

Abstract

Background: School-aged children are increasingly engaging with multiple conflicting texts to understand complex societal issues, however empirical research has not yet examined in what ways contextual factors affect detection of and memory for conflicts.

Methods: The current experiment manipulated contextual factors that included the vocabulary terms that authors of different texts used when describing the same concepts, and the order with which students accessed contradictory information.

Results: After controlling for general science knowledge, adolescent students displayed longer reading times when contradictory stances were presented in an alternating fashion than they did when texts were blocked by stance. When text presentation was alternating, students also remembered more conflicts when the texts used the same vocabulary terms than they did when the texts used different vocabulary terms (non-obvious synonyms). However, when adolescents read texts blocked by stance, they remembered a similar number of intertextual conflicts regardless of whether texts used the same or different vocabulary.

Conclusions: The findings suggest that different contextual factors can facilitate (but also undermine) propensities to notice and remember conflicts across texts. As such, the findings have important implications for theories of text comprehension and applications for adolescents' everyday reading experiences.

Keywords: conflict detection, reading processes, text comprehension, vocabulary

Highlights

What is already known about this topic

- Several decades of research have demonstrated that school-aged children infrequently detect discrepancies within a single text, especially when the statements are in non-adjacent sentences.

What this paper adds

- School-aged readers spent more time processing texts that alternated between opposing stances than when texts were blocked by stance.
- Students also remembered more conflicts when texts alternated between opposing stances using the same vocabulary terms than they did when the texts used different vocabulary terms (non-obvious synonyms).
- When adolescents read texts blocked by stance, however, they remembered a similar number of intertextual conflicts regardless of whether texts used the same or different vocabulary.

Implications for theory, policy, or practice

- The findings can support specifications of theories of text comprehension to account for contextual factors.
- Whereas some contextual factors promote conflict detection and representation, others undermine these processes.
- Providing students with vocabulary training prior to reading multiple conflicting texts may afford opportunities to improve their comprehension.

Introduction

When reading about complex societal issues, it is rare that a single text has the complete answer. Instead, readers must locate, evaluate, and integrate quality information to more completely understand a topic (Braasch, et al., 2018). When engaging in these processes, individuals may come across several types of relationships across separate texts including consistent, complementary, and discrepant ideas about the same topic (Britt, et al., 1999; Goldman, 2004). Thus, *one key reading skill in modern times is that* individuals must be able to recognize these different intertextual relationships during reading, and to engage in an elaborative processing in efforts to construct a more coherent mental representation (Britt & Rouet, 2012; Magliano, et al., 2018). The current work focuses on younger readers' experiences of *noticing and rectifying experiences of cognitive conflict* that stem from intertextual discrepancies about an important societal issue: climate change.

Empirical studies have consistently demonstrated that competent adults monitor their understandings that develop during reading. Specifically, they read sentences that reflect a discrepancy with prior-read information more slowly as compared to sentences that are, instead, consistent with prior-read information (Albrecht & O'Brien, 1993; Hakala & O'Brien, 1995; Rapp, et al., 2001). Recent research by Beker et al. (2016) demonstrated similar patterns when competent adult readers interact with discrepancies distributed across multiple texts.

Slower reading after having come across a discrepancy can be interpreted in relation to mechanisms described within theories of single and multiple text comprehension (Braasch & Bråten, 2017; Britt & Rouet, 2012; Kendeou & O'Brien, 2014; Kintsch, 1998; Myers & O'Brien, 1998). For example, Myers and O'Brien (1998) theorize that a slow down may indicate that previously read conflicting information becomes passively activated from long-term memory,

particularly when there is a high degree of feature overlap. As such, information from prior-read texts and the current text input becomes co-activated in working memory (Kendeou & O'Brien, 2014). This provides opportunities for the reader to detect conflicts that are present, which may result in an experience of cognitive disequilibrium. Research has demonstrated that readers engage in a number of strategies to re-establish cognitive equilibrium when engaging with conflicts within texts. These include changing some of the semantic content of what was read by ignoring one side of the controversy, making inappropriate inferences to “resolve” the controversy, or elaborating information to try to integrate or reconcile opposing views (Blanc, et al., 2008; Rouet, et al., 2016).

