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The Role of Epistemic Beliefs About Authority and Source Presence on Multiple Text
Comprehension

By

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Abstract

The current research examined the role of epistemic beliefs about authority as well as source presence influence multiple text comprehension. Our sample was insensitive to our manipulation of source information availability (no source information, source information, embedded source information), however, several interesting relationships between the individual differences and measures of multiple text comprehension were observed. Prior knowledge was positively related to accurate essay information as well as source mentions in essays and rank-order justifications. In addition, justification by authority beliefs emerged as a positive predictor of source mentions in essays. Misconceptions about vaccines emerged a negative predictor of inclusion of accurate information in essays as well as source mentions in essays. Our findings suggest that readers rely on personal pre-existing beliefs to guide their reading and text comprehension. Further, readers with misconception beliefs appear to use less source information when forming mental representations of multiple texts.

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There has been an indisputable rise in the use of the Internet to retrieve information on important topics such as when readers engage with health information online. With an overwhelming amount of information and resources available on the Internet, deciding what information is reliable and accurate is difficult, to say the least (Braasch, Bråten, Britt, Steffens, & Strømsø, 2014; Goldman, Braasch, Wiley, Graesser, and Brodowinska, 2012). When researching health topics online, it is often the case that conflicting information is presented across multiple texts, resulting in the need for integration and assessment of a variety of factors about the documents that are retrieved via search engines (Ecker, Swire & Lewandowsky, 2014; Freed, Clark, Butchart, Singer, & Davis, 2011). Further, online information source features vary considerably, from doctors and scientists to politicians and celebrities as authors, making coherent comprehension of the topic at hand a complex issue (Ecker et al., 2014; Freed et al., 2011).

Regarding the health topic of interest in the current work, individuals are using the Internet to locate and understand information on childhood vaccinations much more than in the past (Jolley & Douglas, 2014). Research has shown that while most parents still seek advice on childhood vaccines from their doctor, a large number of parents believe and trust misinformation about childhood vaccines online (Freed et al., 2011; Glanz, Kraus, & Daley, 2015). When parents do find and inappropriately rely on misinformation, in particular, correcting misconceptions about vaccines is challenging, and the situation has the potential to lead to dangerous behavioral decisions regarding the need (or lack thereof) for childhood vaccines (Ecker et al., 2014; Horne, Powell, Hummel, & Holyaok, 2015; Nyhan, Reifler, Richey, & Freed, 2014).

Much research has been conducted to better understand how misconceptions, specifically about childhood vaccines, can be combated and corrected during comprehension (Ecker et al., 2014; Freed et al., 2011; Swire, Ecker, & Lewandowsky, 2017). However, just providing individuals with correct information after they encounter misinformation about childhood vaccines is often ineffective (Freed et al., 2011; Glanz et al., 2015; Horne et al., 2015; Nyhan et al., 2014). As interventions that target correcting misinformation are not often successful, and the chances of an individual picking up misinformation online increase when multiple sources of information provide conflicting claims across multiple texts, we turn our focus to conceptualizations about multiple text comprehension to better combat the effects of misinformation.

With regards to multiple text comprehension in relation to source evaluation, this study seeks to better understand how elements of texts and source availability guide processing patterns of online texts (Braasch, Rouet, Vibert, & Britt, 2012; Braasch, Bråten, Strømsø, Anmarkrud, Ferguson, 2013; Braasch & Bråten, 2017; Lawless, Goldman, Gomez, Manning, & Braasch, 2012; Strømsø & Bråten, 2009; Wineburg, 1991). Thus, sourcing, in particular, reflects a complex set of competencies that include attending to, representing, evaluating, and using features of information sources (Bråten, Stadtler, & Salmerón, 2018). Additionally, we will explore the ways in which a reader's epistemic beliefs moderate comprehension across multiple texts when sources are or are not readily available (Bråten, Strømsø, & Ferguson, 2015; Hofer, 2000; Kammerer, Bråten, Gerjets, & Strømsø, 2013; Kammerer, Kalbfell, & Gerjets, 2016; Kiili, Carita, Laurinen, Leena; Marttunen, and Miika, 2008; Schommer, 1990; Strømsø & Kammerer, 2016). How do individuals decide what information is reliable? Do individuals evaluate source information present alongside textual content to make these decisions? Do readily available

source features improve comprehension? How do beliefs about knowledge and knowing contribute to comprehension and evaluation? These questions guide the current work to examine how information on important health topics encountered online is processed and, ultimately, comprehended.

For several decades, research on reading and comprehension has yielded a tremendous amount of foundational discoveries regarding what factors contribute to an individual successfully comprehending texts. This large body of research provides insight into the kinds of difficulties readers experience as they try to form accurate mental models from multiple texts, as well as the kinds of reader, text, and task characteristics that contribute to multiple text comprehension (Bråten, Strømsø, & Britt, 2009; Braasch, Rouet, Britt, Knutsen, Le Bigot, & Vibert, 2010; Bråten, Ferguson, Strømsø, & Amarkurd, 2014; Rouet & Britt, 2011; Wineburg, 1991). When looking to understand how multiple text comprehension is achieved, many models of multiple text comprehension describe the cognitive processes associated with comprehension (Braasch & Bråten, 2017; Braasch et al., 2010, 2012, 2014; Britt & Rouet, 2012; Rouet & Britt, 2011; Rouet, Britt, & Durik, 2017). Across the models, it is clear that individuals must be able to evaluate, process, and integrate information when reading conflicting information across multiple texts, placing priority on readers' individual cognitive processes and abilities and the characteristics that give rise to them.

Prior research explains that when an individual is required to integrate information from multiple documents, they often achieve a deeper understanding of a controversial topic such as childhood vaccines (Braasch, McCabe, & Daniel, 2016; Bråten & Strømsø, 2009; Hagen, Braasch, & Bråten, 2014; Firetto & Van Meter, 2018; Kobayashi, 2009; Wiley, Goldman, Graesser, Sanchez, Ash, & Hemmerich, 2009; Wiley & Voss, 1999). The required processing

and evaluation of information across multiple texts typically results in a more coherent and accurate understanding of the presented information when the claims made across the texts are inconsistent (Anmarkrud, Bråten, & Strømsø, 2014; Goldman et al., 2012; Wolfe & Goldman, 2005). When readers interact with conflicting information across multiple documents, they must often evaluate the reliability and accuracy of the information they are reading. Similarly, when faced with inconsistent claims across multiple documents, readers must then begin to evaluate the reliability and accuracy of text features in order to form an accurate understanding of the topic (Bromme & Thomm, 2016; Bråten et al., 2009; Freed et al., 2011; Goldman et al., 2012).

