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Text navigation in multiple source use

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ABSTRACT

Drawing on theories in evolutionary biology, research on hypertext navigation has posited two profiles to capture how students navigate information sources: the *satisficing* and *sampling* approaches of text access. While students engaged in sampling work to identify an optimal source to exploit for information, students who adopt a satisficing approach to text use spend time on accessing the first text they visit that meets some threshold of acceptability. This study examines the manifestation of these profiles when students navigate multiple, non-hyperlinked texts, without time limitations. Evidence was found for a satisficing, but not a sampling, approach to multiple text navigation. Four sub-profiles of satisficing approaches were identified. Students in the *limited* navigation profile devoted little time to text access. Students in the *primary* profile devoted the bulk of access time to a single text. Those in the *distributed* profile visited the texts they accessed for fairly uniform periods of time. Students in the *discriminating* profile visited certain texts for substantial periods of time, while accessing other texts to a more limited extent. These four navigation profiles were found to be differentially associated with other metrics of text access (e.g., whether texts were revisited), ratings of text usefulness, and task performance.

1. Introduction

Surveys of undergraduates have found over 70% of respondents to conduct academic research using Internet search engines (e.g., Google) rather than library catalogues (Lee, Paik, & Joo, 2012; Martin, 2008). Further, when conducting research for papers and projects, 65% of college students report using websites on the Internet, while only 16% report consulting academic journals and only 6% report using books (Martin, 2008). Such results are consistent with findings that, among college students, using non-textbook materials and selecting sources that are peer-reviewed rank much lower among priorities when writing research papers, than do using available sources that are easy to understand (Burton & Chadwick, 2000).

As undergraduates increasingly rely on non-traditional academic texts (Davis & Cohen, 2001; Thompson, 2003; Van Scoyoc & Cason, 2006), there is a need to understand how students select and make use of the multitudes of information sources available to them on the Internet to meet tasks demands and complete academic assignments. To this end, over a decade of research has focused on how student select sources during Internet search (Gerjets, Kammerer, & Werner, 2011; Kammerer & Gerjets, 2014; Le Bigot & Rouet, 2007; Wopereis & van Merriënboer, 2011) and distinguish among different document types (Bråten, Strømsø, & Britt, 2009; Bråten, Strømsø, & Salmerón, 2011; Rouet, Britt, Mason, & Perfetti, 1996). While much literature has examined how students engage with individual texts (e.g., recall document information, like author: Braasch, Rouet, Vibert, & Britt, 2012; judge text trustworthiness: Bråten et al., 2009), more work is needed to understand how students conceptualize texts in relation to other texts during multiple source use. This is particularly warranted as engaging with multiple texts, rather than a single source, necessarily demands that students simultaneously consider and relate multiple information sources to one another in completing tasks (Britt, Perfetti, Sandak, & Rouet, 1999; Goldman, 2004; Rouet, 2006).

The universe of texts available during task completion has been found to have an impact on students' views of particular sources. For instance, Rouet et al. (1996) found that, when completing a multiple text task in the domain of history, students presented with a library including primary sources differed in their rankings of document trustworthiness and justifications for trustworthiness

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rankings from students presented with a library of secondary sources only. However, work examining how students make use of texts relative to other texts has been limited. In particular, one area in need of further investigation is understanding how students *navigate* or sequentially access texts in a multiple text context (Payne & Reader, 2006; Reader & Payne, 2007). Specifically, there is a need to understand how students' multiple text navigation, or patterns of text access and time allocation, may be associated with their judgments or evaluations of texts accessed and task performance.

The purpose of the present study is three-fold. First, we examine students' navigation in a multiple text context to determine patterns of information access and time allocation. Second, we investigate how students' pattern of navigation may be associated with their judgments of texts' *usefulness* in meeting task demands. Third, we consider how navigation patterns may be associated with other metrics of text access and with task performance.

1.1. Source navigation

Research on students' navigation has primarily focused on *hypertext* systems, where sets of texts or text segments are explicitly linked to one another, in either a lateral or hierarchical fashion (Amadieu & Salmerón, 2014; Potelle & Rouet, 2003; Rouet, Vörös, & Pléh, 2012; Salmerón, Cerdán, & Naumann, 2015; Vörös, Rouet, & Pléh, 2012). Investigations of students' source navigation in non-hyperlinked, multiple text contexts have primarily focused on source selection and how the presentation of search results (i.e., text arrangement in a digital library) may increase students' selection of more trustworthy texts (Kammerer, 2011; Kammerer & Gerjets, 2010a; 2010b; 2012a; Le Bigot & Rouet, 2007; Stadtler, Scharrer, & Bromme, 2013). For instance, Kammerer and Gerjets (2012b) found a tabular, rather than list-like, interface to promote students' selection of objective websites and to reduce their accessing of commercial sources. However, more work is needed to examine not only students' preferences when selecting texts from a library but also how patterns of text access and navigation may manifest during task completion and may be associated with task performance.

1.2. Information foraging theory

Studies examining students' text navigation have been situated in *information foraging theory* (IFT, Pirolli, 2007; Pirolli & Card, 1995; 1999). Information foraging theory draws on evolutionary biology and anthropology to understand how learners, motivated to gather information, may do so most efficiently. At its core, this theory proposes that during information search, learners will select those strategies and engage in those behaviors that will provide them with the greatest access to desired information, while demanding the fewest resources, in terms of time and effort. In selecting sources, then, students are hypothesized to be focused on maximizing the amount of, "relevant information gained per unit time expended" (Pirolli & Card, 1995, p. 51).

