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Identification of main ideas in expository texts: selection versus deletion

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Abstract

Readers often struggle to identify the main ideas in expository texts. Existing research and instruction provide some guidance on how to encourage readers to identify main ideas. However, there is substantial variability in how main ideas are operationalized and how readers are prompted to identify main ideas. This variability hinders identification of best practices for instruction and intervention. The goal of the current series of experiments was to systematically examine the extent to which different tasks (e.g., selecting main ideas vs. deleting details) and different operationalizations of main ideas (e.g., "important ideas" vs. "main ideas") influenced adult readers' identification of sentences containing main ideas as they read 11 expository texts. Across experiments, the results showed that readers were generally unreliable in identifying main idea sentences; however, they were more reliable when they were instructed to select main idea sentences compared to when they were instructed to delete sentences comprised of details, and more skilled readers were more reliable than less skilled readers. The findings from the current experiments challenge existing instructional approaches and call for additional research to better understand readers' main idea selection.

Keywords Comprehension · Main ideas · Reading instruction

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Introduction

Readers must be able to understand expository and informational texts to succeed in academics and everyday life (CCSS, 2010; NAEP, 2019). One essential part of understanding texts is identifying the main ideas (van den Broek et al., 2013). Identifying main ideas is a foundational skill for higher-level comprehension strategies that support meaningful comprehension, such as inferencing, integrating information across texts, and summarizing texts (Boudah, 2014; van den Broek et al., 2003; Williams, 1986). Although identifying main ideas is critical, readers often struggle to do so (Englert & Mariage, 2020; Pressley et al., 1990). Consequently, main idea instruction is prevalent in classrooms and educational interventions (e.g., Afflerbach & Walker, 1992; Baumann, 1984; Stevens & Vaughn, 2021). However, there is substantial variability in how main ideas are operationalized and, as a result, how readers are prompted to identify main ideas. This variability makes it difficult to identify best practices for instruction and intervention. The goal of the current study is to systematically examine the extent to which different tasks (e.g., selecting main ideas vs. deleting details) and different operationalizations of main ideas (e.g., "important ideas," "main ideas") influence adult readers' identification of sentences containing main ideas. Understanding the tasks and conditions that encourage reliable identification of main ideas is essential to inform approaches to instruction and intervention for readers who struggle to understand and use such essential information in expository texts.

To this end, we conducted a series of three experiments to examine how task instructions influenced the reliability with which proficient adult readers' identified sentences that include main ideas in expository texts. We systematically examined the extent to which instructing adult readers to either (1) *select* main ideas or (2) *delete* details from expository texts influenced their reliability in identifying main ideas, while also accounting for key literacy-related individual differences (i.e., vocabulary, prior knowledge). In this context, reliability refers to the extent to which readers agreed with each other about which sentences included main ideas. We also examined the impact of common operationalizations by referring to main ideas either as (1) "main ideas" or (2) "important ideas." The results from these experiments provide insights into the conditions that may optimize readers' recognition of main ideas in expository texts, which in turn can inform instruction and intervention, as well as theories of text comprehension.

Comprehension of expository texts

Successful comprehension of expository texts requires the coordination of several complex cognitive processes. Although there are a variety of theoretical accounts of comprehension, most accounts agree that readers construct a multilevel or multi-layered mental representation of the text as they read (for a review, see McNamara & Magliano, 2009). This mental representation consists of information that is explicit in the text, as well as inferences that connect information

from different parts of the text and integrate information from the text with prior knowledge (van den Broek et al., 2015). If the information in the reader's mental representation is highly interconnected or *coherent*, then it is likely that the information will be retained and remain accessible to facilitate subsequent learning (McNamara & Kintsch, 1996). A mental model can be represented as a network in which the key or essential ideas in the text are more central and more interconnected (Kim & McCarthy, 2021). Thus, identifying main ideas supports the construction of a mental model that is structured around the important information in the text.

To construct a coherent mental representation, readers must engage in construction and integration processes. According to the Construction-Integration model (Kintsch, 1988, 1998), *construction* refers to the activation of information from the text and prior knowledge based on its relatedness to current text content. The result of the construction phase is an associative network of information from the text and activated prior knowledge. The second phase, *integration*, captures the spread of activation within this associative network. Information that is highly interconnected with other information within the network receives more activation and will therefore likely become part of the reader's final mental representation of the text, whereas information that has relatively few connections loses activation and is therefore not retained in the mental representation. Ideally, the main ideas of the text garner more interconnections with other information compared to details or supporting information. That is, information that is perceived as more central to the main point of the text should be both more interconnected with other ideas and more likely to be retained.

There are several individual differences that influence how successfully the construction and integration processes unfold. Prior knowledge, or the knowledge that the reader brings to the reading task, is of particular interest in the current study. In general, more prior knowledge corresponds to better comprehension. Indeed, prior knowledge predicts 30–60% of the variance in comprehension performance (Dochy et al., 1999; Shapiro, 2004). Prior knowledge influences comprehension directly in that more knowledge better enables readers to draw inferences that connect the information in the text to the reader's knowledge base or to other textual information (Goldman et al., 2012; Kendeou & van den Broek, 2005; Kintsch, 1988, 1998; McNamara & Magliano, 2009; Shapiro, 2004). Prior knowledge also influences comprehension indirectly in that more knowledgeable readers are generally better able to select and execute effective comprehension strategies (Byrnes & Guthrie, 1992; Cromley & Azevedo, 2007; McNamara, 2007).

Another individual difference is vocabulary knowledge, or the extent to which readers know the meanings of words and their uses in context (Perfetti, 2007). Vocabulary knowledge tends to be strongly correlated with general reading skill (e.g., $r = 0.84$, Braze et al., 2007; $r = 0.79$, Allen et al., 2014). Both prior knowledge and vocabulary independently facilitate various aspects of reading comprehension (Stahl et al., 1989, 1991) and may therefore serve as a proxy of reading skill. Thus, it is reasonable to suspect that these individual differences may influence identification of sentences that contain main ideas. In particular, readers may be better able to distinguish main ideas from supporting information if they have a stronger knowledge

base (i.e., more prior knowledge and vocabulary knowledge) and reading skills by which to evaluate information.

Main idea identification

Identifying sentences that contain the main ideas requires readers to actively construct meaning from a text by evaluating its content, which in turn encourages a global understanding of the text (Jitendra et al., 2001). Additionally, to perform well on high-stakes assessments, readers are required to identify main ideas, describe how those ideas are supported by details, as well as use sentences containing the main ideas to summarize expository texts (e.g., National Governors Association Center for Best Practices & Council of Chief State School Officer, 2010).

As one would expect, struggling readers underperform when tasked with identifying important information from texts (Miller & Keenan, 2009; Stevens et al., 2018; Winograd, 1984). Winograd (1984) found that skilled eighth-grade readers were more accurate and reliable in identifying main ideas compared to less skilled eighth-grade readers. The main ideas that the less skilled readers identified upon first reading of expository texts had only a weak correlation with the ideas they selected from the same texts after a 6-month lapse. Additionally, the ideas that less skilled readers identified from the texts had little correspondence to the ideas they included in their written summaries of the passages, which suggests that they did not use the main ideas of the text to grasp the "gist" of the text.

Given these relations between identifying main ideas and comprehension, helping readers to identify main ideas can be an effective strategy to improve comprehension performance (Biancarosa & Snow, 2006; Goldman, 2012). Indeed, explicit instruction in main idea identification and summarization was identified as one of the highest impact instructional practices that teachers can use to improve reading comprehension (Edmonds et al., 2009; Gajria, et al., 2007; Garwood et al., 2014; Gersten et al., 2001; Solis et al., 2012).

