

Undergraduate Students' Justifications for Source Selection in a Digital Academic Context

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Abstract

To complete any academic tasks using information from the Internet, undergraduate students first have to select the appropriate sources. However, the types of justifications that undergraduates provide for source selection and how these justifications may be impacted by task characteristics have been underexamined. This study explored undergraduates' reported justifications for source selection when responding to questions in a digital academic context. Participants were first asked to answer two questions, one discrete and one open-ended, using an online library of eight sources varying in type and reliability. Subsequently, a guided retrospective interview was used to elicit undergraduates' justifications for source selection. Source selection decisions were coded as epistemic (e.g., concerned with reliability or credibility) or nonepistemic (e.g., concerned with relevance or accessibility). Undergraduate students' justifications were significantly more likely to be nonepistemic than epistemic. Further, the reasons for selection offered differed when participants responded to the discrete versus open-ended question, to a limited extent. Epistemic justifications for source selection were related to a number of outcome measures, while nonepistemic justifications were not. Findings are discussed in

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reference to research and practice pertaining to undergraduates' multiple source use and task design.

Keywords

multiple texts, source selection, epistemic beliefs, judgments or decision making, trustworthiness evaluation

Whether online or off-line, in school or out of school, students are frequently asked to select from a multitude of sources to address academic or personal questions (Jenkins, 2009). But what cognitive decision making guides this selection process? How do students choose from among the multitude of sources that could potentially provide pertinent information? Prior research has suggested that these decision-making processes are often neither well conceived nor well executed (Britt & Aglinskias, 2002; Metzger, Flanigan, & Zarun, 2003). Rather, when high school students and undergraduates seek information, especially from online sources, they often let some external authority (e.g., Google) dictate their actions (Fast & Campbell, 2004; Griffiths & Brophy, 2005; Julien & Baker, 2009). They appear to quickly select the first or most familiar sources from the litany of entries presented to them and move on (Guinee, Eagleton, & Hall, 2003; Hansen, Derry, Resnick, & Richardson, 2003; Salmerón, Kammerer, & García-Carrión, 2013; Thompson, 2003). These general proclamations about students' engagement with online sources are based on a limited understanding of the thinking and decision making that students engage in during the process of source selection. Particularly at the undergraduate level, there may be more deliberation occurring in students' encounters with online sources (e.g., Rouet, Britt, Mason, & Perfetti, 1996; Strømsø & Bråten, 2010) than has been previously documented in the literature.

Search engines, like Google, that are able to generate millions of results in response to a query and order websites according to relevance-based algorithms, are nonetheless limited in helping users select from this mass of sources (Kammerer & Gerjets, 2012a, 2012b; Rodicio, 2015; Salmerón et al., 2013). While professors may instruct their classes to determine the credibility and reputability of information, undergraduates are often motivated to quickly and efficiently find answers (Becker, 2003; Fast & Campbell, 2004; Lee, Paik, & Joo, 2012). There is a need to determine how students reconcile competing priorities to maximize text credibility, familiarity, and accessibility in their source selections. For example, how do students make determinations about which websites will offer not only easy access to information but also reliable content that fulfills search demands? Further, how do students make these determinations under varying task conditions, when the type and quality of information needed varies?

In this study, we investigated the justifications that undergraduate students reported for selecting sources when responding to two academic questions, one discrete and one open-ended. We were interested in identifying the factors undergraduates considered when selecting sources and when determining which sources might meet their needs. Further, we investigated the consistency of undergraduates' reported reasons for source selection across question types and the extent to which the justifications offered by students were epistemic or nonepistemic in nature. Epistemic justifications for source selection were those demonstrating sensitivity to the nature of a source or the quality of the information within it, for example, undergraduate students' evaluations of source authority and credibility (e.g., Mason, Boldrin, & Ariasi, 2010). Nonepistemic justifications for source selection were based on evaluations of source relevance, ease of use, or convenience (e.g., Lee et al., 2012; Rouet, Ros, Goumi, Macedo-Rouet, & Dinet, 2011). Epistemic- and nonepistemic-based decisions about source access were thought to involve appraisals of both the texts available and the demands a given task posed.

Source Selection Within Information Problem Solving

Several theoretical frameworks have guided studies of students' multiple source use, particularly in online contexts (Reader & Payne, 2007; Rouet, 2006; Rouet & Tricot, 1996). Within these frameworks, the access of multiple sources and their subsequent use are considered to be part of the *information problem solving* process (Brand-Gruwel, Wopereis, & Vermetten, 2005, p. 487), with students' selection of multiple sources constituting a step in a longer process of resolving a search query. Walraven, Brand-Gruwel, and Boshuizen (2009) define an information problem as one where there is a mismatch between known information and the information needed to answer a question. This discrepancy is theorized to serve as the prompt for students' access of sources to satisfy an *information need* (Brand-Gruwel & Stadler, 2011; Walraven, Brand-Gruwel, & Boshuizen, 2008).

Information problem solving, examined in samples ranging from middle school students to adults and PhD candidates, was selected as a guiding framework in this study for several reasons (Brand-Gruwel et al., 2005; Walraven et al., 2008). For one, this framework is comprehensive in nature, identifying both the sources available and the question to which students are responding as central parameters in the source use process. Further, this framework specifically addresses students' interactions with digital sources, with consideration for the informational demands placed on learners in the Internet age (Brand-Gruwel, Wopereis, & Walraven, 2009). In addition, this framework allowed us to consider differences in question type or variations in the *problem* as influencing students' justifications for source selection. In the present study, the *problem* to be solved was formulated as either a simple or *discrete* question, requiring a

response based on only a single source that may be corroborated across texts, or as a complex or *open-ended* question, requiring students to evaluate and reconcile information found in several sources to compose an elaborated response.

Brand-Gruwel et al. (2009) present the Information Problem Solving While Using the Internet Model in which students' use of online sources during problem solving is hypothesized to consist of five skills: (a) defining the problem, (b) searching for information, (c) scanning the information, (d) processing the information, and finally (e) organizing and presenting the information. Although Brand-Gruwel et al. discuss three means by which students initially identify potential sources (i.e., through the use of keywords, hyperlinks, and web addresses or URLs), they do not delve into students' reasoning and justifications for the selection of specific sources. Thus, there is a need to understand how students make decisions about which sources to access, once a set of texts has been identified. The present study attempts to explicate the decision-making processes that students' engage in following searching for information but prior to scanning said information (Brand-Gruwel et al., 2009).

Epistemic and Nonepistemic Justifications for Source Selection

Empirical research has indicated that both secondary students' and undergraduates' spontaneous reporting of justifications for source use is often limited (Gerjets, Kammerer, & Werner, 2011; Kuiper, Volman, & Terwel, 2008; Walraven et al., 2009; Wiley et al., 2009). For instance, Walraven et al. (2009) examined the criteria secondary students provided for evaluating search results and selecting sources. During a think-aloud, students were generally limited in their explicit evaluations of which sources to select from a *hit list*, citing reasons for source access only 24% of the time. Likewise, undergraduates have been found to be limited in their evaluations of search results absent specific instruction to do so (Kammerer & Gerjets, 2010).

As may be expected, students have been found to most frequently evaluate potential sources on the basis of whether those sources were likely to contain an answer to the question motivating source use (Gerjets et al., 2011; Walraven et al., 2009). Specifically, Walraven et al. (2009) determined six criteria high school students use to evaluate search results: (a) source title or summary, (b) source type (e.g., pdf), (c) web address, (d) rank in hit list, (e) prior experience with the source, and (f) language of the source. High school students reported title and summary of the source as their basis for selection significantly more frequently than other reasons (Walraven et al., 2009). In a sample of undergraduate students, search results were most commonly evaluated based on relevance or topicality and were found to be evaluated based on perceived credibility only with specific prompting (Gerjets et al., 2011).