Pirolli (2007) emphasizes that in foraging for information students are not perfectly knowledgeable about the relative merits of various sources in meeting task demands. Rather, learners select texts based on imperfect estimates of the (a) *value* of information a particular text may contain and (b) text *relevance* to a target task. Students make assumptions about the potential value and associated costs of accessing particular texts based on *information scent*. Information scent includes all of the available but indirect cues about the correspondence between information in text (i.e., information patches) and learners' needs (i.e., goals) that students may perceive (Card et al., 2001; Pirolli, 2007; Reader & Payne, 2007); this includes information like URLs or search result descriptions. Studies of information scent have found students to select sources based on (a) topographical or visual cues (i.e., source position, bolded key words), (b) semantic similarity at the word level (i.e., key word matches), or (c) deep semantic overlap, using link information to infer source content (Rouet, Ros, Goumi, Macedo-Rouet, & Dinet, 2011; Salmerón et al., 2017).

As decisions about text access are guided by information scent, when examining how students navigate texts, inferences may be drawn regarding students' expectations of the value of particular sources in meeting task demands. While Pirolli and Card (1999) define value primarily in terms of relevance, little is known about how students may preferentially select and engage texts based on other considerations, such as usefulness (Rouet, Favart, Britt, & Perfetti, 1997; Rouet et al., 1996).

1.3. Information foraging strategies

Drawing on IFT, Reader and Payne (2007) identify two distinct patterns of source navigation that emerge when students are asked to complete tasks requiring the use of multiple information sources: *sampling* and *satisficing*.

1.3.1. Sampling

A *sampling* approach to information use is characterized by learners briefly visiting all available library texts in an effort to identify and select the *best* information source, according to some criteria. The majority of information use time is, then, allocated to this best source, while remaining time is devoted to moving on to the next-best source or to re-sampling remaining texts, if information needs have changed. Navigation consistent with a sampling approach is characterized by initial rapid visits to all available texts and then the devotion of the bulk of study time to a specific text, considered to be the most preferred source.

A sampling navigation strategy is advantageous in that it allows for the selection of an *optimal* source. However, it also requires that some time, which could otherwise be devoted to information gathering (i.e., exploitation), be spent on sampling available texts (i.e., exploration). Further, the efficacy of this strategy is predicated on students being able to quickly and accurately determine which text, from those available, may be optimal.

1.3.2. Satisficing

When learners adopt a *satisficing* approach to text use, all text use time is devoted to learning about a particular topic, rather than about available texts. Unlike a sampling approach to text navigation, students engaged in satisficing devote time to texts they consider to be sufficiently valuable information sources, according to some criteria (i.e., those meeting a *threshold of acceptability*), but are not driven to identify an optimal source among those available. Therefore, navigation consistent with a satisficing strategy reflects ordered source access, with no revisits, and extended time spent on each text at first access.

When satisficing, texts that meet a particular threshold of acceptability are fully processed, with *linear reading* the result (Foltz, 1996). However, texts falling below the threshold of acceptability are more quickly processed before learners move on to the next available source. The rapid processing of texts falling below some threshold of acceptability results in *skimming* (i.e., rapid, selective processing of text information, Duggan & Payne, 2009; Reader & Payne, 2007). Advantages of satisficing are that it ensures that all study time is devoted to information gathering; however, such information may come from sub-optimal sources, nonetheless falling into an acceptable range.

Sampling and satisficing navigation strategies may be

distinguished from one another in at least three ways, with the former considered to be the more sophisticated approach to text navigation (Reader & Payne, 2007). First, a sampling approach to text navigation is associated with students having at least minimal contact with a larger number of texts than a satisficing approach supports. Indeed, while a satisficing approach has been described as one of information exploitation, a sampling approach may better reflect information exploration. Second, sampling may be the result of learners adopting higher standards for source quality vis-à-vis a satisficing approach, wherein students may be focused only on identifying sources meeting a minimal threshold of acceptability. Moreover, while a sampling approach may result in students comparing available sources to one another, within a satisficing approach, students only evaluate texts in relation to personally-determined standards. Third, a sampling approach requires that students make critical decisions about text access at the beginning of navigation while a satisficing approach forestalls this decision making process until later in navigation.

Empirically, satisficing has been found to be a much more commonly occurring strategy than has sampling; with limited evidence for a sampling strategy in use at all (Reader & Payne, 2007; Wilkinson, Reader, & Payne, 2012). Across two time conditions, Reader and Payne (2007) found 68% of students to be satisficers and an additional 20% to follow neither sampling nor satisficing browsing patterns. In a follow-up study, Wilkinson et al. (2012) found a similar distribution of navigation patterns (satisficers: 76.7%; neither pattern: 16.7%; sampling: 6.7%).

More generally, when examining participants' browsing behaviors across four texts varying in difficulty, Reader and Payne (2007) characterized source use as *exhaustive*, with students visiting all available texts, and *systematic*, with texts visited at least once before revisits occurred. Further, regardless of navigation profile, only approximately 50% of study time was devoted to students' use of their favorite or most preferred source. An order effect was additionally identified, with students reading texts accessed early in source use for longer periods of time than they did texts accessed later in navigation.