Although the above-described patterns support different mechanisms described in models of text comprehension, the patterns have been produced primarily by high school and college students. Accordingly, the patterns were presumably produced by participants with sufficient decoding skills, and general world knowledge from which to draw to infer connections across texts. Less research has focused on school-aged children’s noticing and resolving of conflicts within multiple text reading contexts. This is despite the fact that children are reading texts on the Internet to better understand socio-scientific issues such as climate change to complete school assignments, and to make informed decisions in their daily lives (e.g., how to reduce one’s carbon footprint). In service of these reading goals, they too must be able to recognize different types of intertextual relationships – including discrepancies – to construct a more coherent mental representation (Britt & Rouet, 2012). Many studies have focused on children’s attempts to comprehend a *single* text, which have demonstrated that they infrequently detect discrepancies (Garner & Taylor, 1982; Markman & Gorin, 1981; van der Schoot, et al., 2012; Zabrocky & Ratner, 1989). The current research examines two contextual factors that may affect

school-aged readers' detection and mental representation of conflicts when interacting with multiple texts. The focal contextual factors include a) the vocabulary terms that authors of different texts use when describing the same concepts, and b) the order with which students access contradictory information.

The Role of Lexical Encodings in Noticing Conflicts

Beyond a scarcity of empirical studies that examine younger readers' comprehension of intertextual conflicts, research is also limited by the kinds of textual materials that have been used to date. Text stimuli typically reflect clear, unresolvable contradictions (e.g., climate change cannot simultaneously exist and not exist). However, discrepancies in authentic contexts can be far subtler, which could potentially make them more difficult to detect. This may especially be the case for readers with insufficient knowledge of key vocabulary terms within a topic, as one might expect for younger readers. Conflict detection may be especially disrupted when multiple authors use different *lexical encodings* – or non-obvious synonyms – to describe the same concepts (Jucks & Paus, 2013). In fact, recent research has demonstrated that different lexical encodings across multiple texts undermined college student readers' abilities to gain conceptual knowledge, especially if they have lower motivation for the reading task (Schoor, et al., 2019). When authors use non-obvious synonyms, readers ideally apply prior vocabulary knowledge to elaborate on texts' meanings to recognize that contradictions are present. For example, if one text states that "Climate change has nothing to do with human *depletion of fossil fuels*," while another states "human *consumption of natural gases* has caused the Earth to become much hotter than ever before," the reader must activate prior knowledge to infer that the terms *depletion of fossil fuels* and *consumption of natural gases* are, in fact, synonymous. If instead sentences reflecting

intertextual conflicts had used identical terms of *depletion of fossil fuels*, readers may more readily detect and attempt to resolve those conflicts. As noted above, comprehension theories would describe that memory traces of earlier-read information would become activated and return to working memory, especially when propositions share a great deal of feature overlap, as would be the case if identical vocabulary was used (Myers & O'Brien, 1998). However, conflicts across multiple texts that incorporate different lexical encodings may be more difficult for school-aged children to detect.

For children, the very nature of reading is often in service of gaining new topic knowledge, including key vocabulary terms (Snow, 2010). Without knowledge of common synonyms and definitions of key vocabulary terms, important intertextual conflicts may go undetected, which would obviate a need to think more deeply about potential reasons for them. As such, detected conflicts might be an impetus for constructing a representation that uses rhetorical predicates as an organizing factor of what was read (Britt & Rouet, 2012). To test whether this is the case, the current research used textual materials that presented students with identical terms or non-obvious synonyms within conflicting statements across multiple texts. Such an approach affords opportunities to establish causal relationships between vocabulary knowledge, as evoked by the manipulation of different versus the same lexical encodings, and detecting and remembering conflicts in a multiple text reading situation serving as reading outcomes. We expected that identical vocabulary terms would promote conflict detection which may, in turn, also stimulate readers to construct memory representations that incorporate conflicts as an organizing factor.

The Role of Text Presentation Order in Comprehending Intertextual Conflicts

The order with which students access conflicting stances on a topic might also impact detection of and memory for intertextual conflicts. Although effects related to this contextual factor are – as of yet – untested, related single text comprehension research can, again, bolster hypotheses. In one study, middle school students read a story where the protagonist performed an action that was either consistent or discrepant with a previous description of their character (van der Schoot et al., 2012). The action occurred either immediately after the character description or later in the text. When the action was distanced, poorer comprehenders did not spend a longer time on sentences describing contradictory relative to consistent actions; nor did they regress back to re-read character descriptions. By contrast, better comprehenders displayed both of these reading patterns, suggesting they were more likely to notice the contradiction, and attempt to resolve it. When the action appeared directly after the character description, however, both poorer and better comprehenders displayed longer reading times on contradiction sentences and more re-reading of character descriptions. In fact, many studies demonstrate that children are less likely to detect conflicts in non-adjacent sentences relative to the same or adjacent sentences within a single text (Garner & Kraus, 1981-1982; Oakhill, et al., 2005; Yuill, et al., 1989; Zabrocky & Ratner, 1989).

