# Internet-Specific Epistemic Beliefs Predict Users' Source Monitoring During Web Search

*Yvonne Kammerer[1], Ivar Bråten[2], Peter Gerjets[1], and Helge I. Strømsø[2]*
*[1]Knowledge Media Research Center, Tuebingen, Germany*
*[2]Department of Educational Research, University of Oslo, Norway*
y.kammerer@iwm-kmrc.de, ivabra@online.no, p.gerjets@iwm-kmrc.de,
h.i.stromso@ped.uio.no

**Abstract.** This study investigated the predictability of epistemic beliefs about knowledge and knowing on the Internet for spontaneous processing of source information when university students ($N$ = 80) searched the Web to learn about a controversial science topic. Epistemic beliefs were assessed with the Internet-Specific Epistemological Questionnaire (ISEQ) and processing of source information was assessed through think alouds, eye tracking, and selection behavior. Results indicated that more naïve epistemic beliefs, for example that the Internet provides certain and true knowledge, were related to less source monitoring. This is an important finding because paying attention to the sources themselves seems essential when working with multiple documents that vary with respect to trustworthiness.

**Keywords:** Epistemic beliefs; source monitoring; Web search; think alouds; eye tracking.

## Introduction

Theory and research on multiple-documents literacy emphasize that paying attention to or monitoring the sources themselves when learning from multiple documents is important to knowledge construction (Rouet, 2006). While our understanding of learner characteristics that may facilitate or constrain such source monitoring is still in its infancy, some recent findings from our laboratories suggest that not only prior domain knowledge but also beliefs about knowledge and knowing, that is, epistemic beliefs, play a role in source monitoring when readers work with multiple documents to learn about a controversial topic (Kammerer et al., 2009; Strømsø et al., under revision). We note two important limitations of our prior work, however. First, the work utilizing processing data to examine source monitoring only assessed epistemic beliefs at a domain-general level (Kammerer et al., 2009). Second, the work assessing epistemic beliefs at a more specific level only utilized questionnaire data to examine sourcing. In the current study, we tried to overcome both those limitations by using an epistemic belief measure specifically targeting what knowledge and knowing is like on the Internet to predict users' actual processing of source information while working on an authentic Web search task.

## Method

Participants, who were 80 German university students (63 female, 17 male) from different majors with a mean age of 24.04 ($SD$ = 3.67), were given the task of seeking information on the WWW about two competing therapies for Bechterew's disease in order to give informed advice to a fictitious friend.

Before participants started on this task, questionnaire data on demographics and their computer and Web search experience and skills were collected. In addition, one week after the experiment they were administered the *Internet-Specific Epistemological Questionnaire (ISEQ)* developed by Bråten et al. (2005). Following Strømsø and Bråten (2010), we used the dimension concerning certainty and source of knowledge and the dimension concerning justification for knowing to predict source monitoring in this study. Certainty and source of knowledge included eight items (Cronbach's $\alpha$ = .84) with a focus on the Internet as an essential source of certain and true knowledge, with high scores representing the view that certain knowledge and right answers are to be found on the Internet, and low scores indicating that participants are more likely to doubt that the Internet is a good knowledge source that can provide them with certain knowledge (sample item: The truth about almost every issue raised is located on the Internet). Justification for knowing consisted of four items (Cronbach's $\alpha$ = .78)

concerning the critical evaluation of knowledge claims encountered on the Internet through the use of multiple sources, reasoning, and prior knowledge activation. High scores on this measure reflected the idea that Internet-based knowledge claims can be accepted without critical evaluation, whereas low scores represented the view that such knowledge claims need to be checked against other sources, reason, and prior knowledge (sample item: I evaluate knowledge claims that I encounter on the Internet by checking more knowledge sources about the same topic).

To complete the experimental task, participants were presented with two offline, preselected search engine results pages (SERPs), each containing nine search results with titles, excerpts, and URLs of the Web pages. Participants could access all Web pages associated with the search results. For both SERPs (one for each therapy), the Web information varied with respect to trustworthiness, with sources representing official institutions (e.g., department of health), industry and companies (e.g., health farms or pharma industry), and lay people (e.g., a discussion forum). Participants were allowed to use four minutes per SERP, with their eye movements and mouse clicks registered during task performance. In addition, cued retrospective verbal protocols were obtained by presenting participants with their gaze recordings and asking them to report what they were thinking during Web search.

Four dependent variables that could indicate source monitoring were created, two based on the think aloud data, one based on the eye movement data, and one based on the selection data (i.e., the Web pages that participants chose to access). Specifically, the two dependent variables based on think alouds were number of verbal utterances concerning the type of source (e.g., "this is a scientific page") and number of verbal utterances referring to different parts of the search results (e.g., "I looked at the URL because there I can read something about the source"), respectively. The dependent variable based on eye movements was the total dwell time in milliseconds on URLs, and the dependent variable based on selection behavior was the number of times participants accessed the four most trustworthy sources minus the number of times they accessed the four least trustworthy sources. Source trustworthiness was determined in a pilot study where 24 participants rank-ordered the sources.