Specifically, in order to assess the trustworthiness of a document, readers must be able to evaluate and consider available metadata such as source features provided alongside or within texts for successful comprehension (Braasch & Bråten, 2017; Bråten et al., 2014; Goldman et al., 2012; Lawless et al., 2012; McCrudden et al., 2016; Strømsø & Bråten, 2009). Source features can include a variety of information; for example, the author's credentials or information about the date, type, and genre of the publication are all considered different types of source features. Source features can be helpful to individuals in determining the reliability of the presented information; however, source features available on the Internet range from concealed, unavailable or even hard to interpret, making the evaluation of the information presented online even more difficult (Britt & Gabrys, 2002; Flanagin & Metzger, 2008).

Models of multiple text comprehension have accounted for processing and use of source features and source information. For example, Britt, Perfetti, Sandak and Rouet (1999) developed the Documents Model Framework to better understand the mental processes that facilitate multiple document comprehension. The Documents Model Framework (Britt et al., 1999; Britt & Rouet, 2012; Perfetti, Rouet, & Britt, 1999) explains that beyond forming a

detailed understanding of the textual information, there are two additional mental representations required to learn from multiple texts. First, readers must develop an intertext model, which includes document nodes for each text and the intertext links between each of the texts. Second, readers must form an integrated mental model that requires the additional organization of features within and across the texts, like source information. Not only is the content that readers integrate important, the structure of this information is just as important and often relies on the nature of the task at hand. When readers form this integrated model, they are transforming information from multiple documents into an organized and presumably coherent mental representation (Britt et al., 1999; Britt & Rouet, 2012; Perfertti et al., 1999).

More recently, the REading as Problem SOLVing (RESOLV) Model (Britt, Rouet, & Durik, 2018; Rouet et al., 2017) extends earlier models of multiple text comprehension to include the Context Model and the Task Model. The RESOLV model accounts for the understanding that reading is influenced by physical and social aspects that contribute to the overall comprehension of multiple texts. When reading multiple texts, individuals will be influenced by a variety of factors such as prior knowledge on the topic, the reading task, and the audience intended for the task all of which are included in the Context Model (Britt et al., 2018; Rouet et al., 2017). Additionally, the RESOLV model takes a closer look at the goals behind reading, using the Task Model to better understand the individual interpretations and variations in motivation behind reading. Britt et al. (2018) explain that an individual must be able to form an accurate and complete mental model of their goal for reading that is activated by their reading task. A Task Model is highly subjective to change and will update as a function of reading multiple texts while guiding reading and processing based on individual goals. In summary, the RESOLV model research poses two major ideas: 1) readers base their reading decisions on their

interpretation of task demands and 2) readers represent contextual cues beyond the task statement itself (Britt et al., 2018; Rouet et al., 2017).

Beyond these models of multiple text comprehension, prior findings indicate that a spectrum of individual characteristics such as topic and epistemic beliefs regulate how and when individuals use available source information in multiple text comprehension (Barak & Levenberg, 2016; Bråten et al., 2015; Hofer, 2000; Kammerer et al., 2013; Kammerer, Amann, & Gerjets, 2015; Kiili et al., 2008; Schommer, 1990; Strømsø & Kammerer, 2016). Additionally, McCrudden and Barnes (2015) found that topic beliefs play a major role in the metacognitive processes involved in multiple text comprehension, specifically they may guide how information is processed and stored. Given the preceding literature, empirical research examining how the availability of source features within the context of reading, as well as the epistemic beliefs readers bring to bear, was conducted to understand their unique and combinatorial contributions to multiple text comprehension.

As previously explained, when an individual is faced with discrepancies in information across multiple texts, these discrepancies guide him or her towards seeking out, attending to, and evaluating source information (e.g., author credentials, publishing venue). This evaluation of source information may provide a means by which the reader can monitor the accuracy of the provided information, and resolve conflicting information by organizing mental representations in terms of source components (Braasch et al., 2012). Previous research on source evaluation and its application in relation to text comprehension shows readers use a spectrum of strategies when interacting with source information (Braasch & Bråten 2017; Braasch et al., 2016; Bråten & Strømsø, 2005; Bråten et al., 2009, 2014; Kiili et al., 2008; Lawless et al., 2012; Sanchez et al., 2006; Wineburg 1991). When source information is available with discrepant texts, deeper

encoding and better memory for sources typically occurs, which aligns with the discrepancy-induced source comprehension (D-ISC) model of comprehension (Braasch et al., 2012).

Recently, research on the D-ISC model sought to better understand what circumstances facilitate source evaluation in the presence of discrepant information (Braasch & Bråten, 2017). The D-ISC text-processing model describes how sourcing occurs within single texts and expands to include how sourcing occurs across multiple texts, much of which aligns with previous models of text comprehension (Braasch & Bråten, 2017; Braasch et al., 2012). However, this work also describes that, while the majority of models of multiple text comprehension determine a need for source evaluation for successful comprehension, there is a lack of empirical knowledge of exactly what types of factors encourage individuals to attend to and evaluate source information (Braasch & Bråten, 2017; Braasch et al., 2012).

The D-ISC text-processing model additionally explains that, when a reader encounters conflicting information across multiple texts, he or she first experience a passive phase of processing in which discrepant information is co-activated in their working memory. This co-activation triggers a second stage of processing which reflects more cognitive effort. During the second stage of processing, the D-ISC model posits that an individual will need to expend cognitive resources to evaluate, integrate, and decipher discrepant information across texts during encoding. In addition, readers may also use preexisting knowledge about sources or the information provided by the texts to assess the reliability and trustworthiness of different elements of sources and texts (Braasch & Bråten, 2017).