1.4. Navigation profiles

A limited number of additional navigation patterns have been proposed, the majority of these defined based on students' text use in hyperlinked systems. Generally, the patterns identified differentiate students as either accessing texts sequentially and systematically (*breadth-first searchers:* Jenkins, Corritore, & Wiedenbeck, 2003; *content focused:* Juvina & Van Oostendorp, 2006; *sequential studiers:* Macgregor, 1999) or as engaging in more deliberative source access to seek out specific information (*depth-first searchers:* Jenkins et al., 2003; *laborious navigation:* Juvina & Van Oostendorp, 2006; *concept connectors:* Macgregor, 1999). Macgregor (1999) distinguished these two types of profiles as adopting either a comprehensive mode of source use (i.e., sequential studiers) or displaying a more selective, flexible, and adaptive navigation pattern (i.e., concept connectors). The latter profile was associated with higher levels of prior knowledge as well as with higher performance (Macgregor, 1999).

Using cluster analysis, Lawless, Mills, and Brown (2002) confirmed three hypertext user profiles identified in prior research (e.g., Lawless & Kulikowich, 1996). These were *knowledge seekers*, who devoted the majority of study time to accessing content-related links, *feature explorers*, who spent the majority of time accessing specialty features embedded in the hyperlinked system (e.g., maps, images), and *apathetic users*, characterized by the limited time they devoted to accessing content and their seemingly disorganized or random text selection.

In addition to establishing navigation profiles according to manifest source access behaviors, profiles have been established according to user-factors (e.g., Kitajima & Toyota, 2012). In particular, students' navigation may be guided by their (a) prior task experience, (b) perceptions of source relevance, (c) prior knowledge, used to make predictive inferences regarding the information sources may contain, (d) motivation, and (e) self-regulation or monitoring of comprehension (Coiro & Dobler, 2007; Juvina & Van Oostendorp, 2006; Kitajima & Toyota, 2012; Salmerón, Naumann, García, & Fajardo, 2017). Nevertheless, additional work is needed to examine the navigation profiles that may manifest when students are asked complete tasks in more open, non-hypertext environments.

In this study, we examine students' decisions about text navigation and time allocation when texts are not explicitly linked to one another (i.e., non-hyperlinked) and when each source in the digital library provides distinct information relevant to the target topic. Such a library format stands as a contrast to hypertext systems, where texts are explicitly connected to one another both physically, in terms of hyperlinks, and through the content included. We further consider navigation when students have the freedom to access none, some, or all of the texts in a digital library and to spend as much time as they want on source access. By allowing students these degrees of freedom in navigation, it was hoped that the navigation profiles previously established in research on students' hypertext use (e.g., Reader & Payne, 2007; Salmerón et al., 2017) could be validated and that further patterns of text access in digital contexts could be developed. At the same time, consistent with earlier studies of hypertext navigation, we limited the number of sources students could access to six. This delimitation allowed us to both present students with a variety of sources and to analyze a manageable amount of data on navigation. Further, we examine navigation in response to an open-ended task, or one for which a broad range of different student responses may be considered to be comparably valid. This type of task stands as a contrast to discrete assignments asking students to locate specific information in text or a single correct answer. We thought that the open-ended nature of our chosen task would further supported students' freedom of navigation, as any of the sources available in the digital library could have been used by students in formulating a relevant and appropriate task response. Finally, while prior work has inferred students' motivation for source selection based on log data (e.g., apathetic users, Lawless et al., 2002), we directly assess how navigation profiles may be associated with students' perceptions of sources accessed. Specifically, after accessing each text, participants were asked to rate it according to a variety of dimensions, including *usefulness*. Here, students' navigation profiles, developed based on log data (e.g., duration of text access), are examined in relation to their usefulness ratings.

1.5. Usefulness

Text usefulness has commonly been associated with text *relevance*, defined as the extent to which text segments align with external task demands and with learners' internal task goals (McCrudden & Schraw, 2007; McCrudden, Magliano, & Schraw, 2010). Generally, texts that are highly relevant to a topic may also be considered to be highly useful to learners. However, these constructs may be distinguished from one another in at least two ways.

First, while text relevance may be a key evaluative dimension to examine when students are asked to respond to discrete tasks (i.e., those having a single, optimal answer), usefulness may be a more pertinent evaluative dimension to consider when students are responding to tasks that are open-ended (i.e., allowing for multiple

responses that are equally valid). Students' judgments of text relevance have commonly been examined at the sentence level, when learners have been asked to identify specific information in text (i.e., complete a discreet task, McCrudden & Schraw, 2007). In contrast, open-ended tasks are characterized by a large range of responses constituting potentially valid answers and, therefore, a greater universe of texts serving as relevant sources of information. As such, within the context of open-ended task completion, the construct of source usefulness, rather than relevance, may better capture the instrumental value of particular texts in supporting students' idiosyncratic response composition. In other words, when completing an open-ended task, students may be expected to rate a given text uniformly in terms of task relevance but variably in terms of usefulness, depending on the specific response they intend to compose.

Second, students likely base judgments of text usefulness on their existing knowledge and information needs, more so than they do ratings of text relevance. Rouet et al. (1997) examined graduate students' rankings of source usefulness. Students who were experts in the domain of history (i.e., history graduate students) ranked historians' essays as more useful sources in completing the task than did novices in the domain (i.e., psychology graduate students). Novices, as compared to experts, ranked the textbook as a more useful source; conversely, experts ranked participant accounts or primary sources as more useful than did novices. As demonstrated by Rouet et al. (1997) the construct of usefulness is learner-specific, such that texts that are more useful to high knowledge or expert learners, may be much less useful to novices. As such individual-level disparities in usefulness ratings may be expected to arise, even when texts are uniformly relevant to an assigned task.