## Results

We performed four multiple regression analyses using computer and Web search experience and skills, Internet-specific certainty and source beliefs, and Internet-specific justification for knowing beliefs, respectively, as predictor variables in all analyses. In addition, age was included as a predictor to control for any age differences. In the first analysis, using verbal utterances concerning type of source as the dependent variable, the four predictors together explained a significant amount of variance, $F(4, 75) = 3.36$, $p = .014$. In this analysis, computer and search skills were a positive predictor ($\beta = .25$, $p = .028$) and certainty and source beliefs were a negative predictor ($\beta = -.27$, $p = .015$). This indicated that the more experience and skills participants had in using computers and searching the Web, the more likely they were to pay attention to the type of source. In contrast, the more participants believed the Internet to be an essential source of certain and true knowledge, the less they seemed to reflect on the type of sources that they encountered.

In the second analysis, using verbal utterances referring to different parts of the search results as the dependent variable, the four predictors again explained a significant portion of the variance, $F(4, 75) = 3.47$, $p = .012$. In this analysis, only justification for knowing beliefs uniquely predicted verbalizations, $\beta = -.41$, $p = .001$, with this result indicating that the more participants believed that Internet-based knowledge claims could be accepted without critical evaluation, the less they referred to the different parts of the search results, such as the URLs, the abstracts, or the titles.

In the third analysis, including the eye movement variable as the dependent measure, the predictors together did not explain a significant amount of variance, however, $F(4, 75) = 1.59$, $p = .19$. Still,

beliefs concerning the certainty and source of knowledge almost reached significance in this analysis, β = -.22, $p$ = .061, thus indicating a tendency for participants believing the Internet to be an essential source of certain and true knowledge to fixate less on the URLs of the search results.

Finally, when we used the selection of the most trustworthy Web pages relative to the selection of the least trustworthy Web pages as the dependent variable, justification for knowing beliefs tended to negatively predict selection behavior, β = -.22, $p$ = .074, although the predictors together did not explain a significant amount of variance, $F(4, 75) = 1.69$, $p$ = .16. This indicated a tendency that the more participants believed that knowledge claims could be accepted without cross-checking, the less they actually distinguished between more and less trustworthy sources during Web search. Moreover, computer and Web search experience and skills were also a unique negative predictor, β = -.26, $p$ = .029, indicating that the more familiar participants were with computers and Web search, the less they distinguished between more and less trustworthy sources in their selection behavior.

## Conclusion

Taken together, these results provide new intriguing evidence that what may be considered more naïve epistemic beliefs concerning Internet-based knowledge and knowing may contribute to less adaptive processing of source information, with this evidence corroborated across different types of processing data. This suggests that some issues concerning Web based learning may, indeed, be issues of personal epistemology (Hofer, 2004), also affording implications for how learning on the Web may be improved. Interestingly, computer and Web search skills were positively related to verbal utterances concerning type of sources but negatively related to participants' differentiation between more and less trustworthy sources in their selection behavior. This suggests that users more familiar with computers and Web search may sometimes be more likely to click on search results regardless of quality than are users less familiar with computers and Web search.

Because participants were generally unknowledgeable about the search topic, differences in prior knowledge was not considered in this study. Moreover, our correlational data do not warrant conclusions about causality. Finally, assessing epistemic beliefs on a questionnaire like we did may yield other results than assessing them "in action" during task completion. Future work should address those limitations.

## References


Bråten, I., Strømsø, H.I., & Samuelstuen, M.S. (2005). The relationship between Internet-specific epistemological beliefs and learning within Internet-technologies. *Journal of Educational Computing Research, 33*, 141-171.

Hofer, B.K. (2004). Epistemological understanding as a metacognitive process: Thinking aloud during online searching. *Educational Psychologist, 39*, 43-55.

Kammerer, Y., Wollny, E., Gerjets, P., & Scheiter, K. (2009). How authority-related epistemological beliefs and salience of source information influence the evaluation of web search results: An eye tracking study. In N.A. Taatgen & H. van Rijn (Eds.), *Proceedings of the 31st Annual Conference of the Cognitive Science Society* (pp. 2158-2163). Austin, TX: Cognitive Science Society.

Rouet, J.F. (2006). *The skills of documents use: From text comprehension to Web-based learning.* Mahwah, NJ: Erlbaum.

Strømsø, H.I., & Bråten, I. (2010). The role of personal epistemology in the self-regulation of internet-based learning. *Metacognition and Learning, 5*, 91-111.

Strømsø, H.I., Bråten, I., & Britt, M.A. (under revision). Do students' beliefs about knowledge and knowing predict their judgment of texts' trustworthiness? *Instructional Science.*