When multiple distinct texts contradict one another, there is inherently a greater distance between the conflicting statements. Moreover, perceived textual boundaries might signal readers that the texts are separate “entities” (Britt, et al., 2013), which might instigate a “resetting” of their processing. The confluence of these factors may make it less likely that school-aged children detect important intertextual conflicts. The current work manipulates whether readers access texts presenting contradictory stances in an alternating “back and forth” manner, or

whether they access the full scope of one stance before moving on to the conflicting stance (here described as a “blocked” presentation).

Models of text comprehension can be incorporated to offer alternative hypotheses on the relative benefits of the two conditions. First, experiencing the intertextual conflicts in an alternating fashion may support detection, providing opportunities for children to elaboratively process for the purposes of incorporating conflicts within mental representations. In alignment with the “distance effects” described above, if children instead read texts in a blocked way – that is, accessing all ideas related to one side of the controversy before accessing all ideas related to the other side – key conflicts may go undetected with less evidence that of their incorporation into children’s understandings. In related research, competent adult readers displayed more evidence of more balanced understandings of controversial stances when accessed in an alternating compared to a blocked presentation; by contrast, the blocked condition displayed greater evidence of “myside bias” (Maier & Richter, 2013; Wiley, 2005).

One could argue, however, that the alternative hypothesis may be likely. That is, reading about a controversial socio-scientific issue such as climate change might instead require a blocked reading, especially for children with lower knowledge, reading skill, or working memory capacity (Oakhill, et al., 2005; Yuill, et al., 1989). In this sense, children may detect conflicts better if they fully understand one stance before preceding to the conflicting stance. In the parlance of prior comprehension theories, children may benefit from having a coherent, stable representation reflecting an associative network of propositions from one text’s stance integrated with prior knowledge (Kintsch, 1998).

Such a representation could provide a backdrop by which detected conflicts receive more elaborative processing, as they cannot become easily integrated. In this sense, the blocked condition may produce better detection and memory for conflicts relative to the alternating stances, by which readers may become more confused as to the main ideas for the topic. Thus, the current work adds value to the research literature in testing competing hypotheses as to the affordances of reading controversial statements in an alternating or blocked way to examine which encourages (or discourages) noticing of and memory for intertextual conflicts.

Finally, the main effect of lexical encoding condition may depend on the ways that adolescent readers access conflicting information. For example, if texts are written using identical vocabulary terms, it may not matter if the conflicting information is interleaved or blocked. Identical vocabulary terms may stimulate reactivation of prior-read information regardless of how long ago it was read (Myers & O'Brien, 1998), which could result in detecting more conflicts and incorporating them into memory representations. However, if multiple texts use different vocabulary terms, blocked presentation may be more supportive of detecting and comprehending intertextual conflicts. In this sense, the development of a stronger, more connected situation model of one of the opposing stances may facilitate detection of discrepancies, which may in turn lead to processing that increases their incorporation into memory representations (Otero & Kintsch, 1992).

Current Research

The current experiment served to simultaneously investigate two contextual factors potentially influencing younger readers' detection of and memory for conflicts found across multiple texts, and their potential combinatorial effects. Multiple texts were manipulated to

reflect the same or different lexical encodings across sentences that contradict each other on key aspects of climate change, and whether texts were presented in an alternating or blocked order. Thus, a 2 x 2 between-subjects design was used with lexical encoding (same, different) and text presentation mode (alternating, blocked) serving as the independent variables. Conflict detection was inferred from the total number of seconds on the target texts. Incorporation of conflicts into readers' mental representations was inferred from students' memory for intertextual conflicts.

We hypothesized main effects for lexical encoding such that students will display longer reading times and better memory for conflicts when contradictions used identical terms relative to non-obvious synonyms. Main effects for text presentation and interactions between the two variables were investigated to explore whether contradictions presented in an alternating or blocked order lead to longer reading times and better memory for intertextual conflicts. Finally, all analyses controlled for prior domain knowledge, with expectations that it would significantly predict variance for each of the two dependent measures. Thus, analyses of covariance allowed for clearer examinations of the effects of the contextual factors on processing of and memory for intertextual conflicts, above and beyond individual differences in prior domain knowledge.