In alignment with previous work (Braasch et al., 2012, 2016), Braasch and Bråten (2017) explain that readers who pay more attention to sources and make connections across sources and texts will more be more likely to achieve an organized mental representation of conflicting

information across texts. Whereas source features can help individuals determine the reliability of the information they are reading across multiple documents and sources, there are additional challenges with source features on the Internet. For example, in comparison to source features of traditional texts, online texts may be presented with no source information or source information that is difficult to locate within the text itself, often requiring a series of page access steps (Britt & Gabrys, 2002; Flanagin & Metzger, 2008). Recent work on the D-ISC text-processing model suggests that despite different types of conflicts within or across multiple texts, attention to sources will enhance overall comprehension of discrepant texts. However, there is a clear need for empirical research that explores additional facets of the D-ISC model further. For example, a closer look at how prior knowledge or preexisting personal beliefs contribute to the processing of source information across multiple texts may provide better insight into the conditions necessary to promote source evaluation. Further, this line of research also suggests a need to investigate how degree of source availability, in and of itself, moderates the relationship between source evaluation and multiple text comprehension (Braasch & Bråten, 2017), exploring authentic reading conditions where source features are readily available, only available via hyperlink, or altogether absent.

A long line of research establishes a relationship between an individual's epistemic beliefs and a variety of cognitive processes such as comprehension and information processing, leading the current work to focus on how epistemic beliefs guide multiple text comprehension and use of available source information (Bråten, Britt, Strømsø, Rouet, 2011). An individual's personal epistemologies, also known interchangeably as their epistemic beliefs (Greene, Azevedo, & Torney-Purta, 2008; Hofer & Bendixen 2012; Hofer & Pintrich, 1997; 2002), refer to an individual's specific and personal beliefs about what knowledge is, and how their own

knowledge and the knowledge of others is constructed. A better understanding of how individuals view the nature of knowledge may provide key insights into how they interact with information as well as what they choose to believe from that given information (Bråten & Strømsø, 2009; Hofer, 2000; Sandoval, Greene, & Bråten, 2016; Schommer, 1990).

Individuals' preexisting beliefs about how knowledge is constructed can guide how they comprehend conflicting information across multiple texts (Bråten et al., 2009, 2015; Schommer, 1990). For example, research has demonstrated that individuals' beliefs about justification for knowledge or knowing are insightful in understanding how epistemic beliefs predicted multiple text comprehension (Bråten et al., 2013, 2014; Kammerer et al., 2015). Bråten and colleagues (2013), for example, describe three justification beliefs: justification by authority, personal justification, and justification by multiple sources, as well as, how these beliefs have the potential to influence the processing of information across multiple texts (Bråten et al., 2013). Using two studies, this research first showed that students have more confidence in authority when researching unfamiliar topics in comparison to their personal understanding of the information, meaning they will likely trust the information presented by an authoritative source over those that align with their own prior beliefs and knowledge. However, a second study revealed that overall comprehension was not directly predicted by justification by authority beliefs. An explanation for this could be that students' justification beliefs vary in different situations, such as personal online research and research for a school project, leading the current work to better assess how justification beliefs guide multiple text comprehension and source evaluation in a web-based, informal learning setting (Bråten et al., 2013).

Given the unique nature of information available online (i.e., that anyone with or without knowledge can publish on any given topic), understanding how an individual views the

acquisition of knowledge and information online may contribute considerably to comprehension, by comparison with traditional learning environments (e.g., classroom settings, textbooks, etc.). This differentiation between types of information guided prior work to investigate *Internet-specific* epistemological beliefs and their relationship to multiple text comprehension online (Bråten, et al., 2013; Bråten, Brandmo, & Kammerer, 2018; Kammerer et al., 2013; 2015). The Internet-specific epistemic beliefs inventory is similar to the earlier-described justification for knowing inventory of Bråten et al. (2013) in that there are three dimensions – justification by authority, justification by multiple sources and personal justification. However, the items are specifically framed in terms of *online* information and sources. Thus, prior work on justification of knowing was extended to investigate how Internet-specific justification of knowing beliefs relate to the evaluation of source features of multiple texts found on the Internet (Kammerer et al., 2013; 2015). This line of research has revealed that beliefs about the justification of knowing on the Internet contribute to forming an accurate and complete mental model of the information provided within and across multiple texts (Kammerer et al., 2013). All told, Internet-specific epistemic beliefs predict multiple text comprehension and source evaluation (Kammerer et al., 2013; 2015), leading to the current work to assess how these beliefs promote comprehension specifically extending prior work to examine potential moderation based on whether source features are or are not available within the websites.

The controversy surrounding childhood vaccines has grown rapidly, making it a hot topic in news stories and online reading. Personal and preexisting beliefs about childhood vaccines could potentially relate to readers' processing of information across multiple texts, as well as their evaluation of sources (Freed et al., 2011). The Childhood Vaccination Belief Inventory assesses the degree to which individuals believe vaccines to be helpful, harmful, and unnecessary

(Kardash, Braasch, McCabe, Ankney, & Cogliano, submitted). Beliefs that vaccines are helpful reflect accurate beliefs, while beliefs that vaccines are harmful or unnecessary reflect inaccurate beliefs. Given the predictive nature of preexisting beliefs in general (See McCrudden & Barnes, 2016) in the current study, an individual's specific preexisting beliefs about childhood vaccines will be considered in light of their overall prediction of multiple text comprehension and readers' evaluation of available source information (McCrudden & Barnes, 2016; McCrudden et al., 2016; Nyhan et al., 2014).

Current Study

Given the aforementioned theoretical framework, the current study sought to better understand the role of epistemic beliefs about authority and source presence in multiple text comprehension. The current work sought to extend current understandings of how epistemic beliefs about authority may moderate the impact of source availability to interactively contribute to multiple text comprehension (Braasch et al., 2014; Bråten et al., 2015; Bråten et al., 2005). In addition, we sought to better understand how the presence or absence of source features facilitates text comprehension, as prior literature provides a need for a closer look at what type of factors encourage individuals to attend to available source information (Braasch & Bråten, 2017; Braasch et al., 2012). The current work will assess how epistemic beliefs about authority predict overall multiple text comprehension, while also manipulating the presence or absence of source features in the provided texts.