Beyond the relative infrequency with which students explicate or justify their source selections, evidence suggests that learners, from upper elementary school to the undergraduate level, often rely on only surface cues in making choices about which texts to access (Brand-Gruwel & Stadler, 2011; Gerjets et al., 2011; Kuiper et al., 2008; Walraven et al., 2008). Rouet (2006) suggests that in selecting sources, the properties of interest to students are largely superficial and tend to relate to source presentation, rather than to content. This extends to primary and secondary students, undergraduates, and adults. Specifically, when selecting sources based on relevance, *superficial* or *deep semantic* cues may be considered (Dinet, Bastien, & Kitajima, 2010; Rouet et al., 2011). Superficial cues are those of source position and typography, or text-formatting features, such as boldface type or hyperlinks, which are devices used by search engines to signal source relevance. Deeper semantic cues concern the language and structure of a particular text's presentation on the hits page (e.g., the correspondence between the title of the sources and its description). Both superficial cues and deeper semantic cues nonetheless constitute only relevance-based indicators for source selection. These indicators pertain to source presentation and do not reflect epistemic considerations, such as source reliability or credibility. Indeed, participants have been found to determine which links to select based on order and position, as well as link interest, but not based on concerns with source credibility or trustworthiness (Salmerón, Kintsch, & Kintsch, 2010).

Learners' limited considerations of source credibility prior to access (e.g., Salmerón et al., 2010) may stem from students' general difficulties with sourcing or learners' insufficient use of the information available about a source (e.g., its author) to aid in its evaluation, even at the undergraduate level (Britt & Aglinskias, 2002; Strømsø & Bråten, 2014). A source's informational properties, called *semantic source features*, include its author and publisher as well as document type (e.g., newspaper). Empirical work has demonstrated that attention to such sourcing information may be of particular import for students' multiple text evaluation and comprehension and performance on MSU tasks (Bråten, Strømsø, & Britt, 2009; Perfetti, Rouet, & Britt, 1999; Rouet, 2006). However, semantic source features may also impact students' initial source selections and be potential dimensions along which students choose sources to access.

Research on the justifications students offer for source selection is limited (Bilal & Kirby, 2002) and has largely focused on nonepistemic dimensions of source selection, such as source relevance (e.g., Balatsoukas & Ruthven, 2012; Gerjets et al., 2011; Lee et al., 2012; Rouet et al., 2011). However, empirical work on source evaluation *following* source use can inform conceptions of students' source selection process. Bråten et al. (2009) asked participants to evaluate the *trustworthiness* of seven texts and to rate the extent to which they based their rating on various source characteristics including author, publisher information, document type (e.g., newspaper), date of publication, or a one-sentence summary of source content. Those students who attended to source type as an

indicator of trustworthiness performed better on a subsequent test of text comprehension (Bråten et al., 2009). Importantly, in addition to serving as the bases for source evaluations, these same source information-based dimensions (e.g., author and source type) may also serve as the criteria for students' source selection.

Rouet et al. (1996) introduced four classes of students' justifications for evaluations of source content following source use; these included evaluations based on content, author, document type, and students' own opinions. Key findings from this study included both that undergraduate students were particularly attentive to document type as a dimension for source evaluation and that students effectively demonstrated the capability to reason about different types of sources (Rouet et al., 1996). In recent studies, both upper secondary and undergraduate students have likewise been found to be attuned to website credibility, through considerations of author expertise and site authoritativeness (Keck, Kammerer, & Staraschek, 2015; Lee et al., 2012; Thompson, Morton, & Storch, 2013).

To identify additional epistemic reasons for source selection, we can turn to models of epistemic cognition. Greene, Azevedo, and Torney-Purta (2008), elaborating on extant models of personal epistemology (Hofer & Pintrich, 1997; Schommer-Aikins, 2004), proposed a framework with three dimensions: one capturing the nature of knowledge and two concerned with the justification of knowledge or what may constitute a legitimate source of knowledge—these two latter dimensions capture students' epistemic cognition. The nature of knowledge dimension captures the extent to which students believe knowledge to be simple and certain. The justification for knowledge dimensions features students' beliefs about the validity of justifications for knowledge based on authority or based on personal beliefs (i.e., personal justifications). As any of these epistemic-based concerns can inform students' judgments regarding source selection, this framework was considered in examining the reasons students provided for accessing a particular source. Further, theories of epistemic cognition have stressed the importance of examining students' epistemic beliefs as they manifest in specific task contexts (Mason et al., 2010), and as a result, this framework is particularly appropriate for use in classifying students' reported justifications for source selection.

Assessment of Students' Source Selection

A challenge in investigating students' deliberation in selecting sources is choosing an appropriate methodology to capture students' reasoning. Some studies have looked to behavioral indicators of source access (e.g., clicking a link and eye tracking) to better understand the nature of source selection (Bilal & Kirby, 2002; Kammerer & Gerjets, 2010; Mason et al., 2010). Le Bigot and Rouet (2007) considered differences in access when students were given sources

introduced only by their content or by information about content, author, and publication date (e.g., *Conformity* vs. *Asch, 1951: Conformity*). Britt, Rouet, and Perfetti (1996) examined students' source access when texts were arranged either *linearly*, with students proceeding through an ordered progression of sources, or in a *hypertext* framework, with texts linked to one another in a nonsequential ordering. Kammerer and Gerjets (2012a) examined the effects of interface design (i.e., a Google-like, list-base format vis-a-vis a tabular format) on students' selection of objective, subjective, or commercial search results. A tabular interface design was found to result in undergraduates' reduced selection of commercial sources in favor of objective sources. Indeed, studies of source selection have primarily occurred in hypertext systems (e.g., Britt et al., 1996; Reader & Payne, 2007; Wilkinson, Reader, & Payne, 2012); more is needed to be understood about students' source selections in online environments, where sources presented are not explicitly linked to one another and vary in quality and origin. Further, while these studies capitalize on students' behavioral data, they are limited in examining students' reasoning or decision-making processes in electing to access particular sources.

Given students' limited reporting of reasons for source selection (Kammerer & Gerjets, 2012a; Walraven et al., 2009), a recent study examined undergraduate students' justifications for selection under two conditions: when students spontaneously evaluated search results and when they were provided with explicit instructions to do so (Gerjets et al., 2011). Researchers not only identified relevance, particularly topic relevance, as the guiding principle in students' source selection but also identified topic criteria (i.e., topicality and scope) and source quality criteria (i.e., credibility, up-to-dateness, and design) as reasons for students' source selections. The Gerjets et al. (2011) study is of note for its simultaneous consideration of both nonepistemic and epistemic dimensions associated with undergraduates' source selection. In the present study, we were interested in how this multitude of source features may guide students' initial decisions about source selection. Similar to the methods used by Gerjets et al. (2011), in the present study, students' reasoning about source selection was prompted to elicit maximal reporting of justifications and criteria for source selection. Such an examination may be particularly pertinent, as the mass of information multiple source use tasks present make it is necessary to understand which criteria students use for source selection and how these varying standards may be prioritized in selecting sources (Le Bigot & Rouet, 2007).

Present Study

In the present study, we were interested not only in the sources undergraduate students selected when responding to academic tasks but also in conducting an initial exploration of the justifications undergraduate students offered for their selections. As task features, and particularly differences in question prompts,

have been found to influence how students engage with multiple sources (e.g., Cerdán & Vidal-Abarca, 2008; Rouet, 2003), we asked undergraduate students to report their justifications for source selection in response to two different academic questions, one discrete and one open-ended.

Studies of search and source selection (e.g., Bilal, 2000, 2001) have looked at differences in source access when responding to *fact-finding* or *research-based* questions. *Fact-finding* questions are considered to be simple, certain, and routine questions demanding information search, whereas *research-based* questions are considered to be open-ended and requiring the assemblage of information from various sources (Bilal, 2000). Although these studies (Bilal, 2000, 2001) have looked at differences in search and navigation behaviors, students' decision-making processes and justifications regarding which sources to select across task conditions require further investigation. We were interested in the extent to which undergraduates provided both epistemic and nonepistemic justifications for source selection in conjunction with one another in responding to two academic questions. Further, we investigated the extent to which the constellations of the epistemic and nonepistemic justifications undergraduates provided were consistent when responding to the two questions.

The research questions guiding this study were as follows:

1. What types of justifications for source selection do undergraduate students offer in responding to two questions (one discrete and one open-ended) in an online context?
2. To what extent do undergraduate students report epistemic versus nonepistemic justifications for source selection in responding to a discrete versus open-ended question?
3. To what extent do undergraduate students' epistemic and nonepistemic justifications for source selection relate to response accuracy, in the case of the discrete question, and to open-ended response metrics, in the case of the open-ended question?