Method

Participants

A total of ninety-one seventh and eighth grade students (M age =13.56, SD = 0.85; 40% female) from a charter school in the greater midsouth area of the USA participated. Racial/ethnic composition reflected that 93% of participating students were African-American; the remaining 7% were Latino/Hispanic. Students attending the school can be described as having lower socioeconomic status, which is defined by US regions in which 40% or more minors qualify for free

and reduced meal plans (FRMP) (Food and Nutrition Service, 2018). At this particular school, 99% qualify for FRMP. This measure is frequently used as a proxy for school-level socioeconomic status, as it strongly correlates with other indicators of poverty (Nicholson, et al., 2014).

Materials

Prior knowledge in the domain of science. The Measures of Academic Progress (MAP) Growth is an assessment distributed to students across Kindergarten through 12th grade. MAP is a computer adaptive test such that every child receives an individualized set of multiple-choice questions (Fleming, 2016). If an item is answering questions correctly, the test progresses towards more difficult items; if the student answers a question incorrectly, less difficult questions are administered. MAP is an untimed assessment, but standard duration of each test is about 60 minutes. In the focal school for this study, MAP was distributed at the beginning, middle, and end of the school year . A student received a Rasch Unit (RIT) scale score for each test that may be followed and used to compute track academic growth across time. The higher the score, the more it reflects higher achievement for that student in that particular subject (Fleming, 2016). For the current work, MAP performance in science collected at the end of the school year was obtained (assessed 2 days prior to our experimental task).

Climate change texts. Controversies about human contributions to climate change was chosen as the topic because they are authentic to everyday multiple text reading contexts, and because of its relevance to what is taught in middle school science classes to satisfy standards (e.g., Next Generation Science Standards' MS-ESS3: Earth and Human Activity). The materials were designed to maximize control in manipulating lexical encoding. To do so, six texts were created. We first constructed two texts that stated that natural fluctuation, rather than human

activity, is to blame for climate change (one text downplaying the impact of fossil fuel use, another downplaying deforestation). We refer here to these as the “target texts.” That is, all students read the same versions of these two texts and, thus, they were held constant across the manipulation.

Two additional texts were constructed that provided the opposing stance: Human activity is to blame for climate change (one implicating fossil fuel use, another implicating deforestation). Across the set of four texts, each of 10 focal claims within the “natural fluctuation” texts contradicted a corresponding claim in the “human activity is to blame” texts. For instance, the claim “climate change has nothing to do with human depletion of fossil fuels” contradicted the claim “human depletion of fossil fuels has caused the Earth to become much hotter than ever before” found in another text.

To embody the lexical encoding manipulation, alternate versions of the two “human activity is to blame” texts were created. For each of the 10 main claims, key vocabulary terms were replaced by non-obvious synonyms. For example, “human *depletion of fossil fuels* has caused the Earth to become much hotter than ever before” was rewritten as “human *consumption of natural gases* has caused the Earth to become much hotter than ever before” (see Appendix A for another extended example). Thus, although all participants read 4 texts in total, half received text pairs using identical vocabulary terms in contradictory claim sentences; the other half read text pairs using non-obvious synonyms instead. The texts, on average, were approximately 230 words each. Flesch-Kincaid grade levels across all six versions of the texts ranged from 7.8 to 9.4 with the average grade level of 8.6, which was suitable for the age of participants in the current work.

We manipulated text presentation mode such that half of the participants read texts that were “blocked” by stance. That is, they first read two texts claiming climate change is due to human activity, followed by two opposing texts claiming that climate change is due to natural fluctuation. Those receiving the “alternating” condition were instead presented with the two opposing documents arguing whether climate change is due to fossil fuels or natural fluctuation, followed by the two opposing documents arguing whether climate change is due to deforestation or natural fluctuation. Importantly, across all four conditions, the constant texts were always distributed second. This was a conscious decision to examine whether these stimuli did (or did not) re-activate prior-read texts containing contradictions in service of detecting and remembering conflicts.

Memory for intertextual conflicts. Twenty items assessed memory for conflicting claims provided across texts. Instructions accompanying each item asked: “Did you read a statement that contradicted this information?” Students had the option of answering “yes” or “no.” Ten were “yes” items which appeared in the constant “natural fluctuation” texts such that everyone read those exact sentences. To return to the example above, students should answer “yes” to the item “climate change has nothing to do with human depletion of fossil fuels,” as there was an opposing claim in a “human activity is to blame” text.