Unlike relevance, which focuses on task-text correspondence, usefulness captures learner-specific factors (e.g., prior knowledge) and learner-defined task goals. While students' ratings and rankings of text usefulness have been extensively examined alongside trustworthiness ratings, as part of investigations of source evaluation (Baildon & Baildon, 2012; Braasch, Bråten, Strømsø, & Anmarkrud, 2014; Rouet et al., 1996, 1997; Wiley et al., 2009), more work is needed to connect students' perceptions of source usefulness to text navigation. In particular, Rouet et al. (1996) suggest that usefulness may be defined as students' *satisfaction* with the information provided in a given source, relative to perceived task demands. Given that students' evaluations of texts, relative to a threshold of acceptability, have been found to guide navigation (Reader & Payne, 2007), examining students' ratings of text usefulness (i.e., their subjective satisfaction with the information provided) in association with their decisions about text access may offer important insights.

1.6. Present study

In the present study, duration of text access was used to initially characterize students' patterns of navigation when completing a multiple text task. Established navigation profiles were then examined as associated with other metrics of text use (i.e., number of texts accessed, text revisits, and document information accessed), ratings of texts accessed (i.e., usefulness), and performance measures (i.e., response quality). We had the following research questions:

1. How can students' text navigation be characterized? What patterns emerge when examining students' time allocation across multiple texts?
2. What is the nature of the association between students' navigation patterns and metrics of text use (i.e., number of texts accessed, text revisits, document information access)?
3. What is the nature of the association between students' navigation patterns and ratings of texts accessed (i.e., usefulness ratings)?
4. What is the nature of the association between students' navigation patterns and performance on a multiple text task?

2. Methods

2.1. Participants

Participants were 197 undergraduate students at a large Mid-Atlantic University (age: $M = 20.47$; $SD = 2.08$). The sample was majority female (65.48%, $n = 129$; male: $n = 59$, 29.95%). Students reported a variety of racial and ethnic backgrounds. While 49.23% of students were White ($n = 97$), 19.29% were Asian ($n = 38$), 16.24% African American ($n = 32$), 3.55% Latino ($n = 7$), and 6.09% reported biracial or multiracial status ($n = 12$). Nine undergraduates declined to provide demographic information.

Undergraduate students were selected as the target sample for a number of reasons. For one, college-level work has been described as requiring 21st century literacy skills, like the ability to identify, navigate, and integrate information from multiple, varied texts (Britt & Aglinskas, 2002; Dunn, 2002; Gil, Bråten, Vidal-Abarca, & Strømsø, 2010; Goldman, 2004, 2012; Head & Eisenberg, 2010; Rouet, 2006; Segev-Miller, 2004). For another, college students have been described as at the developmental stage where they are capable of the complex cognitive processes required to navigate among, evaluate, and reconcile varied accounts of the same topic (Conley, 2008; Hofer, 2004; Hynd, Holschuh, & Hubbard, 2004; Mason & Scirica, 2006). At the same time, college students have been found to experience difficulties completing tasks requiring the use of multiple information sources (Britt & Aglinskas, 2002). For example, Amadieu, Tricot, and Mariné (2009) found students at the undergraduate level to experience *disorientation*, or conceptual and navigational confusion, during hypertext use. Examining students' text access profiles serves to both document undergraduates' capacities in navigating among multiple information sources and to offer insights into how students may be supported to access information more effectively.

2.2. Procedure

Data were collected across two sessions. In Session 1, students were asked to complete a variety of individual difference measures. These included a term-identification task to assess prior knowledge, used descriptively. In Session 2, participants were asked to complete a *multiple text task*, or to research a prompt using a library of digital texts (i.e., *research phase*) and to compose a written response based on library information (i.e., *response phase*). Data are drawn from a larger study examining students' source evaluation; however, non-overlapping research questions are investigated.

2.3. Prior knowledge

The prior knowledge measure asked students to *please tell me what you know about* each of seven key people (e.g., el Sisi, Morsi), places (e.g., Tahrir Square), and terms (e.g., Arab Spring, Muslim Brotherhood) associated with the Arab Spring in Egypt. Students' identification of each term was scored as correct or incorrect, with scores ranging from zero to seven. The Cronbach's alpha reliability for the prior knowledge measure was 0.91. The mean score on the prior knowledge measure was 2.32 ($SD = 2.61$), on a 7-point scale. This indicates that study participants constituted a low-knowledge or novice sample with regard to the target prompt.

2.4. Multiple text task

During the multiple text task, students were asked to, first, research a prompt using a library of six digital texts, and then, to compose a written response based on library information.

2.4.1. Research phase

Students were first presented with the prompt: Should the United States support General el Sisi and the military regime or Mohamed Morsi and the Muslim Brotherhood? Participants were further instructed to: Please answer as you would if assigned to write a brief essay in response to this prompt for an academic class. In responding to the prompt you will be asked to take a position (i.e., in support of Mohamed Morsi or General el-Sisi or an alternative) as well as to provide specific evidence to support your position.

Participants were further directed to take notes while researching the prompt, as they would not have access to library texts in composing their responses but would be able to use their notes. Students were told that there was no time limit for the task. After receiving the prompt and directions, students were presented with a library of six digital texts that could be accessed to research the target prompt.

2.4.1.1. Library. The library consisted of six digital texts representing a variety of document types: blog post, analysis essay, newspaper, public opinion poll, Twitter, Wikipedia entry. Library texts also varied in authoritativeness (i.e., author expertise) as well as in the perspectives they adopted with regard to the target issue. Texts were identified using a Google search for information on the topic of that task, the Arab Spring in Egypt. Texts were selected to meet a variety of criteria. Specifically, texts were chosen to represent different document types, to vary in trustworthiness and author expertise, and to introduce unique perspectives on the Arab Spring in Egypt while presenting information that was both complementary and partially conflicting. Moreover, texts were selected to be of equal length and readability.