Methods

This exploratory study used a mixed-method design to understand undergraduate students' justifications for source selection and how these may be related to performance. A qualitative coding scheme, based on a typological data analytic approach (Caracelli & Greene, 1993), was used to comprehensively classify undergraduates' justifications for source selection into thematic categories. Quantitative analyses were used to compare undergraduates' justifications for source selection across two types of questions (i.e., discrete and open-ended) and associate these with response accuracy, for the discrete question, and response metrics, for the open-ended question.

Two-way analyses of variance (ANOVAs) were used to compare the frequency of undergraduates' epistemic and nonepistemic justifications for source selection reported when responding to the discrete versus open-ended question. Independent sample *t* tests were used to examine whether undergraduates responding accurately to the discrete question differed in the number of epistemic and nonepistemic justifications for source selection they produced as compared with undergraduates who did not respond accurately. Correlation analyses were used to determine the association between justification for source selection and open-ended response metrics. All analyses were conducted using SPSS version 19 (IBM Corp., 2010).

Participants

Participants were 31 undergraduate students from a large mid-Atlantic university. The sample skewed women (87.10%), and the average age was 22.16 years old ($SD = 0.34$)—a proportion that paralleled the population of the college from which this sample was drawn. The sample was predominantly White (58.06%) and Asian (32.26%), with one student reporting African American ethnicity and two students selecting *other* (6.45%). In the sample, 16.13% of students reported being nonnative English speakers. Students in the study represented a variety of social science majors including education (22.58%), psychology (19.35%), and public health (12.90%). Students' average grade point average on a 4-point scale was 3.28 ($SD = 0.42$).

Undergraduates were recruited from two human development courses and were offered extra credit for participation. Undergraduate social science majors enrolled in a human development course were selected as the sample for this study, as the topics of the search task (i.e., fertility rates and government-sponsored childcare) were considered to be relevant and interesting to participants. We expected participants to have some familiarity with, but not extensive prior knowledge of, these topics. Thirty-five undergraduates initially participated in the study. However, four participants were excluded: One had previously participated in a similar study, two declined to be audio recorded during the interview, and the fourth was not recorded due to a computer malfunction. Thus, a final sample of 31 participants was retained.

Measures

The present study consisted of two primary parts: (a) a search task, in which undergraduates responded to two questions using a library of eight sources and (b) a guided retrospective interview, during which participants were asked to narrate for a researcher how they went about answering the two academic questions.

Prior to receiving the questions and interacting with sources, undergraduates were instructed to answer the two questions *using a list of sources, as if you were doing so for a social science class*. Participants were also instructed to use only the library of sources provided. Undergraduate students were told to use all the time they needed for the task and that after clicking the *submit* button for the first question, they would be presented with the second. Pressing the *Start* button below the instructions took participants to the first question and library of eight sources.

Search questions. The two questions included one discrete (i.e., In the United States, what is the replacement fertility rate?) and one open-ended question (i.e., What is the role of government-sponsored childcare in high fertility rates?). These questions were chosen to represent the variations in tasks for which participants may consult multiple sources and were thought to potentially elicit differing source selection processes. Each question was presented, along with a text box and a *submit* button at the top of the page, above the source library. This question and text box display remained visible while undergraduates accessed sources from the library, and participants were not restricted as to the length of their response. A screenshot of the search task interface is included as Appendix A.

Participants received questions in counterbalanced order. No differences were found in the number of epistemic and nonepistemic justifications for source selection participants generated in response to discrete and open-ended questions, across the two orders of presentation (discrete epistemic: $p = .14$, discrete nonepistemic: $p = .14$, open-ended epistemic: $p = .22$, open-ended nonepistemic: $p = .15$).

Source library. The source library, designed to resemble a Google search results page, included the title and brief description of eight sources that could be used to answer both questions. Participants were informed that these sources were presented alphabetically. Included were three websites, two pdf book chapters, one newspaper article, one magazine article, and one pdf journal article. Each source description had three parts: (a) author or publisher and title; (b) source type (i.e., website, pdf book chapter, and magazine) and link; and (c) description of each source. Descriptions were identical to those obtained from a Google search for each source.

The first source, *Global Politician*, was a conservative website that provided summaries of various blog and article postings. The second source was a chapter titled, *Reasons for Fertility Decline*, from a book published by the National Research Council. The third source was a chapter, *What Determines Fertility*, from the book *Six Billion Plus: World Population in the 21st Century*. A Newsweek article titled, *The End of Motherhood*, was the fourth source and the Wikipedia entry for *Fertility Rate* the fifth. The sixth

source was a website from the Population Research Bureau titled, *Tracking Trends in Low Fertility Countries*, and the seventh source was a journal article from the *Japanese Journal of Population* titled, *Very Low Fertility: Consequences, Causes, and Policy Approaches*. The eighth source was a *Washington Post* newspaper article, *With Each French Birth, A Dividend from the State*. The sources were chosen to represent a variety of source types and to have differing degrees of credibility. A screenshot of the source library is included as Appendix A.

Each of the sources provided information, of varying quality, relevant to the two questions. The sources provided complementary, and at times partially conflicting, information, representing a variety of views and perspectives on the same issues. For example, in the case of the open-ended question, there was a source providing anecdotal evidence of the benefits of government-sponsored childcare for women's careers (magazine article), as well as descriptions of pro-natal policies in foreign countries (blog and book chapter), and sociological analyses of the relation between government supported childcare, traditional cultural practices, and economic growth (book chapter and journal article). Sources were intended to reflect the range of information undergraduate students would encounter through the course of researching the topics of the question.

The Flesch–Kincaid reading ease and Flesch–Kincaid grade level measures were used as readability quotients to assess the appropriateness of the sources for a college-age sample. On average, the eight sources had a Flesch–Kincaid reading ease score of 35.39 (range: 18.2–45.6) and a Flesch–Kincaid grade level of 11.7 (range: 10.5–12.0), suggesting that all eight sources were appropriate for use with an undergraduate sample.

Interview protocol. Following completion of the search task, the first or second author interviewed participants about their process for answering each question. A guided retrospective interview was used. Studies interested in capturing students' reasoning during multiple source use (e.g., justifications for source selection) have used think-alouds to access students' processing (e.g., Mason et al., 2010); however, think-alouds may potentially interfere with processing or overly increase cognitive load (Cerdán & Vidal-Abarca, 2008). We were particularly concerned with interrupting processing, as learners have been found to select sources quickly, and without much deliberation (Wallace, Kupperman, Krajcik, & Soloway, 2000). As we were interested in cataloging the criteria undergraduate students offered in justifying source selection, both epistemic and nonepistemic, we elected to collect data via a retrospective guided interview to allow participants to better report and articulate justifications for source selection. Indeed, prior studies have conducted follow-up interviews to more fully capture the criteria students consider when judging search results (e.g., Walraven et al., 2009).

For each question, participants were first asked, *To start off, I want you to tell me a little bit about how you went about answering the first/second question.* Once undergraduates overviewed their response process, participants recreated their source navigation for the interviewer, relicking and being asked to reflect on the sources they accessed, in the same order as when they answered each question. If participants forgot or misremembered the order of their source use, the interviewer, who had discretely made notes of participants' source use during the task, reminded them.

During the guided interview, participants were asked questions pertaining to their source use and response formulation, as well as overall reflections on their search process. For this study, questions pertaining to undergraduate students' source use, and specifically undergraduates' justifications for choosing each source, were analyzed. For example, for each source that participants accessed, we asked, *Why did you choose source X to answer this question?* or *What made you choose this source?* to elicit undergraduates' justifications for source selection. The complete interview protocol is included as Appendix B. The time it took to complete the interviews ranged from 8.20 minutes to 39.08 minutes, averaging approximately 15.83 minutes.