Ten additional test items required a “no” response. Five of these claims appeared in the constant texts, but they did not have a corresponding claim in the opposing texts. Five additional no response items reflected claims that were generally related to climate change, but were not presented by any of the texts. Thus, memory for intertextual conflicts was inferred from readers abilities to accurately choose yes or no when they should do so, with a total possible of 20 opportunities. Cronbach’s α was .61. Presumably, the relatively low reliability estimate was due

to high difficulty levels for some items. Still, this estimate may be regarded as acceptable for research purposes (Hair, et al., 2006; Kerlinger & Lee, 2000). D prime scores were calculated as a more sensitive measure of memory for intertextual conflicts that took into account Z scores for accuracy, but also for false alarms.

Procedure

All students took the prior domain knowledge MAP test using Google Chromebooks in their homeroom, unless there were documented records of special accommodations. In these cases, students were removed from the large group setting and put in a smaller group to ensure accommodations were met. Although each MAP test is untimed, an hour was allotted for each test, in which the majority of students were able to finish. For those who did not, additional time was allowed to finish the test.

Passive consent forms were distributed to all students' parents/guardians two days prior to participation in the experimental session. First, the study was briefly described, and assent forms were distributed to all students whose parent/guardians permitted participation. After the signed forms were collected, Chromebooks (provided by the school) were distributed. Then, the investigator gave additional verbal instructions that elaborated the main reading task. A Qualtrics link was opened to access the materials, which randomly assigned students to one of the four conditions. Participants were instructed to silently read the four texts on the topic of climate change independently, and at their own pace. The Qualtrics program collected reading time in terms of the number of seconds spent reading each text.

After students finished reading, they completed the Memory for Intertextual Conflicts test, in which the 20 items were randomized. If a student finished early, they were instructed to

work on other tasks until everyone else completed the study. Once all students were finished, the class was debriefed by the investigator and compensated for participating.

Results

Scores on the prior domain knowledge measure ($M = 7.21$, $SD = 3.08$, skewness = 1.00), total minutes spent on constant texts ($M = 217.91$, $SD = 151.01$, skewness = 1.07), and memory for intertextual conflicts as d prime scores ($M = -.03$, $SD = 1.87$, skewness = .03) were all approximately normally distributed. Moreover, correlational analyses showed that prior domain knowledge was positively correlated with memory for intertextual conflicts ($r = .21$, $p < .05$), and negatively with reading time on constant texts ($r = -.30$, $p < .01$). Thus, prior domain knowledge appeared to result in faster reading times for the target texts, and better memory for intertextual conflicts. As such, we controlled for its contribution to performance to more clearly investigate the impact of the experimental conditions.

Detection of Conflicts

To test our predictions regarding the effects of experimental conditions on conflict detection, we performed a 2 x 2 between-subjects analysis of covariance (ANCOVA) with lexical encoding (same, different) and text presentation mode (alternating, blocked) as the independent variables, total seconds on constant texts as the dependent variable, and prior domain knowledge as the covariate. The adjusted means for each condition are provided in Table 1. There was a significant main effect of text presentation mode such that students displayed longer reading times when contradictions were presented in an alternating way ($M = 244.81$, $SE = 20.54$) than they did when texts were blocked by stance ($M = 186.24$, $SE = 19.83$), $F(1, 86) =$

4.21, $p < .05$, $\eta_p^2 = .05$. The main effect of lexical encoding and the interaction did not reach acceptable levels of statistical significance, $F_s < 3.05$, $p_s > .09$. The adjusted means suggested readers spent, on average, about 1 minute longer on the constant texts (that is, irrespective that they were the same texts) if they had come directly after the opposing text than if they had been blocked by stance. Finally, the effect of the covariate (i.e., prior domain knowledge) was statistically significant, with $F(1, 86) = 12.86$, $p < .01$, $\eta_p^2 = .13$.

INSERT TABLE 1 HERE

Memory for Intertextual Conflicts

To test our predictions regarding the effects of experimental conditions on memory for intertextual conflicts, we performed a 2 x 2 between-subjects ANCOVA with lexical encoding (same, different) and text presentation mode (alternating, blocked) as the independent variables, memory for intertextual conflicts as the dependent variable, and prior domain knowledge as the covariate. The adjusted standardized mean d prime scores for each condition are provided in Table 1.

