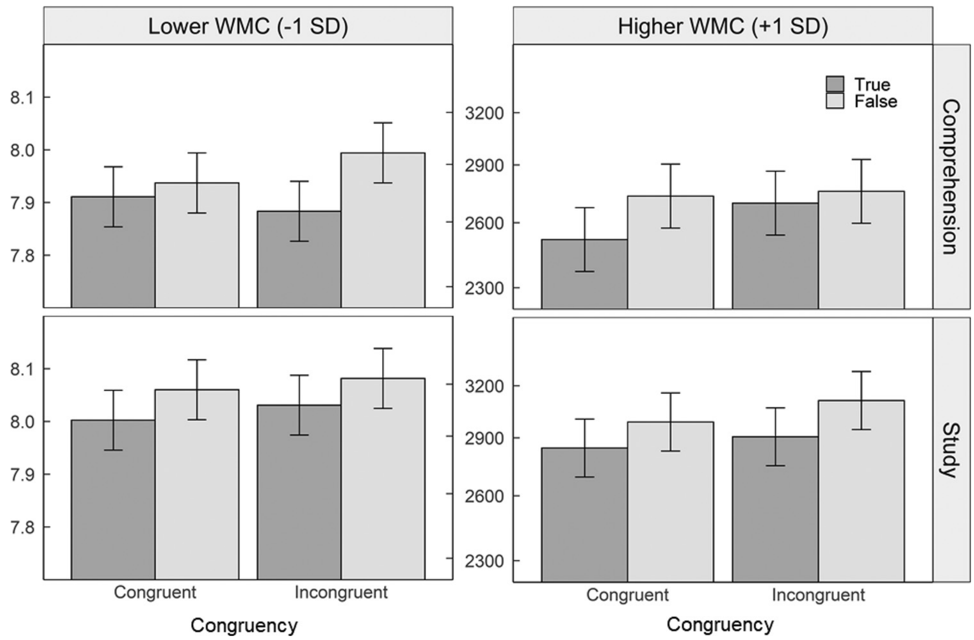
Fixed Effect Estimates for Log Transformed Reading Times on True and False Targets (in log ms) as a Function of Novelty (i.e., Participants Ratings of How Much of the Information They Encountered in the Text Was Novel to Them)



Note. Error bars represent the standard error of the mean at novelty ratings one standard deviation above (62) and below (11) the mean. Participants rated the novelty of the information they encountered in the text on a scale from 0 (nothing is new) to 100 (everything is new). Scales of exponentiated log-values (i.e., approximating untransformed values) are provided as secondary *y*-axes on the right side of the graphs (in ms).

Figure 4

Fixed Effect Estimates of Reading Times on Spill-Over Sentences (in log ms) for Participants With a Lower Working Memory Capacity and Participants With a Higher Working Memory Capacity as a Function of Reading Goal, Congruency and Accuracy



Note. Fixed effect estimates of reading times on spill-over sentences (in log ms) for participants with a lower working-memory capacity (one standard deviation below the mean) and participants with a higher working-memory capacity (one standard deviation above the mean) as a function of reading goal (reading for general comprehension/ reading for study), congruency (target congruent/incongruent with context) and accuracy (target true/false). Error bars represent the standard error of the mean at working memory capacity scores one standard deviation above (2.75) and below (1.5) the mean. Scales of exponentiated log-values (i.e., approximating untransformed values) are provided as secondary *y*-axes in the center of the graphs. WMC = working memory capacity.

Taken together, results of the posthoc analyses of the four-way interaction show inaccuracy spill-over effects in both reading goal conditions. However, for participants that read for comprehension spill-over effects are modulated by the readers' working memory capacity: Higher-capacity readers show spill-over effects of inaccuracy (world knowledge) and incongruency (contextual), whereas lower-capacity readers show a more restricted pattern with spill-over effects only emerging when target information is inconsistent with both sources. Although this interaction should be interpreted with caution, the pattern of results is consistent with the idea that working memory may create a bottleneck during validation processes (Hypothesis 7). In addition, it is consistent with the idea that working memory effects depend on reading goal (Hypothesis 8).

Recognition Memory

There were no significant effects of novelty or working memory capacity on recognition memory scores.