Interview coding. All interviews were transcribed and segmented into idea units, roughly corresponding to independent clauses. To code the justifications that undergraduate students provided for source selection, interview coding was done in three phases. Six interviews (19.35% of the sample) were used to establish interrater agreement. First, each idea unit in these six interviews was coded for whether it was a justification for source selection. Of the 713 idea units, 680 were coded in agreement as justifications or nonjustifications, for an interrater agreement of 95.37%, with disagreements resolved through discussion.

Next, each of the identified justifications was coded as epistemic or nonepistemic with an interrater agreement of 96.88%. All disagreements were resolved through discussion. The first author then coded all of the subsequent idea units for whether they were justification or nonjustifications and coded all justifications for source selection as epistemic or nonepistemic. Epistemic justifications for source selection were those aligned with undergraduates' underlying epistemic beliefs, particularly beliefs about sources of knowledge and justifications for knowledge (Ferguson & Bråten, 2013). More broadly, epistemic judgments were those concerned with the credibility or quality of the sources or the information within them. For example, justifications for source selection coded as epistemic in nature included judgments of source reputability, aligned with the source of knowledge dimension of epistemic beliefs, or a desire for verification, aligned with the justifications for knowledge dimension of epistemic beliefs. Judgments such as *It's a journal article so it should be credible* were coded as epistemic because they were considered to be indicative of undergraduates' beliefs about what constituted an appropriate source of knowledge. In addition,

judgments about the nature of knowledge contained within the source or a personal justification for source selection were coded as epistemic, consistent with the Greene et al. (2008) framework.

Nonepistemic justifications for source selection either concerned a source's *task-based importance* (i.e., source relevance; Rouet & Britt, 2011) or surface source features (e.g., layout; Rouet et al., 2011). Such justifications included source selections based on the presence of keywords in the title as well as those based on a source's accessibility or ease of use. For instance, judgments such as "I just went through the ones that said fertility rate in the name" were coded as nonepistemic in nature.

Finally, within each justifications category (epistemic and nonepistemic), a thematic sorting was done to develop subcategories for the judgments undergraduates offered. Ten a priori justification categories were established based on the literature. These included justification for selection based on *author* or authority, *source type*, *personal justifications*, the *nature of knowledge* within the source (Greene et al., 2008), *source reliability*, *popularity*, and scientific *evidence* presented in a source (Mason et al., 2010), as well as access based on source relevance (determined based on *surface source indicators* or *content*), and *accessibility* (Rouet et al., 1996). Nine additional categories were introduced based on undergraduates' reported justifications that did not fit within the previously identified dimensions. An initial semantic coding of participants' justifications was performed, focused on the specific terms undergraduate students offered in justifying source selection; then, undergraduates' justifications for source selection were grouped into the appropriate categories. For example, when undergraduates used terms such as *trustworthy*, *reliable*, and *reputable*, these were first identified as independent semantic categories and then grouped together as justifications pertaining to source reliability. Having an initial coding based on the specific terms students use in justifying selection allowed for greater precision in creating a taxonomy of undergraduate students' justifications.

Epistemic subcategories. Eight epistemic subcategories and eleven nonepistemic subcategories were identified. Justifications that did not fit in these categories were classified as *other*. Epistemic justifications for source selection included the following: (a) *source reliability*, (b) *information accuracy*, (c) *evidence presentation*, (d) *authorship*, (e) *source type*, (f) a desire for *corroboration*, (g) *personal or popular justification*, and the (g) *nature of knowledge* the source offered. Examples and descriptions of each justification subcategory are provided in Table 1.

Nonepistemic subcategories. Nonepistemic judgments were coded into 11 categories based on the reasons undergraduate students provided for source selection; these included selection based on (a) *source relevance*, (b) *order of source presentation*, (c) *surface source indicators*, such as title or keyword,

Table 1. Epistemic Justifications for Source Selection.

	Percent (N)	Description	Example
Source reliability	17.42 (n = 23)	Source selection based on considerations of trustworthiness, reliability, or reputability	Reliability: "Which isn't, you know, the most reliable source?" Reputability: "Well first I made sure that it was, it seemed like reputable" Trustworthiness: "It seemed the most trustworthy"
Information accuracy	12.12 (n = 16)	Justifications focused on the perceived quality or objectivity of information included in a source Considerations of source accuracy, bias, or credibility	Accuracy: "Yeah. Because I heard from some people around me that there is some wrong information on Wikipedia." Bias: "This seemed like it wasn't a very biased topic" Credibility: "I very well understand the un-credibility of it"
Evidence	5.30 (n = 7)	Justifications based on the evidence or references that a source may have been providing; extent to which a source is scientific	Data: "again I was liking for data" Citation: "I was expecting to see citations" Scientific: "seems a like bit of it more I guess scientifically based"
Author	10.61 (n = 14)	Justifications based on source author or attribution	"It is coming from a doctor" "It's not by like experts"
Source type	26.52 (n = 35)	Justifications based on the type of document a source was	"Honestly I was drawn to it because it was a book" "I know.com they get money"

(continued)

Table 1. Continued

	Percent (N)	Description	Example
Corroboration	11.36 (n = 15)	Justifications concerned with verifying information from a previous source or considering information in light of students' prior knowledge	"I thought that would have like similar information as other sources" "I found another something else confirmed what I had found from Wikipedia"
Personal or popular justification	7.58 (n = 10)	Justifications based on prior knowledge or beliefs about a source or source popularity	"It seems like it makes sense" "Because of the class I took, I knew why"
Nature of knowledge	9.09 (n = 12)	Justifications based on considering the knowledge in a source to be "quick" or "easy" to access	"Wikipedia is my go-to for quick information" "And quick facts and information"
Other	1.57 (n = 2)		

(d) *source accessibility*, or (e) undergraduates' *habitual* use of a source. Nonepistemic justifications further included selection based on the (f) expected *content* of the source, (g) participants' perceived *information need*, or (h) perceived demands of the task, coded as *response-driven* justifications. Finally, nonepistemic justifications included selection based on (i) *prior knowledge* and (j) information found in other sources (*cross-textual* justifications). In cases where participants were not able to fully articulate their justifications for source selection, these were coded as (k) *random* selection. Examples and descriptions of each justification subcategory are provided in Table 2. Justification categories, collapsed for further investigation, are presented in Appendix C.

Response coding. In the case of the discrete question, *In the United States, what is the replacement fertility rate*, participants' responses were scored as correct or incorrect, based on the value presented in the documents.

In the case of the open-ended question, *How is government supported childcare important as a factor in high fertility rates*, responses were coded in four ways. First, participants' word count in response to the open-ended question was totaled. Next, the number of unique arguments participants provided in their response was coded. Arguments referred to the number of unique claims or reasons participants cited in their responses. These varied in terms of the amount and quantity of evidence and explanation provided; however, each argument introduced a unique perspective on the issue. Then, the number of citations that undergraduate students provided in their responses was totaled. Citations included participants either citing the author of a source (e.g., Newbold), or the source type (e.g., journal article or research study), or using a direct quotation or paraphrase from a source. It should be noted that undergraduates were not explicitly instructed to cite sources in their response but rather to answer as they would for an academic class. Thus, we were somewhat liberal in coding the presence of citations or undergraduates' direct referencing of sources. While the number of arguments participants provided served as a measure of the variety of evidence undergraduate students offered in this study, the number of citations they included was seen as an indicator of the quality or warrants for said evidence. While the number of *arguments* participants provided was intended to be a measure of the volume and variety of evidence offered, the number of *citations* sought to capture the quality or warrants for said evidence.

Results and Discussion

Search Overview

In responding to the discrete question (i.e., *In the United States, what is the replacement fertility rate?*), 67.7% of the 31 participants ($n=21$) answered correctly. In responding to this question, undergraduates consulted an average

Table 2. Nonepistemic Justifications for Source Selection.