All of the texts were relevant to the prompt and could be used in composing a response. Texts were presented in the library according to document type (e.g., newspaper) and arranged as an array. Text position was randomized for each participant.

Students were able to access any or all of the texts in the library, in any order they chose, as well as to revisit texts. As students navigated the digital library, meta-data about their text access were logged. Four pieces of log data were recorded: (a) which text was visited, (b) order of access, (c) duration of access, and (d) whether or not students elected to access document information (i.e., author, publisher) in association with each text used. Log data were associated with each text visit (e.g., time per text) and overall metrics of text access were computed (e.g., total time).

After accessing a particular text, prior to being able to return to the digital library, participants were asked to rate each text visited according to a variety of dimensions. In this study, students' ratings of text *usefulness* were the focus of analyses. Participants were asked to rate usefulness on a 100-mm line, ranging from *not at all* to *very* useful.

2.4.1.2. Navigation path analysis. Based on Reader and Payne's (2007) work, duration of text access and time allocation across sources were used as primary indicators in developing profiles of students' text navigation. Four assumptions guided our interpretation of students' time allocation across texts. First, because all of the texts in the library were selected to be relevant to formulating a response to the target prompt, we assumed that all of the available texts offered potentially useful information to students. Second, because the Flesch-Kincaid grade level of all texts included in the library ranged from 9.6 to 13.8, we assumed that undergraduate students could generally read all of the texts without much difficulty. As a result, we further assumed that increased time spent on texts was indicative of greater information exploitation or deeper processing, rather than a marker of reading difficulty. Third, because all of the texts included in the library ranged in length from 352 to 497 words ($M = 445.67$, $SD = 59.19$) and based on an adult reading speed of 150 words per minute (Bell & Perfetti, 1994; Sabatini, 2009), we assumed that a *single* reading of any library text would require approximately 3 min. Fourth, and most fundamentally, it was assumed that time on text was a meaningful metric to examine when trying to understand students' information use. Certainly, time has been used in prior research as a measure of multiple text use and navigation (Bråten, Anmarkrud, Brandmo, & Strømsø, 2014; Goldman, Braasch, Wiley, Graesser, & Brodowinska, 2012; Reader & Payne, 2007; Wiley et al., 2009). In this study, in addition to considering time on texts to be a metric of processing, we considered increased time allocation to be associated with students' preferences for particular sources.

Students' navigation profiles were first examined for evidence of either *sampling* (i.e., briefly visiting each text in the library prior to devoting a substantial amount of time to a preferred source) or *satisficing* (i.e., progressively using each text accessed for substantial periods of time). No students in our sample evidenced a navigation pattern consistent with a sampling approach to text use. Generally, students spent substantial time on initial text access and revisits did not last longer than initial text visits – offering limited evidence of students sampling available texts, prior to committing to an optimal source.

So, we were interested in further understanding the navigation of students adopting a satisficing approach to text use. Metrics of time allocation, including the maximum and minimum time spent per text and the total, mean, and standard deviation of time spent across sources, were used first to classify students' text use as *limited* or *not*. As such, a data-driven or bottom-up approach to establishing navigation profiles was adopted. Students' whose multiple text use was not considered to be (a) limited, were further categorized into three additional navigation profiles: (b) primary, (c) distributed, or (d) discriminating. Students were classified as *limited* in their text use if they either accessed less than three sources or spent less than a total of 6 min on text access. Students adopting a *primary* profile of text navigation had an access path that was characterized by using one text for a significantly longer period of time (i.e., more than 3 min) than the next longest used text; this profile was indicative of students demonstrating a particular preference for one of the sources accessed during navigation, over other texts. In this case, 3 min was selected as the cut mark as this corresponded to the approximate time required to read one of the texts a single time. Participants with a *distributed* navigation profile devoted a similar amount of time to all texts accessed, demonstrating little preferential navigation; specifically, these were students whose standard deviation of time devoted to text access was less than 2 min. Finally, students adopting a *discriminating* profile of text navigation were characterized by having a fairly large standard deviation in the amount of time they spent on accessing texts (i.e., more than 2 min) but a more limited discrepancy in the time they devoted to accessing preferred sources (i.e., less than 2 min). These were students who demonstrated preferential reliance on certain texts but also exhibited more limited use of other texts, resulting in fairly large variation in the amount of time devoted to accessing each text (i.e., standard deviation), even while the difference between the text they used longest and the next most preferred source was fairly small (i.e., less than 2 min). Two minute intervals were selected as the cut point for assigning students to the

distributed and discrimination navigation profiles based on the average standard deviation in the time students devoted to accessing a single text ($M = 1.97$). Students whose pattern of navigation could not otherwise be classified were placed into the *other* category. Examples of time allocation consistent with each navigation profile are included in Table 1.

2.4.2. Response phase

During the response phase, participants were first asked to identify their position with regard to the target prompt (i.e., in support of *el Sisi*, *Morsi*, or an *Other* option). Then students were asked to provide evidence and justification in support of their chosen position. Students' written responses or justifications were coded in two ways. First, the number of unique *arguments* (i.e., claims and justifications) in students' responses was tabulated. Second, the number of *evidentiary justifications* included in students' responses was computed. Evidentiary justifications referred to distinct statements of evidence, example, or explanation students forwarded in support of their arguments. Both the number of arguments and the number of evidentiary justifications in students' responses were continuous variables representing total counts. Participants' responses were first coded for the number of arguments they introduced. Then, each argument was analyzed to determine the number of evidentiary justifications included in association with that argument. Cronbach's alpha for the number of arguments included in students' responses was $\alpha = 0.73$, while reliability for the number of evidentiary justifications in students' responses was $\alpha = 0.89$, based on 18 participants scored (9.14). Reliability was established by two rates and all disagreements were resolved through discussion.