There are multiple strategies, or decision rules, that readers can apply in order to identify main ideas in texts (Kintsch & Van Dijk, 1978). Readers can identify main ideas by applying a *select* mapping rule to select propositions that subsume most other propositions from the text. Alternatively, they can apply a *construct* mapping rule to generate new propositions that subsume most others if suitable text propositions are not already explicit in the text. These selection and construction rules may be sufficient for contrived instructional texts, which often present a main idea in the introductory sentence, and in turn only require readers to examine subsequent propositions in terms of their relation to the introductory sentence (Hare et al., 1989). When main ideas are presented early in the text, readers may easily avoid misjudging the importance of unessential details. In fact, readers often choose the first sentence of a text or paragraph (i.e., a topic sentence) as a main idea (Brown & Day, 1983; Meyer et al., 1980).

Hare et al. (1989) argued that selection and/or construction rules may not be sufficient for more naturalistic texts, including scientific texts that present a collection or list of attributes about a subject. Such "listing texts" often occur in

science and social studies textbooks (Magnus & Hare, 1986). These types of texts typically include restatements of main ideas, supporting information, details and examples, as well as adjunct information to reactivate readers' prior knowledge. For example, science texts that follow a listing structure typically also contain compare/contrast, cause/effect, and sequences. To identify main ideas in texts that provide extraneous information, readers may need to apply a *delete* mapping rule to eliminate unessential ideas from dominating their mental representation of the text (Kintsch & Van Dijk, 1978). Readers typically struggle to identify main ideas in texts that require deletion of a lot of supporting material or details (e.g., Hare et al., 1989).

Relevant to the present investigation is the lack of consensus in the extant research regarding how main ideas are operationalized as it relates to these different decision rules (Hare et al., 1989; Williams, 1988). In some cases, main ideas are conceptualized as newly constructed sentences (Brown & Day, 1983) that capture the macroproposition of the text (e.g.,Stoeger et al., 2014; Toonder & Sawyer, 2021). In other cases, main ideas are operationalized as sentences that are found directly in the text via the *select* or *delete* mapping rules (e.g., Bogaerds-Hazenberg et al., 2021; van den Broek et al., 2003). For example, a brief internet search reveals that many of the lessons readily available to instructors describe "finding the main idea" which implies a selection or deletion, but not a construction strategy.

One of the more detailed descriptions of main idea identification comes from Brown and Day (1983). They propose that readers should (a) delete unnecessary material, (b) delete material that is trivial, (c) delete material that is redundant, (d) substitute a superordinate term for a list of items or actions, (e) select a topic sentence, and (f) invent a topic sentence if there is not a sufficient one directly in the text. Notably, this approach involves deletion, selection, and construction. This approach also highlights that selection and deletion strategies are a precursor to constructing a main idea. That is, even if the main idea is not contained in a single sentence within the text, the reader must go through a process of identifying which sentences contain information that is more central to the main idea and sentences that include mostly detail information.

A second concern is that main ideas have been conflated with related concepts such as "important ideas" (Hare & Milligan, 1984). In the basal readers series, the instructions and examples provided to readers often did not reflect the definition of "main ideas'' that readers encounter at the outset of the reading tasks (Hare & Milligan, 1984; Winograd & Brennan, 1983). For example, some texts provided definitions of "main idea" and "topic" that were almost identical, whereas others distinguished main ideas from topic. Searching the web for "teaching main ideas" reveals clear disagreements in definitions across "main ideas", "themes", "topics", and "important ideas". In some cases, the terms are used interchangeably, while others make explicit distinctions. Such variability limits comparison of methods and results across studies. Consequently, it is difficult to leverage the findings of existing studies to arrive at a "big picture" in terms of the implications of main idea identification to inform comprehension theory. It is also difficult to glean information about the factors that influence identification of main ideas to inform instruction and intervention (Wang, 2009).

The difficulty in leveraging existing findings is problematic in the context of technology-based instruction to improve reading comprehension. How could researchers best develop automated instruction to elicit identification of main ideas that are explicit in expository texts? Readers could be given tasks that instruct them to apply different methods or theory-based decision rules during reading (i.e., *selection* of main ideas vs. *deletion* of details; Brown & Day, 1983; Hare et al., 1989), and the tasks could be operationalized in different ways (e.g., identifying main ideas vs. important ideas). Moreover, the methods and operationalizations that support identification of main ideas may be different for skilled and less skilled readers. More skilled readers may benefit from further instruction or practice in one strategy, whereas a different approach may be required for less skilled readers.

To begin answering these questions, we conducted a series of three experiments that systematically examined how different tasks and operationalizations influence the reliability with which readers identify sentences containing main ideas, while also examining the roles of prior knowledge and vocabulary. Answers to these questions are essential to guide subsequent instruction that aims to improve core aspects of comprehension.

The current study

In this series of experiments, we examined the extent to which different tasks (selection vs. deletion) and framing (main idea vs. important idea) influenced adult readers' identification of main ideas in expository texts. Specifically, for our first question, we examined the number of sentences adult readers identified as containing the main ideas in the texts, as well as their reliability in doing so. We expected the task to influence readers' identification of main ideas because doing so requires readers to either apply (1) a delete mapping rule, which would serve to eliminate information that is nonessential to the text's meaning, or (2) a select mapping rule, which would serve to retain the main ideas in the reader's mental representation of the text's meaning (Kintsch, 1988). It is currently unclear to what extent instructing readers to identify main idea sentences via a selection versus deletion strategy would influence their identification while reading expository texts that include both important and unimportant information. Although no existing research to our knowledge has directly compared selection versus deletion tasks, Hare et al. (1989) showed that both younger and older students struggled to describe main ideas after reading texts that included many extraneous details (and therefore required more deletion to glean the main ideas) compared to texts that contained fewer details (and therefore enabled readers to glean the main ideas via selection). Thus, we hypothesize that readers will be more reliable in their main idea identification in the selection condition compared to the deletion condition. In line with existing research (e.g., Brown & Day, 1983), we also hypothesize that readers will reliably identify the first sentence of each text as a main idea.

Our second question regarded the language used in *framing* the task as identifying main ideas vs. important ideas. We chose to compare these operationalizations or frames in light of the operational variability in extant research and instruction.

Differences in operationalization may influence readers' identification of main ideas because they may elicit different evaluations. On the one hand, readers may consider details or supporting information to be *important*, and therefore may be relatively less selective in the "important ideas" condition than in the "main ideas" condition. On the other hand, the two operationalizations may not elicit differential selectivity. However, extant research is relatively uninformative regarding whether differences in framing will differentially affect readers' identification of main ideas.

Finally, literacy-related individual differences (i.e., prior knowledge and vocabulary) may influence readers' identification of main ideas. With respect to prior knowledge, high-knowledge readers construct more coherent knowledge structures while reading, facilitating the identification of main ideas. By contrast, low-knowledge readers construct less coherent knowledge structures, which may produce processing bottlenecks that hinder identification of main ideas (Afflerbach, 1990). As such, we expected the effects of task and framing to primarily manifest–if at all–for the low-knowledge readers.