	Percent (N)	Description	Example
Relevance	6.97 (n = 47)	Justifications based on the potential pertinence or relevance of a source and its potential utility in responding to the task	Relevant: "To make sure they were relevant to what the question was asking." Useful: "Thought maybe it would be a useful source"
Order	5.64 (n = 38)	Justification based on source location in the source library	"I think because it was the first, at the very top of the list" "Well first I did the first source because it was the first source"
Surface source indicators	21.07 (n = 142)	Justifications based on superficial source features, such as title, source description, or keywords	Title: "From the title" Description: "I mean not all of them [texts] have a very big description." Keywords: "Something that deal with <i>government</i> and <i>fertility rates</i> "
Accessibility	8.61 (n = 58)	Justifications for selection based on perceived length, reading ease, clarity of organization, or source formatting	Length: "I expected it to be a lot more lengthy than it was" Ease of use: "It was easy [to use]" Time: "It was fast [to use]" Effort reduction: "Rather than having to search through all of the articles"; "I was just looking for something that had one line"
Habit based	1.63 (n = 11)	Justifications for source selection based on participants' prior familiarity with a source or its use as a default	Default: "It's just a standard like go-to website" Familiar: "Just because I'm used to like the format"

(continued)

Table 2. Continued

Content	Percent (N)	Description	Example
Content	24.63 (n = 166)	Justifications based on the specific content or information participants wanted to find in a source	“For this one, I think I just wanted to see an example.” “Just to look at the definition”
Information need	5.19 (n = 35)	Justifications based on a curiosity or desire for a specific piece of information	Information need: “Because I wanted to find out more” Understanding: “Just give me a basic understanding”
Response driven	7.27 (n = 49)	Justifications based on participants’ understandings of question demands or a desire to find, “the answer.”	Question: “It was just a short question” The Answer: “I assumed it would have the answer” Information use: “I expected to get enough information to like imply what I was going to say”
Prior knowledge (Nonepistemic)	3.56 (n = 24)	Justifications for source selection based on prior knowledge	“I’m a public health major and I study high fertility versus infertility” “Well I asked myself what is high fertility rate and then I wasn’t very sure”
Cross-textuality	3.41 (n = 23)	Justifications based on students’ experiences or considerations of other texts or superficial similarity of two sources	Prior experience: “Because I remember in the intro it talked about it compared... so I remembered it talked about that” “Because I remembered it had graphs” Similarity: “That looked very much like the other one” Exclusion: “I knew the other sources I had

(continued)

Table 2. Continued

	Percent (N)	Description	Example
Random justification	8.90 (n = 60)	Participants' claims to have selected a source randomly or without knowing why	<p>already done, . . . so that doesn't leave me as much left"</p> <p>Randomly: "I think this, I just picked randomly"</p> <p>"Yeah, I was just hoping"</p> <p>"I did that without looking at it."</p> <p>I Don't Know: "I don't know"</p> <p>"I went to the French one because I was interested in that."</p>
Other	3.12 (n = 21)		

Note. Percentages and counts based on total number of nonepistemic justifications.

of 2.55 sources ($SD=1.73$), ranging from zero to six of the eight sources accessed. The most popular source for this question was the Wikipedia article for *Fertility Rate*, accessed at least once by 61.29% of the participants ($n=19$), followed by the first article in the source library, the conservative blog, *The Global Politician*, accessed at least once by 41.94% of the sample ($n=13$).

In responding to the open-ended question (i.e., What is the role of government supported childcare in high fertility rates?), participants' responses ranged from seven to 335 words, with a mean word count of 71.65 ($SD=63.31$). Participants provided zero to eight unique pieces of evidence in their responses ($M=3.13$, $SD=1.89$). In terms of the number of citations included in participants' responses, these ranged from zero to five explicit references to sources in their responses, with a mean number of 0.55 citations ($SD=1.06$). In responding to the open-ended question, the most popular source was the *Global Politician* blog accessed at least once by 51.61% of participants ($n=16$), followed by the book chapter from *Beyond Six Billion*, which was used by 45.16% of participants ($n=14$). Undergraduates used on average 2.32 sources ($SD=1.85$) in responding to the open-ended question, ranging from accessing no sources to accessing all eight.

Justification Overview

Overall, undergraduates provided an average of 13.03 ($SD=9.86$) justifications per interview, ranging from 0 to 59 reasons for the sources selected. There was a significant positive correlation between the total number of sources used and the number of justifications for selection provided when participants responded to the open-ended question, $r = .48$, $n = 31$, $p < .01$. However, there was no significant correlation between number of sources accessed and justifications provided when undergraduate students responded to the discrete question, $r = .04$, $n = 31$, $p = .85$.

The relation between the number of sources accessed and the number of justifications provided may reflect the fact that participants were asked, *what made you choose that source*, in reference to each of the sources they accessed, allowing them more opportunities to offer justifications for source selection. We created *justification ratio scores* to capture the number of justifications undergraduate students offered in relation to the number of opportunities they had to justify their selections. Specifically, justification ratio scores were computed by taking the ratio of the number of justifications offered to the number of sources used. For example, if, in responding to the discrete question, a participant accessed three sources and offered a total of five justifications for doing so, their ratio score would be 5/3, or 1.67, indicating that the participant made an average of 1.67 justifications per source. A participant who offered the same five justifications having consulted only two sources would have a corresponding

Table 3. Justifications Ratio Scores of Justifications per Source.

Question type	Epistemic			Nonepistemic		
	<i>M</i> (<i>SD</i>)	Min.	Max.	<i>M</i> (<i>SD</i>)	Min.	Max.
Discrete	1.22** (2.35)	0.00	8.00	4.48** (4.98)	0.00	25.00
Open-ended	0.77** (1.00)	0.00	3.00	6.24** (6.07)	0.00	24.00
Total	1.61** (2.90)	0.00	11.00	5.60** (4.63)	0.67	18.50

Note. Differences in the ratio of epistemic versus nonepistemic judgments per source indicated with asterisk.

** $p < .01$.

ratio score of 5/2 or 2.5 justifications per source. The justification ratio scores indicating how many justifications undergraduate students offered per source accessed are summarized in Table 3.

All subsequent analyses were run using both the total number of justifications undergraduate students offered and the computed justification ratio scores. However, the findings were the same regardless of which score was used. Therefore, we elected to report the analyses based on the total number of justifications offered, to allow for greater ease of interpretation.

A repeated-measure ANOVAs with question type (i.e., discrete vs. open-ended) as the within-subject factor determined that undergraduates offered significantly more nonepistemic justifications for source selection than epistemic justifications (21.74 vs. 4.32 justifications per interview, respectively), $F(1, 30) = 57.83$, $p < .001$. However, the repeated-measure ANOVA found no significant differences in the amount of justifications undergraduates offered in responding to the discrete versus open-ended questions, reporting 11.97 ($SD = 7.88$) justifications on average for the discrete question, and 14.10 ($SD = 11.55$) justifications on average for the open-ended question, $F(1, 30) = 0.88$, $p = .36$. For both repeated-measure ANOVAs, the sphericity assumption was violated and the Huynh–Feldt degrees of freedom correction was applied.

Justifications Across Question Type

A series of one-way repeated-measure ANOVAs were run to determine if there were differences in the types of justifications (epistemic vs. nonepistemic) undergraduate students offered in responding to the discrete versus open-ended question. Table 4 provides a summary of the total epistemic and nonepistemic justifications offered for source selection by question type. In the case of both the discrete and the open-ended questions, undergraduate students offered significantly more nonepistemic than epistemic justifications. In the case of the

Table 4. Justifications Subcategories by Question Type.