For this study, source availability was manipulated by either providing participants with source information for each of the texts, providing the texts with no accompanying source information, or providing source information in a separate "about us" section. Thus, the main difference with "about us" condition is that readers were required to click a link to access

information about the source of any given text as if often the case when reading websites on the Internet (Britt & Gabrys, 2002; Flanagin & Metzger, 2008). Participants were asked to read for several purposes: to complete a written essay, to rank-order the reliability of the texts, and to justify their answers. Dependent measures reflect the presence of accurate and inaccurate concepts gleaned from reliable and unreliable texts in the essays, rank order accuracy, and mentions of source features in justifications, respectively. In addition, epistemic beliefs about source authority were collected in order to examine the role that they play in multiple text comprehension, and whether these beliefs moderate the impact that source feature availability may have on the comprehension measures outlined above.

We predicted main effects for source availability such that readers will display greater essay accuracy (more accurate and less inaccurate concepts), better rank differentiation, and more sourcing in rank-order justifications when source features are available in texts compared to when they are not. Moreover, we expected that greater endorsement of beliefs in authority will also predict more accurate essays and rank-order justifications. This will be qualified by an interaction such that, endorsement of beliefs in authority will display greater prediction of essay accuracy, rank differentiation, and sourcing in rank justifications when source features are available.

Method

Participants. Eighty individuals (75% female) at a large university in the mid-south participated (M age = 21.76, SD = 5.81). Participants were compensated with credit towards course participation. The sample population consisted of the following ethnic composition: Caucasian (36.3%), African-American (48.8%), Asian (5%), Multi race (7.5%), Latino (1.3%), and Middle Eastern (1.3%). The number of participants of other ethnicities (Alaskan, American

Indian, and Pacific Islander) each made up less than 1% of the sample.

Materials

Prior knowledge assessment. Participants were asked a series of three questions to obtain a score reflecting their prior knowledge regarding childhood vaccines. These questions were designed to assess understandings of vaccines and their relationship to one's health. Prior knowledge was scored for each question. The first question "What is a vaccine?" was worth two points, one point was awarded for each of the two core concepts related to this question. One point was awarded for understanding that a vaccine includes part of the targeted illness (e.g., A vaccine is weakened form of the virus) and one point was awarded for the use of preventative language (e.g., Vaccines are used to prevent diseases). The second question "How are vaccines administered?" was scored similarly to the first question, again being worth a total of two points, one point was awarded for each of the two core concepts related to this question. One point was awarded for understanding that a vaccine is administered through an injection or shot (e.g., Vaccines are given as shots) and one point was awarded for understanding that a vaccine is administered by a medical professional (e.g., A doctor gives it in a shot). The final question "Which illnesses do vaccinations protect children against?" was scored based on the number of past (polio) and current (influenza) vaccines listed. For example, if a participant listed MMR, influenza and Hepatitis B they were awarded five points in total, one for each accurate mention of an illness that vaccines target. Two raters independently scored 20% of the responses, inter-rater reliability was 100%.

Task instructions. Participants were given the following instructions before reading the texts on childhood vaccines: "Today you will be reading on the topic of childhood vaccines. We are asking you to imagine that you have a friend who has just had a baby and cannot decide

whether they should or should not vaccinate their child. There is a lot of different and conflicting information online and your friend needs your help deciding if they should or should not vaccinate their child. Your task is to develop an accurate, coherent, and complete understanding on the topic of childhood vaccines. You will read 8 texts returned from a Google search on “childhood vaccines”. When you are done reading, you will be asked to write a letter to your friend explaining why you think they should or should not vaccinate their child based on what you read. You will be writing this essay from memory and should include concepts you read in the 8 texts, please take your time reading. You will also be asked to rank the texts in the order in which you find them reliable and justify your answer.”

Texts. A total of eight texts were created to describe information regarding childhood vaccines. Of the eight texts, four of the texts contained accurate information about childhood vaccines while the remaining four texts contained inaccurate information about childhood vaccines. The average number of words per text was 259, with the shortest text containing 200 words and the largest text containing 307 words. To ensure that the texts vary in source reliability (when present), and mirroring authentic texts that can be found in an online search, the source features throughout the eight texts ranged from more reliable (e.g., doctor/scientist) to less reliable (e.g., cyber activist/blogger). The average Flesch Reading Ease of all eight texts was 35.9% with an average Flesch-Kincaid Grade Level of 13.1. See Appendix A for an example of text.

Source availability manipulation. Participants were randomly assigned to one of three conditions: sources unavailable, sources available, and sources embedded. In the first condition, participants only received the texts with their titles with no source information available. In the sources available condition, participants were presented with texts that included source

information at the top of the page. This information included the author, their title (e.g., Epidemiologist at NIH, Chief Editor, etc.), as well as where the information was published (e.g., Organic Lifestyle Magazine, NPR, etc.) and a few sentences describing the intentions behind the publication venue. In the embedded source condition, participants were given the location of where the text was published at the top of the page along with a hyperlink to an “about us” section on the source. When participants selected the “about us” link, they were presented with information from the source of publication. These “about us” sections included information on the intentions behind publication for the source, source credentials, etc. and ranged from 50-100 words. Thus, the major difference between the sources available and sources embedded conditions was the need for participants to click an “about us” section in order to access source information. See Appendix D for an example “about us” section used in the embedded source condition.

Distractor task. To reduce recency effects of working memory, participants completed a 15-item vocabulary task that will serve as a distractor task. We randomly chose 15 words from a 30-item vocabulary quiz fit for a college population (Campbell & Raney, 2016). These vocabulary words (e.g., indifferent, perjure, equivocal) were presented one at a time with four possible answer choices for each word, of which the participants selected the accurate response option.

Essay. Participants were given the following instructions before writing their essay on the topic of childhood vaccines: “Please write a letter to your friend explaining why you think they should or should not vaccinate their child based on your understanding of what you just read in the 8 texts. Please try to include concepts from the reading and express your complete understanding of childhood vaccines. Please be as detailed as possible in your response.” Essays

were segmented into idea units, which were coded based on accurate and inaccurate content-based concepts gleaned from the eight texts, as well as overall source mentions.