In Experiment 1, we examined the extent to which the identification task (i.e., selection versus deletion) and framing (i.e., main ideas versus important ideas) influenced the proportion of sentences in each text that readers identified as containing main ideas and their reliability in doing so. In Experiment 2, we examined the extent to which the task and framing influenced identification of main idea sentences when the workload between the two identification tasks was equated. Finally, in Experiment 3, we examined how the identification task influenced the reliability with which readers identified main idea sentences when they were constrained to identify four sentences from each text, which was intended to increase the selectivity of readers' evaluations.

Experiment 1

The goal of Experiment 1 was to examine the extent to which identification task (selecting main ideas vs. deleting details), framing (referring to main ideas either as "main ideas" or as "important ideas"), and individual differences (vocabulary, prior knowledge) influenced readers' main idea identification in expository texts. We measured both the number of sentences readers identified as containing main ideas from each text, as well as the reliability with which readers identified those main idea sentences.

Method

Participants

Five-hundred seven fluent English readers were recruited from Amazon MTurk. Because MTurk may yield questionable data in the absence of stringent quality control measures (Chmielewski & Kucker, 2020), we implemented existing best practices to help ensure high quality data (Aguinis et al., 2021; Hauser et al., 2019).

Specifically, participants were not permitted to attempt the study if they did not have a Human Intelligence Task approval rate of at least 95%. Moreover, two hundred sixty-two readers were excluded for failing one or more attention check items, because their overall reading times on the texts indicated that their reading rate exceeded a threshold of superior reading speed (i.e., 600 words per minute; Carver, 1992), or because of invariant responding on individual differences measures (i.e., participants chose the same option for every item). Moreover, 151 readers dropped out of the study prior to completion (21 in the deletion condition, 13 in the selection condition, and 117 prior to being assigned to a condition). Because readers were automatically eliminated prior to completing the demographics questionnaire, there are no demographic data to report for excluded participants. After our stringent quality-control measures (i.e., attention checks, reading rate, invariant responses), the final sample included 94 participants (31 female, 63 male). Of the final sample, the average age was 36 years (SD = 11). Seventy-eight percent of participants in the sample were White, 15% were Asian, 3% were Black, 2% were Hispanic, and 1% were Native American. Sixty-one percent of the sample reported holding a four-year college degree, 29% reported holding a graduate degree, and 9% reported holding a high-school diploma. Participants who successfully completed the study were compensated $2.50 for their time.

Design

Participants were randomly assigned to one task condition in which they either selected sentences that included main ideas from the texts or to deleted sentences that did not include main ideas. Participants were also randomly assigned to one framing condition in which the main ideas were either framed as "main ideas'' or "important ideas." Thus, Experiment 1 followed a 2 × 2 between-subjects factorial design (task: selection vs. deletion and framing: "main ideas' 'vs. "important ideas").

Individual difference measures

Readers' prior knowledge was assessed using 14 multiple-choice items about science-related domains (e.g., basic ecology, biology, anatomy) validated in prior research (e.g., O'Reilly et al., 2004). Each item included four answer options. The internal consistency of scores on the prior knowledge test was acceptable (Cronbach's $\alpha = 0.65$). Readers' vocabulary was assessed using a subset of 20 items from an online version of the Gates-MacGinitie Vocabulary subtest (level 6). The internal consistency of scores on the vocabulary test was good (Cronbach's $\alpha = 0.90$). For both prior knowledge and vocabulary, the sum of correct responses served as the outcome.

Expository texts

Readers engaged with 11 expository texts. Some were adapted from McMaster et al. (2012) and others were gathered from internet sources for the development

Table 1 Descriptive statistics for the expository texts

Text topic	Word count	Number of sentences	Flesch–Kincaid grade level
Babies	235	13	7.87
Wind	180	16	8.17
Exercise	195	13	9.08
Floods	230	13	9.16
Hurricanes	201	18	5.79
Matter	218	13	9.72
Moles	187	13	4.88
Mountains	161	14	4.58
El Niño	171	15	6.04
Earthquakes	174	16	6.54
Viruses	183	17	6.47

of a larger corpora. The texts contained between 9 and 18 sentences with an average word count of 185 and an average Flesch–Kincaid score of 7.1. See Table 1 for descriptive statistics for each text. The texts were selected as they were more naturalistic "listing texts" that are commonly found in textbooks and other classroom materials. Texts were presented as individual blocks of text without paragraph breaks. Presenting texts in this way reduced structural cues that may assist readers in identifying main ideas (e.g., Meyer et al., 1980). For example, it is possible that some readers would identify topic sentences for each paragraph as including main ideas simply on the basis of their prior knowledge of conventional text structure (Aulls, 1978; Meyer et al., 1980; Williams & Stevens, 1972).

Task instructions

Readers were instructed to read the series of texts. Prior to reading, they were instructed to either "select sentences that include main/important ideas" from the texts or to "delete sentences that do not include main/important ideas," depending on which task condition and framing condition to which they were randomly assigned. Participants were exposed to each text individually with a task reminder presented before each text.

Procedure

Participants first completed the prior knowledge assessment. Then, participants read the 11 expository texts in random order in one of two task conditions (selection vs. deletion of sentences) and one of two framing conditions (identifying 'main ideas' vs. 'important ideas'). In the selection condition, readers were instructed to carefully read the texts and highlight sentences that contain main ideas. In the deletion condition, readers were instructed to carefully read the texts and highlight sentences that did not contain main ideas. Readers could highlight

any number of sentences in both conditions. In the 'main ideas' condition, the task instructions referred to 'main ideas," whereas in the 'important ideas' condition, the task instructions referred to 'important ideas.' After engaging with all 11 texts, readers then completed the vocabulary assessment and demographic survey. All components were presented in a Qualtrics survey.

Sentence identification reliability scores

The reliability with which readers identified sentences that contained main ideas was calculated by first assigning a score to each sentence. The sentence score was based on the proportion of the overall sample who identified that sentence as a main idea. Thus, the sentence score was based on the proportion of readers in the sample who selected the sentence as a main idea (in the selection condition) and readers who retained the sentence (in the deletion condition). For example, if 10% of the sample identified a particular sentence as a main idea, then that sentence was assigned a score of 0.10. Therefore, sentences that were consistently identified as main ideas were assigned a higher score than sentences that were identified less consistently. These sentence reliability scores were then used to calculate a reliability score for readers. Each reader's reliability score represented the average sentence score of the sentences that the reader identified as mean ideas. Thus, readers with higher reliability scores tended to identify sentences that were also more frequently identified as main ideas by the overall sample.

Table 2 Correlations and descriptive statistics

	M (*SD*)	1	2	3	4	Task		Framing	
						Selection	Deletion	"Main"	"Important"
						M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
1 Reader Reliability	.59 (.02)	-				.61 (.02)	.58 (0.0)	.59 (0.0)	.59 (0.0)
2 Num. Sentences	8.5 (4.9)	-.62***	-			3.8 (2.2)	12.9 (1.0)	8.7 (5.1)	8.4 (4.7)
3 Vocabulary	6.7 (5.5)	.37***	-.13	-		7.8 (5.6)	5.7 (5.2)	6.5 (5.6)	7.0 (5.4)
4 Prior Knowledge	6.1 (2.8)	.24*	-.04	.64***		6.4 (3.0)	5.8 (2.5)	6.0 (2.6)	6.2 (3.0)
5 Duration (s)	1430 (1059)	.10	.03	.05	.11	1557 (1136)	1317 (983)	1349 (906)	1548 (1252)

***$p < .001$; *$p < .05$

Results

Preliminary analyses

A pair of two-way ANOVAs tested equivalence between task conditions (selection vs. deletion) and framing conditions ("main ideas" vs. "important ideas") on prior knowledge, vocabulary, and time on task, as measured in total duration of participation time. Time on task was collected as part of our attention check assurance, but it was also used to explore possible differences in effort across conditions. See Table 2 for descriptive statistics and correlations. Readers in the selection task did not differ from readers in the deletion task in prior knowledge, $F(1, 90) = 1.39$, $p = 0.24$, or duration total (i.e., average total time participants spent completing the study), $F(1,89) = 1.12$, $p = 0.29$. However, readers in the selection task had higher vocabulary scores than readers in the deletion task, $F(1, 90) = 3.93$, $p = 0.05$. Readers in the "main ideas" framing condition did not differ from readers in the "important ideas" framing condition in prior knowledge, $F(1, 90) = 0.02$, $p = 0.86$, vocabulary, $F(1, 90) = 0.10$, $p = 0.75$, or duration, $F(1,89) = 0.72$, $p = 0.40$.