Justifications	Question type					
	Discrete question		Open-ended question		Total	
	N	%	N	%	N	%
Total	371	45.92	437	54.08	808	100
Epistemic	79	9.78	55	6.81	134	16.58
Reliability	14	1.73	9	1.11	23	2.85
Information accuracy	9	1.11	7	0.87	16	1.98
Evidence quality	5	0.62	2	0.25	7	0.87
Source type	17	2.10	18	2.23	35	0.62
Author	9	1.11	5	0.62	14	1.73
Personal or popular justification	8	0.99	2	0.25	10	1.24
Corroboration	10	1.24	5	0.62	15	1.86
Nature of knowledge	6	0.74	6	0.74	12	1.49
Other	1	0.12	1	0.12	2	0.25
Nonepistemic	292	36.14	382	47.28	674	83.42
Relevance	19	2.35	28	3.47	47	5.82
Order	13	1.61	25	3.09	38	4.70
Surface source indicators	49	6.06	93	11.51	142	17.57
Accessibility	28	3.47	30	3.71	58	7.18
Habit based	9	1.11	2	0.25	11	1.36
Content	67	8.29	99	12.25	166	20.54
Information need	20	2.48	15	1.86	35	4.33
Response driven	29	3.59	20	2.48	49	6.06
Prior knowledge	1	0.12	23	2.85	24	2.97
Cross-textual	13	1.61	10	1.24	23	2.85
Random justification	32	3.96	28	3.47	60	7.43
Other	12	1.49	9	1.11	21	2.60

Note. The justifications listed are based on the total number of justifications. Chi-square tests of association could not be conducted due to limited category membership.

discrete question, participants offered on average 9.42 ($SD = 6.34$) nonepistemic justifications, significantly more than the 2.55 ($SD = 3.46$) epistemic justifications they reported, $F(1, 30) = 33.63, p < .001$. For the open-ended question, participants again offered significantly more nonepistemic judgments ($M = 12.32, SD = 9.96$) than epistemic justifications ($M = 1.77, SD = 2.64$) for source selection, $F(1, 30) = 43.60, p < .001$. Again Huynh-Feldt adjusted

degrees of freedom were used to correct for the violation of the sphericity assumption.

In their source selection, undergraduate students appeared to draw few distinctions between the two question types in terms of the judgments they provided for source selection. Specifically, no significant differences were found in the amount of epistemic justifications undergraduate students offered in selecting sources in response to the discrete versus open-ended question, $F(1, 30) = 0.96$, $p = .34$, nor in the amount of nonepistemic justifications participants reported in responding to the two different question types, $F(1, 30) = 2.58$, $p = .12$ as determined by a one-way repeated-measures ANOVA with a Huynh–Feldt degrees of freedom adjustment.

Categories of Justification by Question Type

While undergraduate students offered epistemic and nonepistemic justifications for source selection in similar quantities for each of the questions, differences at the subcategory level did emerge. The purpose of this exploratory work was to fully capture dimensions of undergraduate students' judgments for source selection; thus, all meaningful justifications reported were coded, and even those subcategories that were relatively unpopulated were retained. Nonparametric analyses using the Wilcoxon signed-ranks test for two related groups on an ordinal measure were run to compare undergraduates' categorical reporting of various types of source selection justifications when responding to discrete versus open-ended questions. However, these were all nonsignificant ($Z_s = -1.28 - 0.00$, $p = .20-1.00$). These analyses were possibly nonsignificant due to the qualitative and categorical nature of these data, the accompanying limited sample size, and the relatively few number of justifications undergraduate students reported. These factors limited category size for each type of justification. However, trends in the data will be discussed.

Epistemic justifications. The following percentages are based on the total number of epistemic justifications participants provided in response to each question separately. In the case of both the discrete and open-ended question, the most popular reason cited for selection was source type (discrete: 21.52%, $n = 17$; open-ended: 32.73%, $n = 18$). However, participants provided justifications based on source type more frequently when responding to the open-ended rather than discrete question. In the case of both the discrete and open-ended question, the second most common reason for source access provided was source reliability. These justifications, based on general assessments of source reputation or trustworthiness, constituted 17.72% ($n = 14$) of justifications offered in response to the discrete question and 16.36% ($n = 9$) of justifications offered in response to the open-ended question.

Source access based on personal or popular justifications, or justifications for selection external to properties of the text, was cited more commonly in response to the discrete (10.13%, $n=8$) rather than the open-ended question (3.64%, $n=2$). Justifications for source selection based on a desire for corroboration or validation were similarly reported more often in response to the discrete (12.66%, $n=10$) rather than the open-ended question (9.09%, $n=5$). Conversely, in response to the open-ended question, participants more frequently justified source selection based on the quality of knowledge they expected to find (open: 10.91%, $n=6$; discrete: 7.59%, $n=6$), justifying selection based on a desire for quick or easy information.

Nonepistemic justifications. The following percentages are based on the total number of nonepistemic justifications reported while responding to each question separately. In the case of both the discrete and open-ended question, the most common reason cited for source selection had to do with the expected content of the source (discrete: 22.95%, $n=67$; open-ended: 25.92%, $n=99$). Further, participants commonly cited surface source indicators, or superficial features of the ways sources were presented in the digital library, such as titles or keywords, as justifications for source selection. Participants cited surface source indicators as justifications for selection more commonly in response to the open-ended (24.35%, $n=93$) rather than discrete question (16.78%, $n=49$).

Participants also justified source selection based on having any relevant prior knowledge, regardless of accuracy, more frequently when responding to the open-ended (6.02%, $n=23$) rather than discrete question (0.34%, $n=1$). At the same time, participants more often reported source selection driven by perceived information need or desire for understanding when responding to the discrete (6.85%, $n=20$) rather than open-ended question (3.93%, $n=15$). Similarly, source selection justifications coded into the response-driven category, or justifications for selection based on the perceived demands of the question or a desire to locate a precise response directly in text, occurred more frequently in response to the discrete (9.93%, $n=29$) rather than open-ended question (5.24%, $n=15$). Participants, at times, had trouble articulating their justifications for source selection, reporting selecting source randomly or that they “don’t know” why they accessed a particular source. Such justifications occurred more often as participants responded to the discrete (10.96%, $n=32$) rather than open-ended question (7.33%, $n=28$).

One important difference in undergraduate students’ approaches to answering the discrete versus open-ended question was evidenced in the types of justifications they offered when interviewed about their decision-making process. Specifically, when responding to the discrete question, participants seemed to select sources based on a desire to find an exact correct answer. This was reflected in the relative frequency of response-driven justifications reported. However, when responding to the open-ended question, participants seemed

to view the question as one asking for an opinion, holding all responses equally valid, rather than requiring the reconciliation of multiple potentially relevant responses to formulate the best one. This approach to the open-ended question was reflected in the relative frequency with which participants reported relying on surface source indicators and their prior knowledge in selecting sources. Both of these justification types were focused on superficial relevance, rather than on the potential quality or substance of information in a source. As one representative undergraduate reported when justifying her limited source use for the open-ended question, *Because this is a question that doesn't necessarily ask you to define something, I think it's more of an opinion question.*

Justifications and Response Metrics

We were interested in the relation between the types of justifications participants offered for source selection and their response metrics. Specifically, we examined the extent to which reporting source selection based on epistemic and nonepistemic reasons was related to providing the correct answer, in the case of the discrete question, and providing a quality answer, in the case of the open-ended question.

Discrete question. In examining the relation between the number of epistemic and nonepistemic justifications offered for source selection and response correctness, we ran two independent sample *t* tests. There were no significant difference in the number of epistemic justifications for source selection provided between undergraduate students who answered the discrete question correctly ($M=1.81$, $SD=2.06$) and those who answered incorrectly ($M=4.10$, $SD=5.15$), $t(10.40)=1.36$, $p=.20$. There were also no significant difference in the number of nonepistemic justifications for source selection provided between undergraduates who answered the discrete question correctly ($M=10.33$, $SD=6.64$) or incorrectly ($M=7.50$, $SD=5.64$), $t(29)=-1.16$, $p=.26$.

Open-ended question. In examining the relation between the number of epistemic and nonepistemic justifications for source selection that participants provided and open-ended response metrics, a series of correlation analyses were conducted. The total number of epistemic justifications for source selection participants provided was significantly correlated with the word count included in participants' open-ended responses, $r=.52$, $n=31$, $p<.01$. Further, the number of epistemic justifications provided while answering the open-ended question was also significantly correlated with the number of arguments participants included in their response, $r=.41$, $n=31$, $p<.05$, and the number of citations participants included, $r=.47$, $n=31$, $p<.01$. The total number of nonepistemic justifications for source selection that participants provided in response to the open-ended question were not correlated with any open-ended

Table 5. Correlations Among Performance Measures and Justifications for Source Selection for the Open-Ended Question.

	Word count	Number of arguments	Citations	Total epistemic justifications	Total nonepistemic justifications
Word count	1				
Number of arguments	0.85***	1			
Citations	0.40*	0.25	1		
Total epistemic justifications	0.52**	0.41*	0.47**	1	
Total nonepistemic justifications	0.22	0.20	0.08	0.52**	1

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

response metrics; word count: $r = .22, n = 31, p = .23$; arguments: $r = .20, n = 31, p = .29$; or citations: $r = .08, n = 31, p = .67$. The correlations between all outcome measures (i.e., word count, number of arguments provided, and citations included) as well as the total number of epistemic and nonepistemic justifications for source selections undergraduates generated are included in Table 5.