3. Results and discussion

3.1. RQ1: text navigation

In responding to the first research question, students' navigation was coded into each of four profiles (i.e., limited, primary, distributed, and discriminating); 95.43% (n = 188) of students were able to be successfully categorized into the established profiles. Specifically, 13.20% (n = 26) of students were classified as *limited* in their source use; 13.20% (n = 26) of students were categorized as having a *primary* source access profile, relying heavily on a single preferred source; 51.78% (n = 102) of students had a *distributed* navigation profile, splitting their time fairly uniformly across sources; and 17.26% (n = 34) of students were considered to be *discriminating* in their source use, demonstrating preferential use of some texts over others. Finally, 4.57% of students (n = 9) were placed into the *other* category of text navigation, because their source use could not otherwise be classified. Table 1 summarizes the four navigation profiles developed.

Four time allocation metrics were examined across the four navigation profiles: (a) the total time devoted to text access, (b) the average time spent per text, (c) the standard deviation of time devoted to access, across sources, and (d) the amount of time devoted to students' most preferred source. Data on indicators of time allocation for each navigation profile are included in Table 2.

A one-way analysis of variance, comparing all four navigation profiles, found significant differences in the total amount of time students devoted to total text use, $F(4, 191) = 25.62$, $p < 0.001$, $\eta^2 = 0.35$, corresponding to a large effect. As expected, students in the limited navigation profile devoted significantly less time to text access ($M = 5.10$ min, $SD = 4.05$) than did students in all of the other profiles ($ps < 0.001$). Additionally, students categorized into the discriminating navigation profile devoted significantly more time to text access, overall ($M = 24.24$; $SD = 12.29$), than did students in the limited, primary ($M = 17.07$, $SD = 5.62$), and distributed ($M = 14.36$, $SD = 6.13$) navigation profiles, $ps < 0.01$.

Differences were also found in the average amount of time students spent per text, $F(4, 189) = 9.21$, $p < 0.001$, $\eta^2 = 0.16$, indicating a medium-large effect. Post-hoc analyses using Tukey's HSD determined that students following a discriminating profile of navigation ($M = 4.71$, $SD = 2.13$) spent significantly longer on text access, on average, than did students following either limited ($M = 3.04$, $SD = 3.15$) or distributed ($M = 2.83$, $SD = 1.19$) profiles of navigation, $ps < 0.01$.

Further, we examined differences across navigation profiles in students' variance in time allocation. Profiles differed significantly in the standard deviation of students' time allocation, $F(4,185) = 70.77$, $p < 0.001$, $\eta^2 = 0.60$, corresponding to a large effect. Participants classified as distributed in their text access had a significantly lower standard deviation of time allocation ($M = 1.32$ min; $SD = 0.39$) than did students following a primary ($M = 3.41$, $SD = 1.09$) or discriminating profile ($M = 3.01$, $SD = 0.93$) of text access or participants in the other category ($M = 2.97$, $SD = 0.87$), $ps < 0.001$. Further, students following a limited navigation profile had a significant lower standard deviation of time allocation ($M = 1.17$, $SD = 1.08$) than did students following a primary, discriminating or other path of navigation, $ps < 0.001$.

Finally, we were interested in examining differences in the amount of time students categorized into different navigation profiles devoted to accessing the source they *most* preferred. Indeed, significant differences emerged, $F(4, 192) = 41.50$, $p < 0.001$,

Table 1
Navigation profile summary.

	Limited Navigation	Primary Navigation	Distributed Navigation	Discriminating Navigation	Other
Number	13.20% n = 26	13.20% n = 26	51.78% n = 102	17.26% n = 34	4.57% n = 9
Description	Few texts accessed or texts accessed for a limited amount of time	Students accessing one text for a disproportionality long period of time	Time evenly distributed across texts accessed	Students preferentially access certain texts over others	Students whose navigation could not otherwise be classified
Std. Dev. of Text Access	$M = 1.17$, $SD = 1.08$	$M = 3.41$, $SD = 1.09$	$M = 1.32$, $SD = 0.39$	$M = 3.01$, $SD = 0.93$	$M = 2.97$, $SD = 0.87$
Diff. btwn. most preferred and next favorite text	$M = 1.63$, $SD = 1.64$	$M = 4.83$, $SD = 1.61$	$M = 1.02$, $SD = 0.77$	$M = 1.27$, $SD = 0.60$	$M = 2.31$, $SD = 0.27$
Sample Navigation Profile	*Text 1:* 1.93 min *Text 2:* 2.13 min *Text 3:* 0.31 min	*Text 1:* 8.98 min *Text 2:* 2.34 min *Text 3:* 2.90 min *Text 4:* 4.46 min *Text 5:* 1.56 min *Text 6:* 0.72 min	*Text 1:* 7.04 min *Text 2:* 5.35 min *Text 3:* 3.35 min *Text 4:* 3.35 min *Text 5:* 3.87 min *Text 6:* 2.22 min	*Text 1:* 9.53 min *Text 2:* 3.68 min *Text 3:* 7.60 min *Text 4:* 5.94 min *Text 5:* 2.88 min *Text 6:* 8.56 min	*Text 1:* 5.96 min *Text 2:* 1.07 min *Text 3:* 8.45 min

Table 2
Source use descriptives by navigation profile.