Number of sentences identified as main ideas

We conducted a linear mixed-effects model to examine how the task condition (selection vs. deletion), framing condition ("main ideas" vs. "important ideas"), prior knowledge, and vocabulary influenced the number of sentences readers identified as main ideas. The model included main effects of task, framing, vocabulary score, and prior knowledge score, as well as all two-way interactions, as fixed effects. Participants and texts were included as random effects.

The results showed a main effect of task, such that readers in the deletion condition identified an average of approximately 13 sentences as main ideas from each text (i.e., readers in the deletion condition deleted very few sentences—approximately two sentences per text on average), whereas readers in the selection condition identified an average of approximately 4 sentences as main ideas from each text (i.e., readers in the selection condition selected relatively few sentences; $\beta = 11.01$, $t = 12.49$, $p < 0.001$, $\eta^2 = 0.64$). There was no effect of framing condition on the number of sentences readers identified as main ideas ($\beta = 0.25$, $t = 0.56$ $p = 0.58$). Neither vocabulary ($t = 0.08$, $p = 0.93$), nor prior knowledge ($t = -1.22$, $p = 0.22$) had significant main effects. However, as Fig. 1 shows, the effect of task condition depended on readers' prior knowledge. More knowledgeable readers identified more sentences as main ideas in the selection condition compared to less knowledgeable readers; however, in the deletion condition, more knowledgeable readers identified fewer sentences as main ideas (i.e., deleted more sentences) than did less knowledgeable readers ($\beta = 0.46$, $t = 2.93$, $p = 0.004$, $\eta^2 = 0.09$). As such, a simple slopes analysis revealed that the effect of task was greater for less knowledgeable readers ($\beta = 10.24$, $t = 19.21$, $p < 0.001$) compared to more knowledgeable readers ($\beta = 7.68$, $t = 13.72$, $p < 0.001$). The interaction between task and vocabulary did not approach significance ($t = -0.57$, $p = 0.57$).

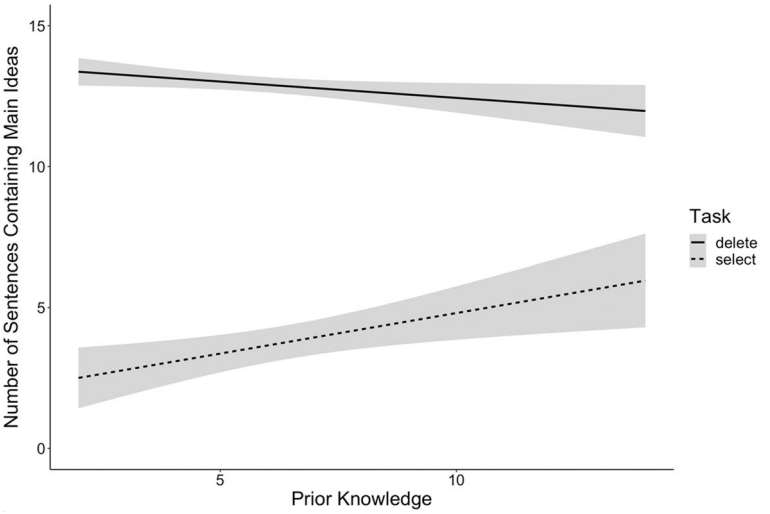

Fig. 1 Effect of Prior Knowledge on Number of Sentences Identified. *Note*. Bands represent 95% confidence intervals

Identification reliability

Across all texts, the mean sentence reliability score (i.e., the proportion of the sample who chose the sentence) was 0.58 ($SD = 0.07$, min = 0.42, max = 0.80). For the first sentence in each text, the mean sentence reliability score was 0.61 ($SD = 0.05$, min = 0.53, max = 0.69). A Welch's *t*-test indicated that readers more consistently identified the first sentence from each text as a main idea compared to other sentences in the texts, $t(11.81) = 2.59$, $p = 0.02$.

A second linear mixed effects model examined the extent to which the same variables influenced the reliability with which readers identified sentences containing main ideas. Specifically, the model included fixed effects of task, framing, vocabulary, and prior knowledge, and participants and texts as random intercepts. The model examined main effects of task (selection vs. deletion), framing ("main ideas" vs. "important ideas"), vocabulary, and prior knowledge, as well as all two-way and three-way interactions, on readers' identification reliability. In terms of the reliability with which readers identified main ideas, readers in the selection condition were marginally more reliable in the sentences they identified as main ideas compared to readers in the deletion condition ($\beta = 0.015$, $t = 1.98$, $p = 0.051$, $\eta^2 = 0.04$). With respect to reliability of main idea identification, there was no effect of framing condition ($\beta = 0.001$, $t = 0.47$, $p = 0.64$), vocabulary ($t = 0.31$, $p = 0.76$), or prior knowledge ($t = 0.17$, $p = 0.86$). However, the effect of task depended on readers' vocabulary. As Fig. 2 shows, readers in the selection task condition were more reliable than readers in the deletion task condition, particularly when they had higher vocabulary skill, whereas vocabulary skill did not influence reliability in the deletion condition ($\beta = 0.002$, $t = 2.83$, $p = 0.006$, $\eta^2 = 0.09$). Specifically, a simple slopes analysis showed that the effect of task was smaller for readers with lower vocabulary

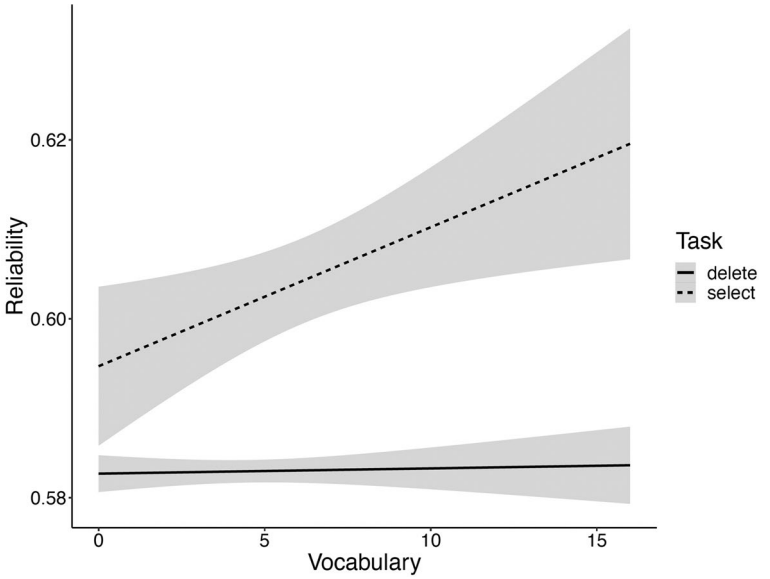

Fig. 2 Effect of Vocabulary on Reliability of Main Idea Selections. *Note.* Bands represent 95% confidence intervals

($\beta = 0.01$, $t = 2.35$, $p = 0.02$) compared to readers with higher vocabulary ($\beta = 0.03$, $t = 7.06$, $p < 0.001$). The interaction between task and prior knowledge did not approach significance ($t = 1.00$, $p = .32$).