Conclusion and Implications

Rouet (2006) suggests that multiple source use is a particularly cognitively demanding task for students. Likewise, Bråten (2008) describes the challenges associated with using multiple sources in responding to varying task goals as presenting a *complex* problem for learners. Given the complexity associated with multiple source use tasks, the present study sought to examine a specific aspect of the multiple source use process, specifically, participants' justifications or reasoning for source selection. Four overarching conclusions may be drawn from this study: (a) participants produced a large number and variety of justifications for source selection; (b) justifications were most commonly nonepistemic, rather than epistemic, in nature; (c) justifications seemed to vary by question type only to a limited extent; and (d) epistemic justifications for source selection related to the quality of participants' responses to the open-ended question.

In light of previous research that has indicated that students tend to provide relatively few spontaneous justifications for source selection (Kuiper et al., 2008; Walraven et al., 2009) when prompted, participants in the present study provided a number of justifications for the discrete and open-ended question, suggesting that students' source access was reasoned and deliberative. Undergraduate students often offered both epistemic and nonepistemic

justifications for accessing the same source and weighed competing factors to determine whether to select a source. Typically, when undergraduates considered both epistemic and nonepistemic factors when justifying their source selections, these predominantly resulted in selecting sources that would most efficiently and easily provide them with information to answer the question.

Indeed, participants justified source accessed much more frequently based on nonepistemic, rather than epistemic reasons. In the case of both the discrete and open-ended question, participants most often reported choosing sources based on relevancy and superficial source features. These judgments, however, did not consider the relative merit, quality, or reliability of the information in a source, simply its relevance. Such justifications may have served to reduce the difficulty of the multiple source use task, selecting sources based on these superficial qualities served to easily and quickly reduce the amount of sources and information necessary to consider.

Given the sheer number of nonepistemic justifications as compared with epistemic judgments undergraduate students reported for source selection, this study contributes to earlier work examining students' reasons for source selection by indicating the need to consider the diverse nature of students' reasons for source selection. Beyond sourcing indicators, such as author and publisher, which undergraduate students reported relatively infrequently (e.g., Bråten, Strømsø, & Samuelstuen, 2008), undergraduates accessed sources for reasons not fully considered in previous research. For example, accessing a source because it was familiar or as a default was a compelling basis for source selection. Within this task, choosing a source for reasons of familiarity may have served an additional function, as participants were able to simplify or routinize the task by capitalize on their experience with a source.

In addition, undergraduates selected sources they thought might be easy to use, read, or understand. Choosing sources for reasons such as these evidence students' concerns for task difficulty. A few participants also reported selecting sources they thought would be useful. The utility judgment was determined to be nonepistemic in nature, but there is a need to investigate further what factors different undergraduate students determined to be useful and what source-related characteristics merited this designation. Of note were the reported dimensions of source evaluation that were independent of the text, including personal or popular justification as an epistemic reason for source selection and prior knowledge as a nonepistemic reason for source selection. These categories serve to emphasize the importance of considering participants' prior knowledge, beliefs, and experiences in understanding undergraduate students' multiple source use.

In general, undergraduate students expressed epistemic justifications were consistent with many of the dimensions of epistemic beliefs established in the literature. However, undergraduates appeared to have epistemic conceptions of not only knowledge, but information as well (i.e., wanting readily available and

quickly accessible information). The notion of quick knowledge is a belief dimension well established in the literature (Greene et al., 2008; Hofer & Pintrich, 1997; Schommer-Aikins, 2004). Yet, rather than being concerned with the nature of knowledge, some participants were concerned with the nature of information a source provided. Previous research has pointed out the need to consider not only the knowledge-related beliefs of students growing up in the Internet age but also their beliefs about information and truth (Alexander, Winters, Loughlin, & Grossnickle, 2012; Lankshear, 2003).

Researchers have suggested that in the Internet age, undergraduates may conflate information with more traditional epistemic concepts of knowledge and truth. This conflation may be associated with or due to the nature of sources on the Internet and online search tasks commonly assigned to students. In particular, information on the Internet is less connected and coherent and may represent a much greater variety of viewpoints and evidentiary quality than information presented in textbooks or by teachers (Barzilai & Zohar, 2012; Dede, 2008). The difficulty of integrating information on the Internet to construct knowledge, as compared with constructing knowledge from textbooks or teacher accounts that may be more ready-formed, may result in students treating information on the Internet directly as knowledge. Barzilai and Zohar (2012) argue that students default to assuming all information on the Internet is true and engage in source evaluation only after explicit instruction. As such, the conceptions of information put forward by undergraduate students through their justifications for source selection should be considered, in future work, in reference to their beliefs about knowledge and truth.

Just as important as considering the dimensions of selection justifications participants reported is considering those dimensions that participants did not offer. Interest, as a motivational or intrinsic justification for source selection, was only reported on two occasions and as such was coded into the *other* category. Perhaps interest was not expressed as a justification because the search task occurred in a constrained lab environment. Nonetheless, interest is known to be a potential key factor in students' text engagement and performance (e.g., Schiefele, 1999). Moreover, only one participant in this investigation justified source selection on the basis of recency, a criterion for source evaluation discussed within the literature (Bråten, Strømsø, & Salmerón, 2011; Gerjets et al., 2011). This may be because the two questions in this task were not perceived as time sensitive. Alternatively, it may be the case that students assume all results generated through Internet search to be recent (Metzger, 2007).

An important aspect of justifications for selection to consider is the extent to which justifications may or may not function independently of one another. For example, in a study by Bråten et al. (2009), the researchers asked participants to evaluate the trustworthiness of sources, and then to justify their trustworthiness ratings based on source features such as author and source type. In the present study, trustworthiness, coded as reliability-based justifications, author, and

source type were all coded as separate dimensions along which participants could have justified source selection. The extent to which these dimensions are independent or co-occurring continues to be a question for further investigation.

In this study, participants provided similar justifications for source selection, regardless of question type. Undergraduates did not differentiate their source selection procedure for the two different questions, as we would have expected based on theoretical models of multiple source use (Brand-Gruwel et al., 2009; Rouet, 2006). More often, sensitivity to question type led undergraduates to make decisions about the kind of response needed, but not about how to select sources. Participants did recognize that the two question types, discrete versus open-ended, required both different types of answers and different kinds of sources to substantiate responses. However, considerations of differences in the responses the two different questions demanded did not transfer to citing different justifications for source selection, evidencing limited competency in adjusting source use behavior to the needs of task and context (List & Alexander, 2015).

The extent to which this was a task requiring participants to truly consider multiple sources remains a question. Although most undergraduate students did access more than one source, they nonetheless seemed to formulate answers only based on a single source. As can be seen from several of the justifications, undergraduates accessed sources in an effort to locate an answer and consulted multiple sources when they were initially dissatisfied with the information in a source. As indicated by the relative paucity of justifications belonging to the cross-textual category, participants rarely carried over information about sources across questions and often did not consider texts in reference to one another. Rather, participants' source selection, even within a multiple source use context, seemed to focus on each source independently. Even though most undergraduate students selected multiple sources, the number of justifications in the response-driven category suggested that many were focused on finding "the answer" and were accessing multiple sources not to integrate information from these texts but to arrive at a precise and readily available response. Important to consider further are participants whose justifications fit into the corroboration category. These participants reported conferring between sources or selecting sources to substantiate or extend information from another source.

Participants' epistemic justifications seemed to have the most bearing on open-ended response metrics when considering a number of indicators (i.e., word count, number of arguments, and number of citations). This finding is consistent with prior work emphasizing the important role students' epistemic beliefs play in multiple-source use task completion (e.g., Strømsø et al., 2008). Despite their frequency of occurrence, neither the number of nonepistemic justifications nor the total number of justifications reported were related to open-ended response metrics, suggesting that reasoning along epistemic dimensions

relates to undergraduate students' process (i.e., source selection) and product (i.e., response metrics) when engaging in multiple source use tasks. It may be argued that the relation between undergraduates' epistemic justifications and word count may in part be explained by greater verbal fluency leading to learners producing both more evaluative statements and more extensive responses. However, we did not believe this to be the case as there was no comparable relation found between participants' nonepistemic justifications for source selection and word count, suggesting that the production of epistemic justifications had an idiosyncratic contribution to response formulation.