Discussion

This study had three main aims. First, we aimed to determine whether readers' purpose for reading affects online validation processes and readers' memory for (in)consistent information. Second, we aimed to investigate whether and how online validation processes translate into offline (memory) products. In doing so, we distinguished between text-based and knowledge-based validation processes. Third, we aimed to investigate whether these effects were influenced by the novelty of the text information relative to the reader's background knowledge and readers' working memory capacity.

Goal Effects on Text-Based and Knowledge-Based Validation Processes and Products

In line with prior findings (Lorch et al., 1993, 1995; van den Broek et al., 2001; Yeari et al., 2015), we observed general effects of reading goal on comprehension, with reading for study resulting in slower reading and in better memory than reading for general comprehension. In contrast to our expectations (Hypothesis 1), we found no clear evidence that reading goals influence online validation processes, as reading for study resulted in slower reading on all targets—regardless of the accuracy or congruency of the presented information. However, reading goals did have distinct effects on readers' offline memory for (in)consistent target information of the texts (Hypothesis 2). The observed stronger memory for participants that read for study applied when the targets in the reading task contained information that was congruent with the preceding text but not when they contained incongruent information. In the latter case, reading for study did not result in a stronger memory representation. In the next paragraphs we elaborate on each of these findings.

There was no evidence that reading goals affect validation processes that occur while readers are processing a text—as there were no interactions between reading goal and accuracy and/or congruency of the presented information on target sentences nor spill-over sentences (Hypothesis 1). This finding is consistent with the idea that the coherence-detection (or epistemic monitoring) component of validation, as described in the RI-Val model (Cook & O'Brien, 2014; O'Brien & Cook, 2016a, 2016b) and the two-step model of validation (Isberner & Richter, 2014; Richter, 2015; Schroeder et al., 2008), is a passive and routine process—unaffected by top-down factors such as people's goals for reading a text. Furthermore, as discussed in the introduction of this paper, it is possible that readers apply a more stringent coherence threshold (a key component of the RI-Val model) when they read for study. In that case, spill-over effects due to incongruent or false information should be less prominent for people that read for study than for people that read for comprehension, because the former are more inclined to complete the validation process of inconsistent sentences before moving on in the unfolding text. Our results do not support this notion, as we did not observe such modulations of spill over as a function of reading goal.

With regard to the repair processes posited by validation models—most explicitly described in the two-step model of validation (Isberner & Richter, 2014; Richter, 2015; Schroeder et al., 2008)—the interpretation of our data is less straightforward. As discussed in the introduction, elaborative processes to repair and resolve an inconsistent section of a text are under strategic control of the reader and may take place during or after reading a text (Maier & Richter, 2013; Richter, 2011). The absence of reading time differences between the conditions suggests that reading goals do not modulate epistemic elaboration during reading of the target and spill-over sentences. It is important to note that it does not rule out the possibility that reading goals affect repair and reflective processes after these relevant sentences have been read.

On a methodological note, it is possible that we did not observe an interaction between reading goals and online validation because sentence-by-sentence reading times are not sensitive enough to detect changes in validation processes elicited by reading goal manipulations. However, sentence-by-sentence reading time measures have been used in other studies investigating the influence of task demands on online validation processes (e.g., Williams et al., 2018). Williams et al. (2018) used changes in task demands (i.e., varying the number of comprehension questions participants had to answer after reading each text) rather than explicit instructions (as in the current study) to manipulate readers' coherence threshold, observing that these subtle changes affected reading times for the target sentences. Thus, sentence reading times in principle are sensitive enough to pick up validation effects. The absence of reading goal effects in the present study therefore suggests that variations in global goals for reading the texts do not (or less strongly) affect validation processes in comparison to properties of the immediate learning context, such as the task demands used by Williams et al. (2018).