Number	Limited Navigation	Primary Navigation	Distributed Navigation	Discriminating Navigation	Other	Total
	13.20% n = 26	13.20% n = 26	51.78% n = 102	17.26% n = 34	4.57% n = 9	N = 197
Time						
Total Time	$M = 5.10$, $SD = 4.05$	$M = 17.07$, $SD = 5.62$	$M = 14.36$, $SD = 6.13$	$M = 24.24$, $SD = 12.29$	$M = 20.58$, $SD = 9.50$	$M = 15.54$, $SD = 9.17$
Average Time	$M = 3.04$, $SD = 3.15$	$M = 3.87$, $SD = 1.18$	$M = 2.83$, $SD = 1.19$	$M = 4.71$, $SD = 2.13$	$M = 4.36$, $SD = 1.31$	$M = 3.40$, $SD = 1.86$
Std. Dev Time	$M = 1.17$, $SD = 1.08$	$M = 3.41$, $SD = 1.09$	$M = 1.32$, $SD = 0.39$	$M = 3.01$, $SD = 0.93$	$M = 2.97$, $SD = 0.87$	$M = 1.97$, $SD = 1.16$
Most Preff. Text	$M = 3.44$, $SD = 3.31$	$M = 8.83$, $SD = 2.27$	$M = 4.55$, $SD = 1.41$	$M = 8.29$, $SD = 2.95$	$M = 8.01$, $SD = 1.95$	$M = 5.77$, $SD = 2.96$
Text Access						
No. Unique Texts	$M = 2.15$, $SD = 1.38$	$M = 4.54$, $SD = 1.21$	$M = 5.20$, $SD = 1.12$	$M = 5.15$, $SD = 1.10$	$M = 4.67$, $SD = 1.22$	$M = 4.68$, $SD = 1.54$
No. Texts w/Revisits	$M = 2.27$, $SD = 1.48$	$M = 5.04$, $SD = 1.87$	$M = 5.74$, $SD = 1.60$	$M = 5.74$, $SD = 1.68$	$M = 4.89$, $SD = 1.45$	$M = 5.15$, $SD = 1.99$
Average Revisits	$M = 0.12$, $SD = 0.33$	$M = 0.50$, $SD = 0.95$	$M = 0.51$, $SD = 0.95$	$M = 0.53$, $SD = 0.86$	$M = 0.22$, $SD = 0.44$	$M = 0.45$, $SD = 0.87$
Percent of Students Revisiting	11.54% (n = 3)	26.92% (n = 7)	32.35% (n = 33)	38.24% (n = 13)	22.22% (n = 2)	29.44% (n = 58)
Percent Doc Info Accessed	$M = 17.75\%$, $SD = 35.02\%$	$M = 36.73\%$, $SD = 41.50\%$	$M = 44.04\%$, $SD = 40.94\%$	$M = 69.67\%$, $SD = 34.24\%$	$M = 40.74\%$, $SD = 44.18\%$	$M = 44.28\%$, $SD = 41.56\%$
Percent Accessing Doc Info	23.08% (n = 6)	50.00% (n = 13)	61.76% (n = 63)	88.24% (n = 30)	55.56% (n = 5)	59.39% (n = 117)
Usefulness						
Average Usefulness	$M = 54.22$, $SD = 19.19$	$M = 62.55$, $SD = 12.10$	$M = 61.41$, $SD = 15.55$	$M = 64.12$, $SD = 13.45$	$M = 50.48$, $SD = 15.32$	$M = 60.68$, $SD = 15.52$
Std. Dev. Usefulness	$M = 22.84$, $SD = 15.73$	$M = 21.87$, $SD = 10.78$	$M = 22.27$, $SD = 10.72$	$M = 22.43$, $SD = 12.53$	$M = 26.80$, $SD = 9.45$	$M = 22.52$, $SD = 11.52$
Max Usefulness	$M = 70.26$, $SD = 20.38$	$M = 84.73$, $SD = 12.01$	$M = 84.10$, $SD = 14.39$	$M = 89.32$, $SD = 10.67$	$M = 78.67$, $SD = 15.75$	$M = 83.21$, $SD = 15.25$

$\eta^2 = 0.46$, corresponding to a large effect. As expected, students categorized into the primary profile devoted significantly more time to accessing their preferred source ($M = 8.83$, $SD = 2.27$) than did students in the limited ($M = 3.44$, $SD = 3.31$) and distributed ($M = 4.55$, $SD = 1.41$) navigation profiles, $ps < 0.001$. Likewise, students in the discriminating profile devoted significantly more time to the source they used longest ($M = 8.29$, $SD = 2.95$) than did students following limited or distributed navigation paths, $ps < 0.001$. Finally, students in the other category, whose navigation profile could not be classified, used their most preferred source for significantly longer ($M = 8.01$, $SD = 1.95$) than did students following a limited or distributed pattern of navigation, $ps < 0.001$.

3.1.1. Trends in navigation

Reader and Payne (2007) identified an order effect in navigation; specifically, they found that texts accessed later in navigation were used for progressively less time. So, we were interested in when, during navigation, were students' most preferred sources accessed. For 35.03% of students (n = 69) the most preferred source was the one accessed first, while for 28.43% (n = 56) of students the most preferred source was the one visited second. A chi-squared test determined a significant association between students' navigation profile and when, in the order of text access, their most preferred source was visited. To ensure adequate expected counts in each cell, the order of access for students' most preferred source was collapsed into four categories (i.e., most preferred source accessed *first*, *second*, *third*, or *fourth or later*) and students in the other category, whose navigation profiles could not be otherwise classified, was excluded from analysis. The chi-squared was significant, $X^2(9, N = 188) = 22.07$, $p < 0.01$, Cramer's $V = 0.20$, indicating a small-medium effect. Examining standardized residuals determined that students following a limited navigation profile were significantly more likely to spend most of their time on the first text they accessed (65.38%, n = 17) and significantly less likely to access their most preferred text third in navigation (7.69%, n = 2). Conversely, students adhering to a discriminating profile of text navigation were significantly less likely to access their most preferred source first (17.65%, n = 6).