Rank-Order and justification. Participants were asked to rank-order the reliability of the texts they read based on the following instructions “You are now going to rank-order the texts from most (1) to least reliable (8) for understanding childhood vaccinations.” Participants were given a list of the eight texts in a similar format to the Google search engine research page. Participants were able to drag and drop the texts in the order in which they agree the texts are reliable. Participants were asked to justify their rank-order of the texts in a short answer format using as much detail as possible. Each participant was given an accurate and inaccurate rank score based on their responses. Justifications were coded based accurate and inaccurate content-based concepts gleaned from the eight texts, as well as overall source mentions.

Internet-Specific Epistemic Justification Inventory. Participants completed the 12-item Internet-Specific Epistemic Justification Inventory (ISEJ) that was used to assess beliefs concerning justification for knowing specifically on the Internet (Bråten et al., 2005, 2017; Kammerer et al., 2013; 2015). The ISEJ consists of 3 factors: justification by authority (*When I find information about a health topic on the Internet, I check whether it comes from an expert source*), justification by multiple sources (*To determine whether information I find about a health topic on the Internet is trustworthy, I compare information from multiple sources*), and personal justification (*When I find information about a health topic on the Internet, I evaluate whether this information is consistent with my own understanding of the topic*). Participants responded on a 10-point Likert scale ranging from *completely disagree (1)* to *completely agree (10)*. Average scores were aggregated. Higher scores indicated higher levels agreement with the given statement. Prior estimates of Cronbach’s alpha levels (.8, .92 and .92 respectively) using

multiple larger data sets reflect good reliability on the three factors. Reliability within the current data set was also quite good (Cronbach's alphas of .78, .89, and .9 respectively). See Appendix B for a list of items used in the inventory.

Childhood Vaccination Belief Inventory. Participants completed the 13-item childhood vaccination belief inventory (CVBI), which measured their beliefs on the helpfulness, harmfulness, and unnecessariness of childhood vaccinations (Kardash, Braasch, McCabe, Ankney, & Cogliano, submitted). Statements regarding the helpfulness of vaccines (*Childhood vaccinations are effective in preventing diseases*) were considered accurate statements about vaccines. Statements regarding the harmfulness of vaccines (*Vaccines do more harm than good*) and statements regarding the unnecessariness of vaccines (*In modern times, most serious illnesses are already eradicated so vaccines are unnecessary*) were considered inaccurate statements about vaccines. Participants responded on a 10-point Likert scale ranging from *completely disagree (1)* to *completely agree (10)*. Average scores were aggregated. Higher scores indicated higher levels of agreement with the given statement. Prior estimates of Cronbach's alpha levels (.87, .78 and .77 respectively) using multiple larger data sets reflect good reliability on the three factors. Reliability within the current data set was also quite good (Cronbach's alphas of .89, .87, and .90 respectively). See Appendix C for items used in the inventory.

Procedure

After completing an informed consent, participants completed a brief prior knowledge assessment. Participants were then given task instructions and completed the reading portion of the study. Next, participants completed the distractor task. After, participants were given instructions for the essay and completed the essay section of the study. Participants were then asked to rank-order the texts and provide justification for their responses. Finally, participants

completed the epistemic belief measures and demographic questions before being debriefed to assure no lingering misconceptions about childhood vaccines remained.

Results

In general, participants had average prior knowledge ($M = 4.91$, $SD = 1.92$) on the ways vaccines are administered and work to prevent diseases. Moreover, their CVBI ratings demonstrated that they generally believed that vaccines are helpful ($M = 7.75$, $SD = 1.98$) and believed less that they are unnecessary ($M = 3.37$, $SD = 1.73$) or harmful ($M = 2.95$, $SD = 1.63$) before reading. Regarding source justification by authority beliefs, participants' ratings demonstrated they generally had high justification by authority beliefs ($M = 8.43$, $SD = 1.71$). Because most measures used in this study did not conform to parametric assumptions (e.g., homogeneity of variance, normality), all analyses used in this study reflect non-parametric statistics.

Inter conditional differences

Belief revision. A series of Kruskal-Wallis tests using gain scores for helpful, harmful and unnecessary beliefs as dependent measures (see table 1) demonstrated there were no statistically significant differences in gain scores for the three belief types across the three conditions.

Concepts in essay responses. A series of Kruskal-Wallis tests were performed using accurate and inaccurate concepts, as well as source mentions, in essay responses as dependent measures. For all analyses, there were no statistically significant differences in essay responses across the three conditions (see table 1).

Rank-order decisions. A series of Kruskal-Wallis tests were conducted to investigate whether the source manipulation (i.e., available, unavailable, embedded) promoted more

accurate ranking of the reliable texts. The results of these analyses show that, in fact, the manipulation of source availability did not produce any statistically significant differences in how accurately individuals ranked the texts across the three conditions (see table 1).

Rank-order justifications. A series of Kruskal-Wallis tests were performed using accurate and inaccurate concepts, as well as source mentions, in rank-order justifications as dependent measures showed there were no statistically significant differences in essay responses across the three conditions (see table 1).

Individual differences

Correlations. The inter-group analyses show that, in general, the manipulation of source presence produced no significant results. Thus, we now shift the analytical focus towards the individual differences data to more fully understand the contributions of reader characteristics to multiple text comprehension. Table 2 presents correlations amongst the individual reader characteristics including: prior knowledge, the three vaccination beliefs measured by the CVBI, and all coarse-level dependent measures also reflected in table 2.

Spearman correlations revealed several relationships between variables. When looking at source mentions in essay responses, participant's prior knowledge and pre-existing beliefs that vaccines are helpful were both positive predictors. These results suggest that individuals who held more accurate prior knowledge and accurate topic beliefs that vaccines are helpful before reading were more likely to mention sources within their essays. Similarly, pre-existing inaccurate beliefs that vaccines are harmful and unnecessary were both negative predictors of source mentions in essays. These results demonstrate that individuals who held more misconceptions about vaccines prior to reading, in general, were less likely to mention sources in their essay responses. Justification by authority beliefs also emerged as a positive predictor of

source mentions in essays. This relationship demonstrates that those who held more justification by authority beliefs prior to reading the texts were more likely to mention sources in their essay responses.