Main effects of lexical encoding (same: $M = 0.41$, $SE = 0.27$; different: $M = -0.33$, $SE = 0.25$; $F(1, 86) = 3.88$, $p = .05$, $\eta_p^2 = .04$) and text presentation mode (alternating: $M = -0.32$, $SE = 0.26$; blocked: $M = 0.41$, $SE = 0.25$; $F(1, 86) = 4.09$, $p < .05$, $\eta_p^2 = .05$) were statistically significant. However, these main effects were qualified by a statistically significant interaction between the variables ($F(1, 86) = 8.09$, $p < .01$, $\eta_p^2 = .09$). Tests of the simple effects of lexical

encoding within each level of text presentation order showed that there was a statistically significant effect of lexical encoding when the text presentation was alternating, $F(1, 86) = 6.60$, $p < .01$, $\eta_p^2 = .13$, but not when the text presentation was blocked, $F(1, 86) = 1.62$, ns , $\eta_p^2 = .04$). Thus, when the text presentation was alternating, students remembered more conflicts when the texts used the same lexical encodings ($M = 0.56$, $SE = 0.39$) than they did when reading texts with different lexical encodings ($M = -1.21$, $SE = 0.36$). However, when the text presentation was blocked, students remembered a similar number of intertextual conflicts regardless of whether texts used the same ($M = 0.26$, $SE = 0.37$) or different lexical encodings ($M = 0.56$, $SE = 0.35$). Tests of the simple effects of text presentation mode within each level of lexical encoding showed that when the lexical encodings were the same, students remembered a similar number of intertextual conflicts independent of whether text presentation was alternating or blocked ($M = 0.26$, $SE = 0.37$ vs. $M = 0.56$, $SE = 0.39$), $F(1, 86) = 0.44$, ns , $\eta^2 = .01$. However, when the lexical encodings were different, students remembered more conflicts when text presentation was blocked ($M = 0.56$, $SE = 0.35$) than when it was alternating ($M = -1.21$, $SE = 0.36$), $F(1, 86) = 11.77$, $p < .001$, $\eta_p^2 = .12$. Taken together, this series of simple effects indicates that presenting students with conflicting positions on a controversial issue in an alternating way may actually impede students' memory for intertextual conflicts unless identical lexical encodings are used across texts to describe the same underlying concepts. Finally, the effect of the covariate (i.e., prior domain knowledge) was statistically significant ($F(1, 86) = 8.07$, $p < .01$, $\eta_p^2 = .09$).

Discussion

This study extends understandings of contextual factors that support or undermine adolescents' comprehension of conflicts distributed across multiple texts. To the best of our

knowledge, it is the first study to simultaneously examine the direction and extent to which lexical encoding and text presentation order conditions affect younger readers' abilities to detect and remember instances where two texts' authors are making the opposite claims within a controversial topic. By manipulating both variables, while also controlling for general scientific knowledge, we were able to investigate the unique and combinatorial effects of the focal variables on processing and performance. Expectations were that students would display longer reading times and better memory for intertextual conflicts when contradictions used identical terms relative to non-obvious synonyms. Competing hypotheses concerning text presentation were also explored to establish whether contradictions presented via alternating stances versus a condition blocked by stance lead to longer reading times with subsequent memory benefits for intertextual conflicts.

Regarding the results, students spent more time reading texts that alternated between conflicting stances in a point/counterpoint way, compared to instances where they read texts blocked by stance. Moreover, when students accessed conflicting stances in an alternating way, they displayed worse memory for intertextual conflicts, unless the various texts used identical vocabulary terms. When multiple texts used non-obvious synonyms to convey the same concepts, an alternating presentation lead to worse performance than blocked presentation. Thus, the memory findings seem to support that multiple texts employing identical vocabulary can counteract negative consequences associated with an interleaved presentation of controversial information.

Several important reading processes may become disrupted when multiple texts use different vocabulary terms to convey conflicting claims. First, when the currently-read sentence and memory traces do not share featural overlap, the cue may not signal and activate highly-

relevant, semantically-related information (Myers & O'Brien, 1998). If prior-read information does not become activated – or does to a lesser degree – a threshold may not be reached by which it gets returned to working memory (Kendeou & O'Brien, 2014). Working memory serves as a space where connections can be formed between a text's propositions and activated prior knowledge. Without detection, students would likely engage in less coherence-building processes across the various texts, obviating a need to construct a memory representation incorporating contradictions as an organizing factor (Braasch & Bråten, 2017; Bråten & Braasch, 2018).