Discussion

The results from Experiment 1 indicated that readers in the deletion condition did not reliably identify main ideas in the texts. In fact, readers in the deletion condition deleted very few sentences as nonessential. In turn, the large number of retained sentences were included in the calculation of readers' reliability scores, which greatly reduced the variability in reliability for readers in the deletion condition. It is highly unlikely that readers in the deletion condition judged most of the sentences in the texts as main ideas. A more likely interpretation is that readers were simply reluctant to delete sentences. In the selection condition, readers tended to identify approximately four sentences as main ideas from each text and did so more reliably when they had higher vocabulary (i.e., better readers). However, referring to the task as identifying "main ideas" versus "important ideas" had no impact on the number of sentences identified as main ideas or the reliability with which those sentences were identified.

A difference between the selection and deletion task conditions in the current experiment was the differential workload for readers. Readers in the selection condition were required to simply highlight sentences that contained main ideas via mouse-click. Readers in the deletion condition were required to highlight all sentences *except* those that contained main ideas. The more demanding task for readers in the deletion condition

may explain why those readers identified substantially more sentences as main ideas (i.e., deleted relatively few sentences from the texts). Therefore, in Experiment 2, we modified the task to equate the workload between the selection and deletion conditions, thereby affording a fairer comparison.

Experiment 2

In Experiment 2, we addressed the differential workload in the previous experiment by requiring readers to decide via mouse-click for every sentence in both the selection and deletion conditions. We also omitted the framing manipulation (i.e., "main ideas" vs. "important ideas") and simply instructed all readers to identify "main ideas," as the framing manipulation had yielded no effect in Experiment 1. Thus, the goal of Experiment 2 was to replicate the results observed in Experiment 1, while holding the workload between the two conditions constant.

Method

Participants

Five-hundred eighty-five readers from Amazon MTurk completed the experiment. Two-hundred fifty-five readers were excluded from analyses based on the same criteria and best practices used in the previous experiment (i.e., failed attention checks and/or unrealistically short overall reading times). Moreover, 171 readers dropped out of the study prior to completion (24 in the deletion condition, 13 in the selection condition, and 134 prior to being assigned to a condition). Thus, the final sample consisted of 159 participants (57 female, 101 male). The mean age of participants in the sample was 35 years ($SD = 10$). Seventy-two percent of participants in the sample were White, 20% were Black, 3% were Asian, 3% were Hispanic, and 1% were Native American. Sixty-three percent of participants in the sample reported holding a four-year college degree, 27% reported holding a graduate degree, and 9% reported holding a high school diploma. All participants were fluent in English. Participants who participated in the previous experiment were unable to participate in the current experiment. Participants were again paid $2.50 for their time.

Design

Participants were randomly assigned to a two-level task (selection vs. deletion) between-subjects design.

Individual difference measures

Prior knowledge and vocabulary were assessed with the same measures used in the previous experiments. Internal consistency of scores on the prior knowledge

measure was $\alpha = 0.63$, and internal consistency of scores on the vocabulary measure was $\alpha = 0.83$.

Expository texts

Readers engaged with the same set of expository texts used in the previous experiment.

Task instructions

Prior to reading each text, readers who were randomly assigned to the deletion condition were instructed to "delete any sentence that does not contain a main idea of the text. If you think a sentence does NOT contain a main idea, click it and choose 'Yes, delete' If you think a sentence does contain a main idea, click it and choose 'No, do not delete'." Readers who were randomly assigned to the selection condition were instructed to "keep any sentence that contains a main idea of the text. If you think a sentence does contain a main idea, click it and choose 'Yes, keep' If you think a sentence does NOT contain a main idea, click it and choose 'No, do not keep'." Thus, all participants had to make a judgment on all sentences.

Procedure

The procedure was the same as in previous experiments, except for the task. In the current experiment, readers in the selection condition were required to highlight each sentence via mouse clicks and indicate either "Yes, keep" or "No, do not keep." Readers in the deletion condition were required to highlight each sentence and indicate either "Yes, delete" or "No, do not delete." Thus, the workload was equal in both conditions in terms of the number of mouse clicks required from each reader to complete the task.

Sentence identification reliability scores

Reliability scores for each sentence and reader were calculated in the same way as in the previous experiment.

Results

Preliminary analyses

A series of independent-samples t-tests tested equivalence between task conditions on individual difference variables (see Table 3 for descriptive statistics and correlations) and time on task. Readers in the selection condition did not differ from readers

Table 3 Descriptive statistics and correlations

	M (*SD*)	1	2	3	4	Selection *M* (*SD*)	Deletion *M* (*SD*)
1 Reader reliability	.70 (.02)	–				.703 (.01)	.698 (.01)
2 Num. sentences	9.9 (2.2)	−.59***				9.7 (2.2)	10.4 (2.2)
3 Vocabulary	6.3 (4.4)	.12	.05			6.4 (4.5)	6.3 (4.6)
4 Prior knowledge	5.4 (2.6)	.11	−.03	.49***		5.4 (2.5)	5.0 (2.3)
5 Duration (s)	2134 (1444)	−.05	−.07	.22**	.18*	101.0 (81.5)	76.5 (45.6)

***$p < .001$; **$p < .01$; *$p < .05$

in the deletion condition with respect to vocabulary, $t(156) = 0.63$, $p = 0.51$, or prior knowledge, $t(156) = 0.30$, $p = 0.76$. With respect to time on task (i.e., amount of time readers spent on average engaging with each text), readers in the selection condition did not differ from readers in the deletion condition, $t(156) = -0.917$, $p = 0.36$.

Number of sentences identified as main ideas

We conducted a linear mixed-effects model to examine the extent to which task condition (selection vs. deletion), prior knowledge, and vocabulary influenced the number of sentences readers identified as main ideas. The model included task, vocabulary score, prior knowledge score, as well as all two-way interactions, as fixed effects. Participants and texts were included as random effects. With respect to task condition, the results showed that the number of sentences identified by readers in the selection condition was marginally lower than the number of sentences identified in the deletion condition ($\beta = 0.67$, $t = 1.82$, $p = 0.071$, $\eta^2 = 0.02$). With respect to individual differences, neither vocabulary ($t = 1.10$, $p = 0.27$) nor prior knowledge ($t = -0.66$, $p = 0.51$) influenced the number of sentences readers identified as main ideas. Neither two-way interaction approached significance.

Identification reliability

Across all texts, the mean sentence reliability score (i.e., the proportion of the sample who chose the sentence) was 0.70 ($SD = 0.02$, $min = 0.61$, $max = 0.81$). For the first sentence in each text, the mean reliability score was 0.79 ($SD = 0.06$, $min = 0.47$, $max = 0.85$). A Welch's *t*-test indicated that readers more consistently identified the first sentence in each text as a main idea compared to other sentences in the texts, $t(12.69) = 6.24$, $p < 0.001$.