Considering the on- and offline results together yields an interesting contrast: Reading for study led to more careful processing of all target types; it also led to stronger memory for all textual information except for incongruent information which was processed more extensively, just like the other portions of the texts, but was not remembered better (Hypothesis 2). Given that readers did detect all inconsistencies—including those involving text incongruencies—this pattern suggest that incongruency with the text is dealt with differently than inaccuracy with reader's background knowledge (consistent with Hypothesis 3a and 3b). Because readers that read for study are more likely to put effort into building a comprehensive, coherent representation of the text than are readers with a simple comprehension goal (e.g., Britt et al., 2018; Lorch et al., 1995), they are more likely to try and resolve incongruencies. Indeed, they generally take more time to read the texts than their counterparts that read for comprehension. The fact that this added processing did not lead to better memory for incongruent target information suggests that for those incongruencies the additional effort put into resolving incongruencies when reading for study generally did not lead to successful resolution of those incongruencies or attained resolution by adjusting the representation of the target information to fit the context (i.e., make it congruent)—and thus lowering memory for the precise target sentence.

On-Line Text-Based and Knowledge-Based Validation Processes and Offline Text Memory

In addition to the effects of reading goals on validation, the current study considered potential differences between text-based and knowledge-based validation. In line with prior findings (Albrecht & O'Brien, 1993; Menenti et al., 2009; O'Brien et al., 1998, 2004, 2010; O'Brien & Albrecht, 1992; Rapp, 2008; Richter et al., 2009), the results showed inconsistency effects for both text and knowledge inconsistencies. Furthermore, the current results replicated those of earlier studies (van Moort et al., 2018, 2021) by showing that knowledge inaccuracies generally elicited a prolonged disruption of the reading process, resulting in spill-over to the next sentence. However, the current results also contradicted prior findings. Unlike in earlier studies, using a similar paradigm, (van Moort et al., 2018, 2020), in the current study we also observed prolonged disruptions due to text incongruencies. These mixed patterns of spill-over effects across studies are puzzling. One possible explanation is that that subtle variations in samples, instructions, and research methodologies (cf. van Moort et al., 2018, 2020, 2021) affected the settings of readers' coherence thresholds (see RI-Val model; Cook & O'Brien, 2014; O'Brien & Cook, 2016a, 2016b), resulting in small but detectable differences in the amount of spill over across studies.

To obtain a detailed picture of the relation between the on- and offline results for text-based and knowledge-based validation, we conducted a series of mediation analyses. Supporting Hypothesis 4, the results showed that the reading times at the target sentence mediated the offline memory result. However, they suggest that the relation between online validation processes and offline text memory differs between text-based and knowledge-based validation. Specifically, we found that when readers encounter a sentence that is incongruent with the context, the reading time for that sentence increases and the magnitude of this increase, in turn, predicts the decrease in performance on the memory test. Thus, the probability of correctly recalling an incongruent section of a text seems to diminish as the intensity of the repair processes that occur after detecting that incongruency increase. This may reflect the fact that repair processes may take on various forms. For example, readers may adjust the incoming information to make it fit with the representation of the preceding text, they may decide to dismiss the incongruent information and 'remove' it from their developing situation model, and so on. It would be useful for both theory and instruction to investigate the range of repair processes in which readers engage in response to within-text incongruencies and how the different processes relate to comprehension and memory for the text as a whole.

In contrast, the effects of world knowledge inaccuracies on memory performance were not mediated by reading time. This absence of a mediation effect can be interpreted in several ways. One possibility is that reading time disruptions that are observed when readers encounter false sentences do not index postdetection repair processes. If that is the case, our world knowledge manipulations seem to have influence the (offline) memory products primarily via mechanisms that occur after the text has been read. Another possibility is that in our materials the repair processes to resolve world-knowledge inaccuracies are relatively straightforward and do not result in detectable changes in sentence reading time. A final possibility is that efforts to repair inaccuracies elicit detectable processing costs but that the amount of time spent on them does not reflect the quality or effectiveness of those processes. In that case increased reading time durations will not correlate with reduced performance on the memory test.

In conclusion, although the mediation analysis cannot tell the full story, it is a powerful tool to decipher whether and how online (reading time) processes translate into offline (memory) products. In the context of our discussion on text-based versus knowledge-based validation, the mediation analyses complement prior findings by indicating that these types of validation have different processing signatures and may trigger different coping mechanisms to protect emerging and final mental representations of readers against inconsistencies (cf. van Moort et al., 2018, 2020, 2021).

Effects of Individual Variations in Topic Novelty and Working-Memory Capacity

We explored whether the above findings were influenced by individual differences; we specifically considered the degree to which the topic of a text was novel to the reader, and reader's working memory capacity.