The findings also suggest that younger readers may not have had the requisite knowledge of the vocabulary terms' meanings to infer their direct relatedness (Cook & Guéraud, 2005). Although this cannot be directly tested within the current study, an additional analysis was conducted whereby “higher” and “lower” general scientific knowledge groups were created by way of a median split using students' MAP scores. Inclusion of this variable did not produce interactions with the effects of lexical encoding and presentation order presented above. A lack of moderation possibly stems from MAP's assessment of a student's general background knowledge about science, and not specifically their knowledge of key vocabulary terms within the climate change topic. Future extensions could include a prior knowledge measure of key vocabulary terms within the topic of climate change. Expectations would be that specific topic knowledge would facilitate comprehension, uniquely and in combination with the other contextual factors. Such effects would suggest that prior topic knowledge affords opportunities for readers to make inferences across texts, which could support detection of and memory for intertextual conflicts.

Participating middle school students might have perceived within the alternating condition that the texts were continuously introducing “new” concepts across reading cycles, which may have taxed text processing in ways that undermined conflict detection and representation. In this sense, poorer performance when interleaved texts used different vocabulary terms may stem from reader perceptions that the texts conveyed unrelated ideas, and accordingly were processed with little connections made across the texts. According to theoretical models of text comprehension, ideas that are ill-connected to a mental representation that evolves over successive processing cycles can become inhibited or decay until they are eliminated from the representation (McNamara & Magliano, 2009). Future research could develop and test materials and computational models to investigate whether interleaved texts using different vocabulary result in less activation of prior-read information, integration amongst the ideas, or perhaps both.

On a positive note, when conflicting ideas across multiple texts were conveyed using identical vocabulary, readers appeared to detect and remember more conflicts, regardless of whether they were experienced in close physical proximity to one another or more distally. Memory traces of oppositional statements were presumably passively and automatically activated based on an exact featural overlap amongst the vocabulary terms, which likely stimulated the return of said information to working memory (Myers & O’Brien, 1998). Co-activation of conflicting propositions affords opportunities to more elaboratively process relationships them for the purposes of establishing coherence (Kendeou & O’Brien, 2014). For the current work, students may have allocated additional processing efforts to organize mental representations of what was read in terms of a central rhetorical predicate, such as “two texts *contradict each other* regarding the role of human depletion of fossil fuels in climate change”

(Britt & Rouet, 2012). Unlike with Maier and Richter (2013) and Wiley (2005), interleaving the conflicting stances seemed to hinder rather than help younger readers to understand both sides of the controversies within the domain of climate change, possibly because they were confused by the constant shifting of perspectives across texts. However, when texts displayed clear contradictions by means of identical vocabulary terms, this potentially detrimental effect was alleviated.

On the other hand, when younger readers accessed the scope of ideas related to one side of the controversy before they accessed all ideas related to the other side (i.e. reading “blocks” of texts), they remembered a similar number of intertextual conflicts regardless of whether texts used the same or different terms. If one assumes younger students do not have a strong prior knowledge network regarding key climate change concepts, and the ways that people typically disagree about them, a blocked presentation may support constructing stronger episodic representations of the textbase (Kintsch, 1998). In this way, younger students may benefit from gradually developing a more complete and connected representation of one side of the controversy before they move on to read about the other side of the controversy. A coherent, interconnected network of texts’ propositions reflecting human causes for climate change, for example, could serve as a backdrop to support readers in recognizing when later-read texts state that humans are not to blame for climate change, or vice versa.

The data were limited with respect to the kinds of dependent measures that were used, including the coarse-grained processing measure of full text reading time. In alignment with Ferreira and Yang (2019), the current research incorporated an “online” reading measure to make inferences about the ways that readers build mental representations while engaging with the texts, and an “offline” memory measure to make inferences about the contents of the

representation that were constructed. In this research, processing patterns that occurred during reading did not perfectly map onto the subsequent understandings about conflicts that were presumably developed from reading experiences (Rapp & Mensink, 2011). Seconds per page may not have been sensitive enough to capture potential processing differences, as one might expect based on theory. Future research could incorporate more fine-grained cognitive trace data (e.g., eye movements or think aloud comments produced during reading) to investigate the extent to which younger readers detect conflicts when multiple texts use identical terms and non-obvious synonyms within conflicting statements, as well as how these processes might be moderated by text presentation order. Moreover, additional evidence is needed regarding the resolution strategies that ensue given these contextual conditions.