When looking at rank-order decisions, pre-existing accurate topic beliefs that vaccines are helpful are a positive predictor of accurately ranking the texts based on reliability. Further, both misconceptions negatively predicted how accurately someone ranked the text. For rank-order justifications, prior knowledge emerged as a positive predictor of source mentions in justifications, as it did in essays. There was also a significant positive correlation between source mentions in essay responses and source mentions in rank justifications. In brief, if people sourced, they did so consistently.

Regressions. Due to collinearity issues between pre-existing helpful beliefs and the two misconception beliefs and also between the two misconceptions, we removed pre-existing helpful beliefs and combine the two misconception beliefs resulting in an aggregate misconception score. To examine the extent to which individual differences (prior knowledge, misconceptions, and justification by authority beliefs) predict text comprehension, a series of linear regressions were conducted. Table 3 shows the results of these regressions analyses performed separately using source mentions in essays, rank-order decisions, and rank-order justifications. When looking at accurate essay concepts, the predictor variables together explained a statistically significant amount of variance, $F(3, 76 = 4.34, p < .01 (R^2 = .15)$. Of the predictors, pre-existing misconceptions about vaccines were a negative predictor of accurate essay concepts, $\beta = -.34, p < .01$. For inaccurate essay concepts, the predictor variables together explained a statistically significant amount of variance, $F(3, 76 = 3.05, p = .05)$. Of the predictors, pre-existing misconceptions about vaccines were a positive predictor of inaccurate

essay concepts, $\beta = .34, p < .01$. For source mentions in essays, the predictors together explained a statistically significant amount of variance, $F(3, 76 = 5.36, p < .01 (R^2 = .18)$. Within the set, justification by authority beliefs were the only unique positive predictor of source mentions in essays, $\beta = .25, p < .05$. When looking at rank-order decisions, the predictor variables together explained a statistically significant amount of variance, $F(3, 76 = 7.74, p < .001 (R^2 = .23)$. Of the predictors, pre-existing misconceptions that vaccines are harmful were a negative predictor of rank-order decisions, $\beta = -.49, p < .001$. For source mentions in rank-order justifications, the predictor variables together did not explain a statistically significant amount of variance, $F(3, 76 = 2.3, p = .08)$.

Discussion

This study sought to understand how epistemic beliefs about justification by authority and presence or absence of source features in the provided texts impact multiple text comprehension. All hypotheses related to the manipulation of source availability were not confirmed. Our findings show that despite manipulations varying the availability of source information, readers did not differ in measures of multiple text comprehension (belief change, essay responses, rank-order discrimination, or rank-order justifications) across the three conditions. While unexpected, our participants seemed to be insensitive to the manipulation in that the presence or absence of source information did not influence our sample's overall multiple text comprehension. For the individual differences analyses, however, several interesting findings emerged. Thus, as the remainder of the discussion will detail, reader characteristics were far more informative regarding what guides multiple text comprehension over the text manipulation, despite our hypotheses.

Prior knowledge was positively related to the inclusion of accurate content in essays, as well as source representation and use after reading, including in essays and rank-order justifications. Based on these findings, we infer that readers bringing more prior knowledge to bear created representations of source information because both essays and rank-order justifications reflected performance without the texts present (i.e., from memory). Similarly, Ozuru, Dempsey, and McNamara (2009) found that an individual's prior knowledge was positively related to their overall comprehension of a single text, demonstrating how prior knowledge facilitates readers' integration of information between multiple scientific concepts. Specifically, when reading two texts on biology, readers with high prior knowledge were determined to achieve better overall text comprehension through open-ended responses about two texts (Ozuru et al., 2009). The agreement between prior work and our current findings further strengthens the understanding that certain individual differences are beneficial to overall multiple text comprehension, specifically that prior knowledge can promote the assimilation of information across various concepts. With respect to the Documents Model Framework, prior knowledge appeared to facilitate the presence of more accurate concepts in memory, possibly reflecting a stronger integrated mental model relative to those with less prior knowledge (Britt et al., 1999; Britt & Rouet, 2012; Perfertti et al., 1999). Moreover, prior knowledge also appeared to facilitate readers in constructing mental representations of connections between sources and their respective content, potentially reflecting a stronger intertext model (Britt et al., 1999; Britt & Rouet, 2012; Perfertti et al., 1999).

We also found that pre-existing accurate beliefs that vaccines are helpful were positively related to the inclusion of accurate content in essays, source representation in essays and rank-order justifications, and the ability to appropriately rank-order the texts. Past research has shown

that pre-existing beliefs often guide the processing of textual information (Kardash et al., submitted; Kardash & Scholes, 1996; Kendeou & Van Den Broek, 2005; Lord et al., 1979; Maier & Richter, 2013). In particular, individuals tend to process information in a biased manner, meaning their pre-existing beliefs appear to determine what information readers focus on and include in their mental representations of what was read (Lord et al., 1979; Maier & Richter, 2013). Given that the current findings indicate a similar relationship between pre-existing beliefs and comprehension, this relationship may reflect belief assimilation or motivated reasoning in that readers appear to rely more on their personal attitudes and beliefs than on the textual information itself (Druckman & Bolsen, 2011; Kobayashi, 2016; Lord et al., 1979).

When looking at how pre-existing accurate beliefs relate to the Documents Model Framework, pre-existing accurate beliefs appeared to reflect a stronger integrated mental model and intertext model relative to those with less accurate pre-existing beliefs (Britt et al., 1999; Britt & Rouet, 2012; Perfertti et al., 1999). Much like prior knowledge, pre-existing accurate beliefs appear to facilitate the development of stronger integrated mental and intertext models by helping to form connections amongst key concepts germane to understandings childhood vaccinations, as well as between content and source information within and across texts (Britt et al., 1999; Britt & Rouet, 2012; Perfertti et al., 1999). While our work aligns with prior findings on how pre-existing knowledge and beliefs contribute to multiple text comprehension, few studies include both in analyses to measure their unique contributions to processing and representing multiple texts, specifically when forming accurate mental representations when interacting with multiple, diverse texts.