With respect to the influence of novelty we found that the processing difference between true and false targets—the amount of conflict a reader experiences or the inaccuracy effect—diminished when readers had less knowledge of the topic (i.e., the topic had greater novelty) - as predicted in Hypothesis 6. This finding supports the premise that validation routinely takes place. It also illustrates the importance of topic-relevant or world knowledge for successful comprehension of texts (Alexander & Jetton, 2016; Kintsch, 1988; Myers & O'Brien, 1998; Ozuru et al., 2009; Samuelstuen & Bråten, 2005; Shapiro, 2004). Interestingly, the diminishing inaccuracy effect described above was due to novelty affecting the processing of true targets, but not false targets. The less novel the true information was the shorter the reading time, but for false information less novelty did not shorten the reading time. Although one should be cautious with this subtle interaction, one can speculate that it signifies that having knowledge about a topic primarily facilitates processing of text information that converges with this knowledge, rather than hinder processing of conflicting information.

Furthermore, the effect of novelty on spill-over sentence reading times was modulated by reading goal: When the amount of novel information in a text increased, readers tended to slow down on the posttarget sentence when they read for study, but not when they read for comprehension. These results suggest that readers engage in deeper or more effortful processing of novel information when the reading goal requires a deep understanding of the text (Hypothesis 5).

With respect to the role of working memory in validation, we considered scenarios in which working memory capacity would affect the coherence-detection phase and/or the epistemic elaboration phase. Contrary to our expectations (Hypotheses 7 & 8), the results did not signal any main effects of differences in working memory capacity on processing of the target sentences. We did observe an effect of working memory on spill-over sentences as part of a complex (four-way) interaction. When reading for comprehension, the spill-over patterns of higher-capacity readers differed from the spill-over patterns of lower-capacity readers—i.e., arguably more prominent spill-over effects for higher-capacity readers. When reading for study, however, the spill-over patterns for higher- and lower-capacity readers showed no differences. A possible, speculative, explanation for this pattern of results is that when higher-capacity readers are reading for comprehension, they adopt a more lenient processing approach (with processing being allowed to spill-over to the next sentence) than lower-capacity readers. This difference between higher- and lower-capacity readers disappears when people are reading for study which may trigger a more stringent processing approach for higher-capacity readers that allows more validation processes to be completed before proceeding to the next sentence. Such interpretation may have interesting implications for the coherence threshold of the RI-Val model (Cook & O'Brien, 2014; O'Brien & Cook, 2016a, 2016b), as it suggests that this threshold varies depending on readers' working memory capacity: Because higher-capacity readers have the capacity to process more information simultaneously they may set a lower coherence threshold than lower-capacity readers, resulting in more 'delayed' processing. The observation that spill-over effects become weaker when higher-capacity individuals read for study also fits this scenario: When reading for study these individuals may set a higher threshold that allows more validation processes to be completed before proceeding to the next sentence. This account does not provide a perfect explanation for the results, but it raises interesting points for future research.

Conclusions and Future Directions

Taken together, results suggest that coherence-detection is a routine aspect of comprehension that is not affected by reading goals (Cook & O'Brien, 2014; Isberner & Richter, 2014; Singer, 2019; van den Broek & Helder, 2017). The interpretation of the results is less straightforward for the epistemic elaboration component of validation (Isberner & Richter, 2014; Richter, 2015; Schroeder et al., 2008); the results are incompatible with the idea that reading goals modulate the early phases of epistemic elaboration, yet do not rule out that late epistemic phases (including possibly postreading validation processes) are affected by reading goal manipulations. Because reading goals did affect readers' memory for target information, the most parsimonious conclusion is that reading goal influences take place after the initial detection of the inconsistency and also after initial repair processes activated by epistemic elaboration. Determining precisely which afterdetection processes are influenced by reading goals and whether the effects we observed are unique to the particular goals for reading used in this study would be fruitful directions for further research. In addition, mapping the time course of reading-goal influences requires more detailed examinations of when and how goals exert their influence (e.g., by assessing the mental representation during reading, immediately after reading a text, and at later points in time). To attain a more comprehensive overview of how reading goals assert their influence it is important to study a large variety of reading goals, of instructions that are used to manipulate such reading goals, and of incentives used to motivate readers to follow these instructions. In the current study the stakes of performing well on the memory task were relatively low and it would be interesting to see whether we observe similar results in more realistic learning settings. Furthermore, it is important to study reading goal effects at various levels of comprehension and learning. The recognition memory task used in the current study assessed text memory, but future studies could also include measures of deeper comprehension and understanding (see, e.g., Millis et al., 2018) to assess not only what readers remember from a text but also what they learned from a text. In addition, the recognition memory task was designed to measure how readers have adapted their situation model during reading (i.e., whether they integrated the inconsistent information into the model). Although we adapted the task to measure situation-model representations (for example, by explicitly instructing participants to judge whether they had seen the information in the sentence before rather than the exact sentence, increasing the complexity of the task by including opposite versions of targets they had seen and presenting the task to participants the next day), it is still a relatively indirect measure of readers' situation model. Therefore, future studies could include additional measures that assess situation model strength, such as inferential comprehension questions or recall measures.