We conducted a second linear mixed-effects model to examine how the task condition (selection vs. deletion), prior knowledge, and vocabulary influenced the reliability with which readers identified sentences as main ideas. The model included task, vocabulary score, prior knowledge score, as well as all two-way interactions, as fixed effects. Participants and texts were included as random effects. With respect to task condition, readers in the selection condition identified sentences more reliably than did readers in the deletion condition, $\beta = 0.005$, $t = 3.68$, $p < 0.001$, $\eta^2 = 0.08$.

With respect to individual differences, the results showed that neither vocabulary ($t = 0.57$, $p = 0.57$) nor prior knowledge ($t = 0.90$, $p = 0.37$) played significant roles in the reliability of identifying main ideas. Neither two-way interaction approached significance.

Discussion

The results from Experiment 2 corroborated the findings from Experiment 1. Readers more reliably identify sentences containing main ideas when the task instructs readers to select, or "keep," sentences compared to when they are instructed to delete sentences that are not main ideas. Moreover, when the workload between the two tasks was equated, the number of sentences readers identified as main ideas did not differ across tasks, and neither readers' prior knowledge nor vocabulary influenced performance. Interestingly, readers in both the selection and deletion conditions identified approximately 10 sentences from each text on average, whereas in Experiment 1, readers in the selection condition selected only 4 sentences as main ideas from each text. Requiring readers to make an explicit decision for each sentence appeared to influence their evaluations, such that they evaluated the majority of sentences in each text as main ideas. In other words, readers were less selective in their evaluations of sentences when they had to make an explicit decision for each sentence.

Because readers were relatively unselective, in the following experiment we provided a benchmark number of sentences to identify as main ideas for each text. Specifically, we provided readers with a required number of *four* sentences for each text. A required number of sentences was intended to encourage greater selectivity. This required number was based on the average number of sentences readers identified as main ideas in the selection condition in Experiment 1. Thus, we examined the extent to which fixing the number of sentences readers were required to identify influenced their reliability in the selection and deletion conditions.

Experiment 3

In Experiment 3, we addressed the lack of selectivity in readers' identification of main ideas by imposing a target number of four sentences to identify from each text. Because readers tended to be unselective even when the workload was balanced between the selection and deletion conditions, it was difficult to determine if framing ("main ideas" vs. "important ideas") would influence readers' identification of main ideas if they were more selective. Therefore, we re-introduced the framing manipulation given that readers were forced to be more selective in the current experiment.

Method

Participants

Eight-hundred seventy-eight readers from Amazon MTurk participated in the study. Four-hundred eighty-two readers were excluded from analyses based on the same criteria and best practices used in Experiments 1 and 2—either by failed attention checks or unreasonably short overall reading times. Moreover, 227 readers did not complete the study (55 readers who initially began the deletion task dropped out, 13 readers who initially began the selection task dropped out, and 159 dropped out prior to being assigned to a condition). Therefore, the final sample included 150 participants (65 female, 85 male). The average age was 36 years (SD = 10). Seventy-five percent of participants in the sample were White, 9% were Black, 4% were Asian, and 1% were Hispanic. Fifty-six percent of the sample reported holding a four-year college degree, 25% reported holding a graduate degree, and 8% reporting holding a high school diploma. All participants were fluent in English. Participants who participated in the previous experiments were unable to participate in the current experiment. As in the previous experiments, participants were paid $2.50 for their time.

Design

The current experiment followed the same 2 (task: selection vs. deletion) × 2 (framing: "main ideas" vs. "important ideas") between-subjects design used in Experiment 1. However, because readers were required to identify four sentences in the current experiment, the number of sentences identified was not a dependent variable. The sole dependent variable was identification reliability.

Individual difference measures

Readers completed the same assessments of prior knowledge and vocabulary as in Experiments 1 and 2. Internal consistency of scores on the vocabulary measure was good (Cronbach's $\alpha = 0.90$); however, internal consistency of scores on the prior knowledge measure was lower than ideal (Cronbach's $\alpha = 0.55$), which may indicate that readers in the sample held relatively incoherent and fragmented prior knowledge bases.

Expository texts

Readers engaged with the same set of expository texts from Experiments 1 and 2.

Task instructions

Readers were instructed to read the series of texts. Prior to reading each text, they were instructed to either "select four sentences that best capture the main ideas/

important ideas" from the texts or to "delete the sentences that do NOT contain the main ideas/important ideas of the passage until only the four sentences that do capture main ideas remain," depending on which task condition and framing condition to which they were randomly assigned. Participants were exposed to each text individually with a task reminder presented before each text.

Procedure

The procedure was identical to that followed in Experiment 1, with modifications to the identification task. In the current experiment, readers were required to either "select four sentences" or "delete all but four sentences" in each text. Thus, in the selection condition, readers were limited to highlighting four sentences in each text. In the deletion condition, readers were required to retain four sentences in each text by highlighting *all but* four sentences.

Sentence identification reliability scores

Reliability scores for each sentence and reader were calculated in the same way as in Experiments 1 and 2.

Results

Preliminary analyses

A series of two-way ANOVAs tested equivalence between task condition (selection vs. deletion) and framing condition ("main ideas" vs. "important ideas") on prior knowledge, vocabulary, and time on task. See Table 4 for descriptive statistics and correlations. With respect to prior knowledge, readers in the selection condition were more knowledgeable than readers in the deletion condition, $F(1, 145) = 4.29$, $p = 0.04$. There was no difference between readers in the "main ideas" framing condition and readers in the "important ideas" framing condition on prior knowledge, $F(1, 145) = 0.19$, $p = 0.66$. With respect to vocabulary, readers in the selection condition had higher scores than did readers in the deletion condition, $F(1, 145) = 10.21$, $p = 0.002$. There was no difference between readers in the "main ideas" framing condition and readers in the "important ideas" framing condition on vocabulary, $F(1, 145) = 0.37$, $p = 0.54$. Thus, despite random assignment to conditions, readers in the selection condition had higher prior knowledge and vocabulary than did readers in the deletion condition. With respect to time on task (i.e., average time readers spent engaging with each text), readers in the selection task condition spent less time overall compared to readers in the deletion task condition, $F(1,144) = 8.74$, $p = 0.004$. However there was no difference between readers in the "main ideas" condition and readers in the "important ideas" condition, $F(1,144) = 0.30$, $p = 0.59$. The task x framing interaction was not significant, $F(1,144) = 1.74$, $p = 0.19$.

Table 4 Descriptive statistics and correlations

	M (*SD*)	1	2	3	Task		Framing	
					Selection	Deletion	"Main"	"Important"
					M (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
1 Reader reliability	.33 (.03)	–			.34 (.03)	.32 (.03)	.33 (.03)	.33 (.03)
2 Vocabulary	7.5 (5.5)	.64***	–		8.9 (6.1)	6.3 (4.6)	7.4 (5.8)	7.6 (5.1)
3 Prior knowledge	5.3 (2.3)	.52***	.50***	–	5.8 (2.3)	5.0 (2.3)	5.5 (2.5)	5.2 (2.2)
4 Duration (s)	1890 (968)	.24***	.19***	.12***	68.6 (40.8)	93.0 (50.0)	84.1 (48.0)	80.0 (46.9)

***$p < .001$

The non-equivalence in prior knowledge and vocabulary between the selection and deletion task conditions may be due to the differential attrition between the selection and deletion task conditions. It is likely that less skilled, less knowledgeable readers dropped out of the deletion condition more often than those in the selection condition. Indeed, the longer task duration and higher dropout rate in the deletion task condition compared to the selection task condition lend support to the idea that the deletion task was more demanding than the selection task.