The relation between the number of epistemic justifications for source selection and response metrics manifested only in the case of the open-ended question. As the open-ended task required a more elaborated response, including information from a variety of sources, participants' selection of sources along epistemic dimensions may have had a greater impact on response metrics, in this case. It may also be that our undergraduate sample included students habituated to locating specific isolated pieces of information online, as required by the discrete question, and who did so successfully regardless of the dimensions along which they were selecting sources.

Limitations

With these conclusions in mind, it is important to note several limitations. First, the limited sample size reduced the robustness of effects that could be identified and presented challenges to the generalizability of findings. While the sample was sufficient to identify large effects (Cohen, 1977), the rate of type II error may be increased.

Second, the online and closed hyperlinked interface, which provided flexibility in navigation between provided sources, limited participants' access beyond the study interface. Some participants noted that if they had been able to complete the study at home, they would have preferred to use a search engine or library database to begin their search. To mitigate this limitation, the interface was designed to simulate selecting sources from a search engine results page. Delimiting participants' source options to a digital library was necessary to standardize the range and types of sources participants could access.

Third, conducting the study in a lab setting with a researcher present may have impacted undergraduates' performance on the search task. Some participants may have felt uncomfortable during the observation or interview part of the study or may have felt time pressure to complete the study. Alternately, for some participants, performance may have improved because they were being

observed. However, the presence of a researcher brought several benefits. For instance, possible issues associated with computer error were somewhat mitigated, and behavioral records allowed for participants to be retrospectively guided through their search task.

Even though undergraduates were asked about their interest in the task, motivational variables were not fully examined in this study. Participants reported a range of interest levels. Further, there were likely individual differences in the extent to which participants' interest, or lack thereof, impacted task performance. Given that our sample was composed of human development undergraduates, we thought it reasonable to expect engagement with the task, given its relevancy to students' course work. Nonetheless, future research should more specifically consider the association between task topic and undergraduates' majors as well as examining differences in task performance across majors.

Although no order effects were found in the number of epistemic and nonepistemic justifications participants generated in responding to discrete and open-ended questions, there is a need to further examine possible order effects. Particularly, in responding to the open-ended question, all of those participants who elected not to access any sources received the open-ended question second. Undergraduates reported not selecting sources because they knew what information was available, having examined sources in responding to the discrete question, which they were presented with first. However, through the retrospective interview, participants were afforded the opportunity to explicate their search process. Because the primary analyses in this study concerned not the number of sources accessed, but rather the type of justifications participants provided, both conditions were examined together.

Source selection is only the first step in students' interactions with multiple sources (Rouet, 2006). While this study provided an understanding of the variety of undergraduate students' epistemic and nonepistemic justifications for source selection, the next step is to move beyond justifications for selection, to examine students' source navigation, use, and evaluation of content. How justifications may be similar or different when participants are given the opportunity to find the sources themselves rather than being provided with a library of sources is not yet well understood. Further, as was reported by several of the participants, undergraduates' justifications for source selection may vary depending on their relative experience and interest in a field. In addition, work should not only manipulate the type of question undergraduate students are responding to but also vary the domain of the question, and more consistently measure variables related to participant interest and motivation.

Appendix A. Screen Shot of Search Task

Screen shot of search task



Appendix B. Retrospective Interview Questions

After completion of the search task, students will be asked to reflect on the processes they used to respond to each question. The following questions sequenced participants through each of the websites they accessed, first for Question 1, then for Question 2. Questions about sources were followed in the order of log-file data.

Question 1

Source use

- a. Why did you choose X source to answer this question?
- b. What were you expecting from Source X?
- c. What did you do when Source X loaded?
- d. What did you think of Source X/Did Source X meet your expectations?
- e. How did you know to stop using this source?
- f. Why did you choose Source Y next?
- g. Why did you decide to use only a single source or X sources to answer Q1?
- h. Why did you elect not to use any additional sources to answer Q1?

Question answer

- a. Why did you begin writing your answer before, after, or during this source?
- b. How did you know you were done answering Q1?
- c. Were you able to find what you needed to answer Q1?
- d. How confident were you with your response to Q1?

Overview

- a. How was the process you used to find information in Q1 or Q2 similar or different to the process you usually use to find information on the Internet?
- b. How was the process you used to find information for Q1 similar or different to the process you used to find information for Q2?

Protocol repeated for Question 2.

Concluding questions:

- a. What was your experience of search task overall?
- b. Did you find this task interesting or not so interesting?
- c. Did you find this task easy or difficult?
- d. Are there any additional comments you would like to make at this time?

Appendix C. Collapsed Subcategory Analysis.

Given the number of justification subcategories identified, some subcategories were collapsed to further examine the frequency with which different types of justifications were invoked across discrete and open-ended questions. These collapsed justification subcategories are summarized in Tables 6 and 7.

Table 6. Collapsed Epistemic Justification Subcategories.

Collapsed subcategory	Comprehensive subcategories included	Explanation	Total
Source-level factors	<ul style="list-style-type: none"> ● Source reliability ● Author ● Source type 	Justifications for source selection considering aspects of the source, as a whole	54.55% (n = 72)

(continued)

Table 6. Continued

Collapsed subcategory	Comprehensive subcategories included	Explanation	Total
Content factors	<ul style="list-style-type: none"> • Information accuracy • Quality of evidence • Nature of knowledge 	Justifications for source selection based on the content in a source	26.51% (n = 35)
Corroboration	<ul style="list-style-type: none"> • Corroboration 	Justifications concerned with verifying information	11.36% (n = 15)
Source reputation	<ul style="list-style-type: none"> • Personal or popular justification 	Justifications for source selection based on perceptions of the source	7.58% (n = 10)

Note. For each collapsed subcategory, paired-sample *t* tests found no significant differences in the frequency of epistemic justifications produced across question types (source level: $p = .62$, content: $p = .49$, corroboration: $p = .34$, personal justifications: $p = .18$).

Table 7. Collapsed Nonepistemic Justification Subcategories.

Collapsed subcategory	Comprehensive subcategories included	Explanation	Total
Relevance	<ul style="list-style-type: none"> • Relevance 	Justifications for source selection based on perceived source correspondence to task demands	6.97% (n = 47)
Surface factors	<ul style="list-style-type: none"> • Surface source indicators • Order 	Justifications for source selection based on superficial source features, like title or order of presentation	26.71% (n = 180)
Ease of use	<ul style="list-style-type: none"> • Accessibility • Habit based 	Justifications based on user-friendliness of the source, either based on formatting or students' prior familiarity with the source	10.24% (n = 79)

(continued)

Table 7. Continued

Collapsed subcategory	Comprehensive subcategories included	Explanation	Total
Information driven	<ul style="list-style-type: none"> ● Content ● Information need ● Response driven 	Justifications based on a desire to locate specific information or “the answer” in a source	37.09% (n = 250)
Cross-referencing	<ul style="list-style-type: none"> ● Prior knowledge ● Cross-textuality 	Justifications for source selection based on prior knowledge or students’ experiences with prior texts	6.97% (n = 47)
Random	<ul style="list-style-type: none"> ● Random 	Justifications based on students reporting to select a source “at random”	8.90% (n = 60)

Note. For each collapsed subcategory, paired-sample t tests found no significant differences in the frequency of nonepistemic justifications produced across question types (relevance: $p = .39$, ease of use: $p = .74$, information driven: $p = .51$, cross-referencing: $p = .19$, random: $p = .78$). However, there was a significant difference in the number of surface source-based justifications generated, $t(30) = 2.59$, $p < .05$. Specifically, significantly more surface-based indicators were generated in response to the open-ended ($M = 3.81$, $SD = 3.36$) rather than the discrete question ($M = 2.00$, $SD = 2.61$).

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