Turning to the influence of epistemic beliefs on comprehension, a greater endorsement of justification by authority beliefs prior to reading appeared to guide individuals to include more

source information in essay responses constructed from memory. The predictability of Internet-specific epistemic beliefs on comprehension aligns with prior findings (Bråten et al., 2013; Kammerer et al., 2013), showing that, in general, epistemic beliefs contribute to overall source evaluation and decision making on the web. While prior work has shown that students tend to trust authoritative sources of information more than their own personal knowledge when reading (Bråten et al., 2013), our findings uniquely demonstrate the predictability of justification by authority beliefs and the use of source information in essay responses. This inclusion of source information could indicate individuals who put more trust in authoritative sources (e.g., scientists, researchers, doctors) are more likely to pay attention to source information in the texts while reading, mentally representing source-content links, and later using these facets of their understandings when writing their essays (Bråten et al., 2013; Britt et al., 1999; Britt & Rouet, 2012; Perfertti et al., 1999).

With respect to how epistemic beliefs fit into theoretical models of text comprehension, work by Bråten et al. (2011) characterizes how epistemic beliefs are essential for multiple text comprehension. Specifically, this review explains an integrated mental model between multiple text comprehension and epistemic beliefs that facilitates the understanding that epistemic beliefs are influential of processing strategies and source evaluation (Bråten et al., 2011; Strømsø & Britt, 2010; Strømsø, Bråten, Britt, 2010). In alignment with this work, our findings suggest that readers who hold justification by authority beliefs are more likely to include links between content and source information across texts into their mental model, which could, in turn, lead to the better integration of information and representation of this information in the intertext model (Bråten et al., 2011). Given the influence that epistemic beliefs can have on multiple text

comprehension, it is possible that greater beliefs in justification by authority could facilitate better multiple text comprehension as a result of stronger mental and intertext models.

One sobering finding is that pre-existing misconceptions about childhood vaccines made it less likely that readers would represent and recall source information, as evidenced particularly in their essays. Moreover, the more misconceptions an individual had prior to reading, the less able they were to distinguish reliable from unreliable texts in their rankings. Thus, in problematic alignment with past research, the current results seem to also lend support that readers tend to process textual information in a way that preserves their pre-existing beliefs (Kardash & Scholes, 1996; Kendeou & Van Den Broek, 2005; Lord et al., 1979; Maier & Richter, 2013). For example, past research has shown that when readers are presented with belief consistent and belief inconsistent information, prior beliefs will influence how readers process the information, often in a biased manner that supports their own beliefs (Lord et al., 1979; Maier & Richter, 2013).

While our work shows a similar pattern with misconception-based beliefs, the current work uniquely shows a negative relationship between prior misconceptions and source evaluation and use. If an individual has pre-existing misconceptions about childhood vaccines, they appear to process inaccurate information in the texts as accurate information and vice versa. This inability to distinguish accurate information from inaccurate information is reflected in the inappropriate rank-ordering of the texts, explicitly, ranking accurate texts as less reliable, and inaccurate texts (espousing their current misconceptions) as more reliable.

In relation to the Documents Model Framework, readers who are processing the texts through a lens of misconceptions may have attended less or perhaps even actively ignored source information (when present) leading to a likely inaccurate integrated mental model (Britt et al.,

1999; Britt & Rouet, 2012; Perfertti et al., 1999). Such cursory processing may have been the reason that sources were not a part of the readers with pre-existing misconceptions' mental representations of what they read. In combination with a lack of sourcing and source representation, misconception readers appear to be unable to differentiate more from less reliable information across texts, which could lead to an inaccurate or incomplete intertext model (Britt et al., 1999; Britt & Rouet, 2012; Perfertti et al., 1999). With an inability to form accurate mental representations due the apparently strong influence of misconception-based beliefs, readers with misconceptions could be at a much higher risk for drawing unreliable conclusions when reading multiple texts. These findings clearly require more research to help determine why pre-existing misconceptions undermine source evaluation and use.

In summary, the Documents Model Framework assumes that an ideal mental representation of information deduced from multiple texts takes into account source information and that this source information is remembered as well as used as a result of this accurate representation (Britt et al., 1999; Britt & Rouet, 2012; Perfertti et al., 1999). The current work suggests that readers rely on their prior knowledge and a host of different prior beliefs to guide their reading and comprehension. Of concern, our results particularly indicate that the more you endorse misconceptions prior to reading, the less likely you are to evaluate source information during reading, presumably leading to less source information being included in the Documents Model Framework. The problematic implication is that not only do misconceptions lead to the less inclusion of source information in mental representations of the texts, they also lead people to be unable to differentiate between reliable and unreliable information. All told, although research has demonstrated that source information is important for making decisions about the reliability of the texts (Braasch et al., 2012; Bråten et al., 2018; Bråten, Britt, Strømsø, & Rouet,

2011; Britt et al., 2013; Strømsø, Bråten, & Britt, 2010), it appears to be the case that possessing misconceptions undermines a reader's ability to do. In a post truth era, future work could look to further document this relationship between misconception-based beliefs and comprehension. Assuming such a pattern replicates with new participants, in new contexts, with alternative resources, and so forth, future interventions could be developed to target those most at risk for inappropriately processing textual information based on problematic beliefs.

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Table 1

Statistical values for belief revision, essay responses, rank-order decisions, and rank-order justifications.

Variable	Unavailable sources <i>M (SD)</i>	Available sources <i>M (SD)</i>	Embedded sources <i>M (SD)</i>	Test statistic
Belief Revision				
Gains in helpful beliefs	-0.2 (1.4)	-0.25 (1.63)	-0.73 (1.25)	$H = 1.15, ns$
Gains in harmful beliefs	-0.72 (1.64)	-0.62 (1.43)	0.22 (1.32)	$H = 4.92, ns$
Gains in inaccurate beliefs	-0.55 (1.94)	-0.49 (1.67)	-0.04 (1.24)	$H = 0.52, ns$
Essay Responses				
Content-based accurate mentions	10.5 (6.56)	10.11 (5.37)	9.72 (5.15)	$H = 0.20, ns$
Content-based inaccurate mentions	2.07 (4.02)	2.00 (3.98)	1.16 (2.44)	$H = 0.39, ns$
Source mentions	0.96 (1.9)	0.93 (1.39)	0.64 (1.04)	$H = .54, ns$
Rank-order discrimination	2.32 (2.61)	1.56 (2.29)	2.88 (1.45)	$H = 3.97, ns$
Rank-order Justifications				
Content-based accurate mentions	3.11 (1.57)	3.3 (1.2)	2.8 (1.41)	$H = 1.53, ns$
Content-based inaccurate mentions	2.96 (1.62)	3.1 (1.57)	2.84 (1.77)	$H = 0.06, ns$
Source mentions	1.00 (1.94)	1.85 (2.76)	2.28(3.27)	$H = 5.69, ns$

Table 2

Bivariate correlations.