Identification reliability

Across all texts, the mean sentence reliability score was 0.27 ($SD = 0.11$, $min = 0.05$, $max = 0.60$). We examined the extent to which task (selection vs. deletion) and framing ("main ideas" versus "important ideas") influenced the reliability with which readers identified sentences that contained main ideas, while also accounting for vocabulary and prior knowledge. To do so, we conducted a linear mixed-effects model that included main effects of task, framing, prior knowledge, and vocabulary, along with all two-way and three-way interactions as fixed effects, and participants and texts as random effects. With respect to task condition, the results again showed that readers in the selection condition ($M = 0.341$, $SD = 0.027$) were overall more reliable in identifying main ideas compared to readers in the deletion condition ($M = 0.322$, $SD = 0.031$; $\beta = 0.037$, $t = 2.41$, $p = 0.017$, $\eta^2 = 0.04$). With respect to framing condition, readers who were instructed to identify "main ideas" ($M = 0.331$, $SD = 0.028$) were marginally more reliable overall than readers who were instructed to identify "important ideas" ($M = 0.329$, $SD = 0.033$), ($\beta = 0.024$, $t = 1.89$, $p = 0.061$, $\eta^2 = 0.03$). There was a main effect of prior knowledge, such that readers with higher prior knowledge ($\beta = 0.005$, $t = 2.71$, $p = 0.008$, $\eta^2 = 0.05$) were more reliable than were readers who had lower prior knowledge. Similarly, there was a main effect of vocabulary, such that readers who performed better on the vocabulary measure were more reliable in their selection of main ideas as compared to those with less vocabulary knowledge ($B = 0.004$, $t = 3.61$, $p < 0.001$, $\eta^2 = 0.09$). None of the interactions approached significance.

Discussion

The results of Experiment 3 corroborated those from the previous experiments. Readers in the selection condition were more reliable in identifying sentences containing main ideas. Also, readers with higher vocabulary and prior knowledge were more reliable overall than were readers with lower vocabulary and prior knowledge. However, this experiment showed that instructing readers to identify "important ideas" led to less reliable identification of main ideas than did instructing readers to identify "main ideas." Moreover, because readers could only select four sentences from each text, the overall mean reliability scores were lower than in Experiment 1. The lower reliability scores suggest that readers overall tended not to converge with one another on the sentences they believed contained main ideas when they had to choose more selectively, but readers with higher prior knowledge were more reliable than were readers with lower prior knowledge.

General discussion

Readers' identification of main ideas in texts is important for successful comprehension. However, readers often struggle to reliably identify these main ideas. Although main idea instruction is relatively common, there has been little systematic investigation of what task prompts are most effective. The goal of this set of experiments was to systematically investigate the conditions under which readers are most reliable or consistent in identifying main idea sentences in naturalistic expository texts. Understanding conditions and individual differences that support readers' identification of main ideas can guide comprehension strategy instruction and interventions to improve students' reading comprehension.

We examined the extent to which task (selection vs. deletion) and framing ("main ideas" vs. "important ideas") influenced adult readers' identification of main ideas in expository texts. We also examined how these effects were moderated by individual differences across readers, namely prior knowledge and vocabulary. In each experiment, we altered the constraints of the selection or deletion task to explore how these demand characteristics influenced readers' main idea identification. In Experiment 1, participants were free to select or delete as many sentences as they chose; In Experiment 2, participants were asked to make a keep or delete decision on every sentence; and in Experiment 3, participants were limited to choosing only four main idea sentences. In Experiments 1 and 2, we examined how the different tasks and framing influenced the number of sentences that readers identified as main ideas and how this varied across knowledge and vocabulary. In Experiments 1, 2, and 3, we examined the extent to which these factors influenced the reader's ability to discriminate between main idea sentences and nonessential sentences.

Across all three studies, there was evidence that asking readers to select main idea sentences was more effective at eliciting identification of main ideas compared to asking them to delete sentences that did not contain main ideas. In both Experiments 1 and 2, readers who were asked to select main ideas retained fewer main

idea sentences than those who were asked to delete unessential sentences, which suggests that choosing which sentences to include elicited greater discrimination between main ideas and details or unessential ideas. This finding is corroborated by results in all three experiments showing that prompting readers to select the main idea sentences also resulted in higher reliability/consistency scores as compared to those who were prompted to delete.

Beyond the effects of task instruction, the results varied across experiments. For example, when readers were free to choose any number of sentences (Experiment 1), there was no effect framing –that is, there was no effect of whether they were asked to select/delete "main ideas" as compared to "important ideas". By contrast, there was a marginal benefit in asking for "main ideas" instead of "important ideas" when readers were restricted in the number of main idea sentences they could choose (Experiment 3). The effects of individual differences were also inconsistent across the three experiments. In Experiment 1, participants' vocabulary test performance moderated the effect of the selection versus deletion instruction, such that the benefits of selection were reserved only for those with higher vocabulary. The added constraints in Experiments 2 and 3 attenuated this interaction. When participants were required to make a decision on every sentence (Experiment 2), there were no main effects or interactions related to individual differences. By contrast, the effects of individual differences were more pronounced in Experiment 3 in that both prior knowledge and vocabulary significantly predicted readers' reliability score.

With respect to the *number of sentences* readers identified as main ideas, the results of Experiment 1 suggested that readers were far more selective in the selection condition compared to the deletion condition. Readers in the deletion condition were tasked with deleting sentences that contained supporting information or details, yet they tended to delete few sentences from the texts. Moreover, knowledgeable readers tended to delete more sentences and select more sentences than did less knowledgeable readers–and tended to do so more reliably. This effect of prior knowledge suggests that less knowledgeable readers not only deleted relatively few sentences from the texts, but they were also less selective in the sentences they deleted. The large number of retained sentences could indicate that readers in the deletion condition evaluated the sentences differently from readers in the selection condition, but it could also indicate that readers in the deletion condition were daunted by the demands of task, which entailed clicking on every sentence that was not a main idea to "delete" it and therefore demanded a higher workload compared to the selection condition. Of course, the lower required workload in the selection condition may also explain why readers identified much fewer sentences in the selection condition compared to the deletion condition–they acted on relatively few sentences simply because the task did not require them to do so. Thus, the task in Experiment 2 equated the workload between the selection and deletion conditions by ensuring that readers clicked on each sentence in the texts. The results of Experiment 2 were consistent with Experiment 1 in that readers identified marginally fewer sentences as main ideas in the selection condition compared to the deletion condition. However, the difference in Experiment 2 between the selection and deletion conditions was much smaller compared to Experiment 1, and the number of sentences selected as

main ideas was much higher. Thus, when the task required readers to act on each sentence in the texts, they appeared to be less selective when evaluating main ideas.