In addition, reading goal effects depend on the quality of the text, as reading for study improves memory for congruent, but not for incongruent target information. This has important consequences for the interpretation of results from studies investigating the effects of reading purpose, because these studies predominantly use coherent and true texts. Moreover, the current results raise interesting questions, for example whether an incongruency in a text only affects memory for the incongruent information itself or whether it also affects memory for other (related) elements in the mental representation.

The current results replicate earlier findings that the processes involved in coherence monitoring depend on validation against both contextual information and background knowledge (van Moort et al., 2018, 2020, 2021). Furthermore, they suggest that reading goals differentially affect processing of text and knowledge inconsistencies, respectively, given that reading for study results in longer reading times on both types of inconsistencies but only improves memory for inaccuracies. To further examine these differential effects a more detailed understanding of these processes is needed. Research methods that have high temporal resolution (e.g., eye tracking, EEG) and research methods that provide more qualitative data (e.g., think-aloud procedures) may be useful in mapping potential differences between text-based and knowledge-based validation. In addition, statistical methods such as (multilevel) mediation analyses can further enlighten us about how online comprehension and validation processes translate into offline memory products. Moreover, to gain insight into the effects of readers' background knowledge on knowledge-based validation processes, future studies could include more extensive assessments of readers' knowledge on a text topic. In addition, it would be interesting to investigate other sources of individual differences that may play a role in validation, for example, individual differences in reading ability. As skilled and less skilled readers tend to differ in their ability to access relevant knowledge during reading (Singer & Ritchot, 1996), future studies could examine potential differences between skilled and less skilled readers in validation processes and products—particularly in knowledge-based validation. Finally, the current study focused on text-based and knowledge-based validation processes in the context of reading single texts, but future studies could extend this work by examining when and how readers use these informational sources—and perhaps other informational sources (e.g., readers' prior beliefs; Gilead et al., 2018) – to construct a coherent and adequate mental model when reading multiple texts (e.g., when reading on the web to make an informed decision on a controversial topic; Rouet & Britt, 2011).

The minimal effects of working memory we observed on either online processing or offline representation are only partly in agreement with earlier findings from studies using a similar paradigm (van Moort et al., 2018, 2020). The mixed effects across studies may be attributed to differences between the groups that were tested, or it may illustrate that the role of working memory in validation processes is more complex than initially thought. Including working memory capacity as a covariate seems insufficient to see which of these possibilities is accurate. Therefore, future studies may include direct manipulations of working memory load during processing (cf. de Bruïne et al., 2021).

There has been a longstanding acknowledgment by reading researchers that one's purpose for reading plays an important role in reading, but a challenge for theories of reading has been to describe when and how specific component reading processes are influenced by reading goals. To deepen our understanding of this issue a more detailed examination of how readers' goals affect component processes of comprehension is needed. Building on the strong tradition of research on goal effects on online comprehension processes and offline products of comprehension, the current study has taken the first step by examining how reading goals affect validation processes. Although reading goals affect readers' processing of the text as a whole, we observed no evidence that they affect the coherence-detection phase of validation. They did influence postdetection processes, differentially affecting readers' memory for incongruent and false targets. To develop a comprehensive model of reading goal effects, future studies may extend this work by going beyond the impact of reading goals on comprehension of the text as a whole and focus on their effects on specific component processes.

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