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Prior knowledge	-											
2. Pre-helpful	.29**	-										
3. Pre-harmful	-.35**	-.74**	-									
4. Pre-unnecessary	-.32**	-.83**	.82**	-								
5. Justification by authority	.04	.12	-.09	-.16	-							
6. Essay content accurate	.22*	.23*	-.35**	-.28**	.14	-						
7. Essay content inaccurate	.12	-.16	.23*	.25*	-.12	-.5**	-					
8. Essay source mention	.25*	.3**	-.32**	-.38**	.35**	.24*	-.15	-				
9. Discrimination score	.05	.31**	-.41**	-.33**	-.03	.27**	-	.17	-			
10. Rank accurate justification	-.03	-.19*	.04	.19*	.13	.0	-.02	-.06	-.13	-		
11. Rank inaccurate justification	-.12	-.19*	-.07	.08	.05	.12	-.2*	-.15	.06	.34**	-	
12. Rank source justification	.27**	.13	-.12	-.17	.02	.26*	-.13	.27**	.09	-.56**	-.12	-

Note. * $p < .05$ ** $p < .01$

Table 3

Variance explained by full model and beta weights for predictor variables.

Predictors	Essay Accurate Concepts	Essay Inaccurate Concepts	Essay Source Mentions	Rank-order Discrimination Score	Rank-order Justification Source Mentions
Prior knowledge	0.06	0.19	0.16	-0.05	0.18
Misconceptions	-0.34**	0.34**	-0.22	-0.49**	-0.15
Justification by authority	0.09	0.01	0.25*	-0.16	0.06

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

Appendix A

Example of text.

Straight talk about vaccinations

Medical experts agree that the benefits of vaccinating your child far outweigh the risks. Many serious diseases are now controlled or eliminated by vaccinations. Parents today may be too young to remember the toll these diseases took before vaccines were developed. The vaccination program in the US has been one of the most successful health campaigns – in terms of saving lives – in history. But it will only continue to be successful if people have their children vaccinated.

Let's take a look at an example. One investigation looked at hundreds of thousands of children comparing the risk of various vaccine-preventable diseases in children whose parents had refused or delayed vaccines with children whose parents allowed vaccinations. Unvaccinated children were 23 times more likely to develop whooping cough, nine times more likely to be infected with chicken pox, and 6.5 times more likely to be hospitalized with pneumonia than vaccinated children from the same communities. Clearly, parental decisions to withhold vaccinations place children at greatly increased risk for potentially serious infectious diseases.

This sad state of affairs exists because parents have been persistently and insidiously misled by information in the press and on the Internet. Moreover, the health care system has not effectively communicated the anti-vaccination counterarguments, such as how the side effects of vaccines are minimal in comparison to the adverse life-threatening effects of many diseases. Physicians and other health experts need to be more proactive, providing better information and engaging parents much earlier than is usually the case.

Appendix B

Items on the Internet-Specific Justification Inventory.

Personal Justification

1. When I find information about an educational topic on the Internet, I evaluate whether this information is consistent with my own understanding of the topic.
4. To check whether information about an educational topic I find on the Internet is reliable, I evaluate it in relation to my own knowledge of this topic.
7. I evaluate whether information I find about an educational topic on the Internet seems logical.
10. When I read about an educational topic on the Internet, I evaluate whether this information is consistent with what I already know about this topic.

Justification by multiple sources

2. I evaluate claims I find about an educational topic on the Internet by checking several information sources on the same topic.
5. When I read something about an educational topic on the Internet, I compare several websites that deal with this topic.
8. To evaluate whether information I find on the Internet about an educational topic is reliable, I check whether it is consistent with information on other websites.
11. To determine whether information I find about an educational topic on the Internet is trustworthy, I compare information from multiple sources.

Justification by authority

3. When I read something about an educational topic on the Internet, I evaluate whether this information is written by an expert.
6. To determine whether information I find about an educational topic on the Internet is trustworthy, I evaluate whether the author has sufficient knowledge of the topic.
9. When I find information about an educational topic on the Internet, I check whether it comes from an expert source.
12. To evaluate whether information I find about an educational topic on the Internet is reliable, I try to determine whether it is written by a person with a high level of competence in the area.

Appendix C

Items on the Childhood Vaccination Belief Inventory.

Helpful items

2. Even when diseases seem to no longer exists, outbreaks can occur if children go unvaccinated.
4. The side effects of vaccines are minimal compared to the benefits.
9. Childhood vaccinations are effective in preventing diseases.
12. If a friend was considering vaccinating his/her children, I would definitely recommend vaccination.
13. I would identify as [1 completely anti-vaccination to 10 completely pro-vaccinations].

Harmful items

3. Vaccines carry harmful ingredients.
5. We just don't know enough about vaccines yet to say they aren't dangerous.
7. Vaccinations can cause serious developmental problems like autism.
11. Vaccines do more harm than good.

Unnecessary items

1. Most illnesses that vaccines target are not that serious so it is unnecessary to vaccinate children.
8. In modern times, most serious illnesses are already eradicated so vaccines are unnecessary.
6. Vaccines only reduce illness in a small percentage of children.
10. Children's natural immune systems fight off diseases better than vaccinations.

Appendix D

Example “about us” section used in the embedded source condition.

Scientific American Magazine

Established 1983

“The mission of our magazine is to provide accurate and empirical evidence about current and past health topic. Regarding information on childhood vaccines, this magazine strives to provide information on how necessary vaccines are in terms of living a long, healthy life free from vaccine-preventable diseases. We work with doctors, nurses, researchers, and statisticians all over the world to provide trustworthy and true information for our readers.”