With respect to the *reliability* with which readers identified main ideas, we hypothesized that readers would show better reliability or consistency in the sentences they identified as main ideas in the selection condition compared to the deletion condition. Consistent with this hypothesis, the results from the present experiments indicated that readers were more reliable with one another in their identification of main ideas in the selection condition compared to the deletion condition. In other words, readers were more consistent in the sentences they *selected* as main ideas in the texts compared to the sentences they *deleted* as supporting details. These results are also consistent with existing work showing that readers struggle to delete details and supporting information during reading of expository texts (Hare & Milligan, 1984), but to our knowledge this is the first study to directly compare selection to deletion tasks using the same text, as existing work compared readers' performance on texts that required more deletion versus texts that required less deletion (Hare et al., 1989). Additionally, more knowledgeable readers tended to be more reliable in their identification of main ideas than were less knowledgeable readers, especially in the selection condition, and readers with higher vocabulary tended to be more reliable than those with lower vocabulary. Readers may have been more reliable in identifying main ideas in the selection condition because instructing them to select sentences that include main ideas may have increased the relevance of the main ideas in the texts relative to details–which may have been especially true for more knowledgeable, skilled readers. In contrast, instructing readers to delete sentences that include details or supporting information may have increased relevance of details relative to main ideas.

Implications

The current findings challenge existing work regarding readers' identification of main ideas. Specifically, Brown and Day (1983) proposed several "macrorules" for identifying main ideas. These macrorules emphasize deletion and construction, rather than selection. In the current study, readers were relatively hesitant to delete unnecessary sentences from the texts when they were not provided with a target number of sentences to retain as main ideas, and even when readers were provided a target number, they were less consistent in the main ideas they identified compared to the selection condition.

Thus, even for adult readers, the deletion rule may be less viable for the types of expository texts used in the current study compared to the selection rule. If typical adult–albeit untrained– readers struggle to reliably identify main ideas in expository texts that include unnecessary information, then it is likely that children face a greater struggle.

Instruction in identification of main ideas is important for effective comprehension instruction, as it underlies arriving at a durable, gist-based understanding of the text content (Edmonds et al., 2009; Gajria, et al., 2007; Garwood et al., 2014; Gersten et al., 2001; Scammacca et al., 2007; Solis et al., 2012). However, the lack

of agreement about which sentences constituted a main idea complicates the development of main idea instruction at scale. Indeed, developing automated approaches to identifying main ideas in instructional texts is not feasible if typical adult readers cannot consistently identify main ideas. Although readers in the current study were more reliable in the selection condition compared to the deletion condition–particularly when they had higher vocabulary–reliability was overall quite low, regardless of condition.

One potential reason for the generally low consistency among readers in their main idea identification is that the texts were presented without structural cues that readers may normally use. Namely, texts in the current study were presented without paragraph breaks or headings, which are text signals that readers often rely on to identify essential information (i.e., topic sentences of paragraphs, alerts to connections in a text; Meyer et al., 1980). Indeed, text signals may direct readers' attention to top-level structure of a text (Loman & Mayer, 1983; Lorch & Lorch, 1985) and encourage construction of a mental representation that reflects the hierarchical organization of the text and relative importance of its content. Without text signals (as in the current experiments), readers may be more likely to default to encoding texts as a temporally organized list of facts to be memorized (Meyer & Rice, 1982, 1989; Meyer et al., 1980).

Another potential reason for low consistency among readers is that readers may have been evaluating main ideas using different criteria. For example, one text contains the following two sentences: "First, the mole has short, solid legs that are good for building tunnels. This helps the mole dig tunnels so it can hunt for worms." The first sentence describes an attribute about the topic (moles), and the second sentence describes the use of that attribute. One reader may identify the first sentence as a main idea rather than the second because it *introduces* an important attribute for the animal's survival. However, another reader may identify the second sentence as a main idea rather than the first because it explains *how* the attribute aids survival. Thus, although the two readers may have identified the same information as essential in their mental representation of the text, they may have differed in which sentence they choose as best capturing the main idea. Indeed, the much lower sentence-level reliability scores in Experiment 3 corroborate this possibility.

Limitations

The results of the current study should be interpreted cautiously in light of its limitations. First, one goal of our study was to test the feasibility of using crowd-sourced main idea selection. Thus, we did not identify main ideas a priori. However, the current results speak to the fact that it is likely challenging to establish agreed upon main ideas in these descriptive informational texts. One explanation could be that our crowdsourced workers were not carefully following directions, misunderstood the task, or were not giving their best effort. However, our use of time-on-task measures and responses to attention check items as measures of attentiveness suggest this is not the case. Further, our own post-hoc evaluation of which sentences reflected the main ideas of the text suggested that even experts' identification may be unreliable. Second, the current study did not include

a comprehension assessment for the texts. Identifying the relation between reliability in identifying main ideas and comprehension–either via comprehension questions or written summaries–would be useful to understanding how readers' evaluations of relative importance of text contents supports comprehension outcomes. Third, each experiment leveraged crowdsourcing from online samples. Although we implemented several best practices for online data collection (Aguinis et al., 2021; Hauser et al., 2019), it is possible that our results were influenced by fraudulent survey access and inattention, which are general risks with online data collection (Kennedy et al., 2020). Fourth, the language manipulation (main ideas vs. important ideas) may have been unclear to some readers. In the "main ideas" condition, readers may be unaccustomed to considering multiple main ideas as opposed to a single main idea, and in the "important ideas" condition, readers may wonder "important for what?" Indeed, the ambiguity of the "important ideas" condition may explain the slightly lower reliability of readers' selections in that condition compared to the "main ideas" condition in Experiment 3. Our instructions for selecting a main idea as compared to an important idea in this study were intentionally ambiguous. While variation in how participants interpreted these instructions may explain some of the mixed findings (see McCrudden et al., 2010), the variability also further highlights the potential practical implications of what constitutes a main idea in a reader's mind. That is, readers seemed to struggle to agree upon main ideas within a text, even when given the same instructions. The inconsistent and often interchangeable ways that existing activities and interventions use terms like "main idea", "main ideas", "topic", and "important idea" may make this task increasingly difficult, especially for less skilled readers. Finally, the current study did not include a measure of reading comprehension skill as a predictor. Although prior knowledge and vocabulary tend to correlate very strongly with reading comprehension skill and may therefore serve as proxies (Allen et al., 2014; Braze et al., 2007), including a measure of reading comprehension would afford a more direct understanding of the relations between comprehension skills and identification of main ideas.

Another consideration is the grain-size of our prior knowledge measure. While all the texts were scientific in nature, they varied on their sub-domains (e.g., life science, earth science), subjects (e.g., biology, geology) and the specific topics of each text. Prior work shows that domain knowledge is a strong predictor of comprehension, but also that more specific knowledge can interact with or even supersede the contribution of more general knowledge (e.g., McCarthy et al., 2018; McCarthy & McNamara, 2021). The aim of the current study was to understand relatively text-general effects. Thus, we elected to use a short, general science prior knowledge test to explore the effects of this domain knowledge across different texts. However, future work should explore the extent to which more topic-specific knowledge might impact the reader's ability to identify main ideas.

Conclusions and future directions

Although identifying main ideas is considered a key skill in literacy practices, students need support to do so. This study indicates that identifying the main ideas in a

text is a more complex task than is often acknowledged—even adult readers struggled to distinguish main ideas from details and supporting information in relatively short, descriptive expository texts. Our findings also suggest that researchers and educators need to consider how their task instructions can influence their students' ability to identify main ideas in texts.

Subsequent work in this context should strive to establish an a-priori operationalization of main ideas in order to examine the *accuracy* of readers' selections and how both accuracy and reliability in main idea selection relates to comprehension and retention of information. Deeper understanding of the relations between task instructions and main idea identification can help educators provide more effective methods for helping students to improve their literacy skills (Table 4).

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Declarations

Conflict of interest The authors have no conflicts of interest to disclose.

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