The simplicity of the intertextual conflict memory measure was also a limitation. Free recall memory measures could provide a more nuanced understanding of the ways that conflicts are represented, and the coherence that does or does not result from the different reading conditions. For example, Stadtler et al. (2013) demonstrated that readers of multiple texts (as compared to those reading the same information aggregated within a single text) wrote essays reflecting a more balanced memory for conflicting information. Future research could explore whether conflicting texts using identical vocabulary, in particular, promote more balanced memory for intertextual conflicts as evidenced in essays written from memory.

Additional research might also explore moderation of the effects initially demonstrated here as a function of student characteristics that have been related to comprehension in prior research, including reading skill (van der Schoot, et al., 2012; Zabucky & Moore, 1989; Zabucky & Ratner, 1989) and working memory capacity (Oakhill, et al., 2005; Yuill, et al., 1989), to name but a few. Moreover, because participant-specific socio-economic status (SES)

was not available, analyses incorporating it as a unique and moderating factor were not possible. It is worth noting however that, in a large-scale Programme for International Student Assessment (PISA) survey, participant SES status accounted for a considerable amount of variability (12%) in digital literacy tasks (OECD, 2015). These tasks assessed several facets of digital literacy including navigation, evaluation, and – important for the current work – integration of ideas across multiple texts. Future work could use larger sample sizes, which could allow for testing interaction effects between contextual conditions, SES status, prior knowledge of the topic, on conflict detection and memory.

Moreover, additional contextual factors could be manipulated (e.g., reading instructions) to identify whether some promote detection and deeper processing of contradictions across texts more substantially than others (Markman & Gorin, 1981; Zabucky & Moore, 1989). Finally, based on the current findings, vocabulary interventions could be developed and implemented to identify best practices for preparing adolescents for reading multiple conflicting texts. Several studies have demonstrated that providing school-aged children with vocabulary training generally improves subsequent reading comprehension (Beck, et al., 1982; Brinchmann, et al., 2016; Elleman, et al., 2009). In a similar vein, future educational interventions might provide students with vocabulary training in the content domain prior to interacting with multiple texts. This could enlighten whether these kinds of activities prepare adolescent students for detecting and representing ideas within a controversial domain.

General Conclusion. The complexities of the current literacy context make it such that adolescents must engage in a host of related processes when reading about complex societal issues. Although some are outside of the scope of the current work (e.g., information location

and evaluation), the current work focused on noticing and rectifying experiences of cognitive conflict that stem from intertextual discrepancies about an important societal issue. Experimental manipulations of text access and the words used to convey the key ideas informed on contextual factors that may support (and undermine) successful processing and representation of intertextual conflicts. Future research could build on these ideas to identify additional contextual factors that promote understandings for adolescents with different reader characteristics, including the affordances of different kinds of reading tasks.

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Example of Lexical Encoding Manipulation

Same Vocabulary

If humans keep **cutting down trees**, there will only be a few trees to **soak up** carbon dioxide from the **atmosphere**. When **cutting down of trees** occurs, the trees **decay**. Huge amounts of **greenhouse gases** escape from **decaying** trees.

Different Vocabulary (Non-obvious Synonyms)

If humans keep up with **deforestation**, there will only be a few trees to **absorb** carbon dioxide from the **aerospace**. When **deforestation** occurs, the trees **decompose**. Huge amounts of **molecules of carbon** escape from **decomposing** trees.

Appendix A

Target Constant Text (read by everyone)

Humans can continue to cut down trees to meet their needs, as they have for years. This is because **decaying** trees have no impact on climate change. No **greenhouse gases** are released in the **atmosphere** when **trees are cut down**. To sum up, human's **cutting down of trees** is not causing climate change. Temperatures will continue to naturally rise and fall as they always have.

Table 1.

Adjusted means (standard errors) for target text reading times (seconds) and memory for intertextual conflicts (d prime scores) as a function of order of text presentation and lexical encoding conditions

| | Alternating stances | | Blocked by stances | |
|------------------------|---------------------|------------------|--------------------|------------------|
| | Same vocab. | Different vocab. | Same vocab. | Different vocab. |
| Sentence reading times | 198.89 (30.77) | 290.72 (28.10) | 180.93 (29.02) | 191.55 (27.18) |
| Memory for conflicts | 0.56 (0.39) | -1.21 (0.36) | 0.26 (0.37) | 0.56 (0.35) |