Further re-evaluating Reader and Payne's conclusions about text navigation, we considered what percent of total source use time students devoted to accessing their most preferred source (2007). Percent of total time devoted to the most preferred source differed significantly across navigation profiles, $F(4, 189) = 57.50$, $p < 0.001$, $\eta^2 = 0.55$, corresponding to a large effect. In particular, students following a limited navigation profile devoted a significantly higher percentage of total source use time to their most preferred source ($M = 68.56\%$, $SD = 19.86\%$) than did students adhering to all other navigation profiles (i.e., primary: $M = 54.18\%$, $SD = 11.77\%$; distributed: $M = 34.00\%$; $SD = 8.75\%$; discriminating: $M = 36.48\%$, $SD = 7.63\%$; other: $M = 42.65\%$, $SD = 10.70\%$), $ps < 0.001$. Additionally, students following a primary pattern of text access used their preferred source for significantly longer than did students following a distributed or discriminating navigation profile, $ps < 0.001$.

3.2. RQ2: navigation profiles and metrics of multiple text use

Navigation profiles were determined according to students' patterns of time allocation; these profiles were further examined in association with three indicators of multiple text use: (a) the number of sources students used, (b) whether or not students revisited texts, and (c) the proportion of sources for which students accessed document information. Text access metrics of each navigation profile are summarized in Table 2.

Across navigation profiles, students differed significantly in the number of texts they accessed, $F(4,192) = 36.80$, $p < 001$, $\eta^2 = 0.43$, corresponding to a large effect. However, the only significant difference to emerge was that students in the limited navigation profile used significantly fewer texts ($M = 2.15$, $SD = 1.38$) than did students in all of the other profiles (primary: $M = 4.54$, $SD = 1.21$; distributed: $M = 5.20$, $SD = 1.12$; discriminating: $M = 5.15$, $SD = 1.10$; other: $M = 4.67$, $SD = 1.22$), $p < 0.001$.

A chi-squared test did not find a significant association between students' navigation profile and whether or not they revisited texts during source use, $X^2(4, N = 197) = 6.00$, $p = 0.20$.

A one-way ANOVA determined that students classified into the various navigation profiles differed significantly in the proportion of sources for which they accessed document information, $F(4,189) = 6.39$, $p < 0.001$, $\eta^2 = 0.12$, corresponding to a medium effect. Post-hoc analyses using Tukey's HSD determined that

students classified into the limited navigation profile accessed document information significantly less commonly (M = 17.75%, SD = 35.02%) than did students in the distributed (M = 44.04%, SD = 40.94%) and discriminating (M = 69.66%, SD = 34.24%) navigation profiles, $p < 0.05$. Additionally, students adopting a discriminating navigation profile accessed document information for a significantly higher proportion of texts than did students following either a primary (M = 36.73%, SD = 41.50%) or distributed navigation profile.

3.3. RQ3: navigation profile and usefulness ratings

Navigation profiles were further examined in association with students' ratings of text usefulness. Three metrics associated with students' usefulness ratings were examined: (a) average ratings of text usefulness, (b) the standard deviation in students' usefulness ratings, and (c) maximum usefulness ratings. Usefulness ratings by navigation profile are included in Table 2.

Students' average ratings of usefulness differed significantly across navigation profiles, $F(4, 189) = 2.62$, $p < 0.05$, $\eta^2 = 0.05$, indicating a small to medium effect. However, post-hoc analyses using Tukey's HSD did not identify any significant differences in pairwise comparisons across navigation profiles.

The four navigation profiles also did not vary in their standard deviation in usefulness ratings, $F(4, 185) = 0.34$, $p = 0.85$.

Maximum ratings of text usefulness did differ across the four navigation profiles, $F(4, 189) = 6.54$, $p < 0.001$, $\eta^2 = 0.12$, indicative of a medium effect. The only significant difference was that students in the limited source use profile rated maximally useful texts as, nevertheless, significantly less useful (M = 70.26, SD = 20.38) than did students belonging to the primary (M = 84.73, SD = 12.01), distributed (M = 84.10, SD = 14.39), and discriminating (M = 89.32, SD = 10.67) navigation profiles, $ps < 0.01$.

There was a significant correlation between students' average ratings of text usefulness and the total time students devoted to text access, $r(1, N = 194) = 0.17$, $p < 0.05$, indicating a small to medium effect. For 41.12% of students (n = 81), the source accessed for the longest period of time was also rated as most useful. Conversely, for 49.75% of students (n = 98), the source accessed for the least amount of time was also rated as least useful.

3.4. RQ4: navigation profiles and response metrics

Navigation profiles were examined in association with indicators of multiple text task performance. Students' in different navigation profiles, likewise had responses that differed in the number of arguments they included, $F(4, 192) = 3.49$, $p < 0.01$, $\eta^2 = 0.07$, associated with a small to medium effect. As may be expected, students adhering to a limited navigation profile included significantly fewer arguments (M = 1.08, SD = 0.93) in their responses than did students following a primary (M = 2.15, SD = 1.57), distributed (M = 2.02, SD = 1.46), or discriminating (M = 2.21, SD = 1.25) pattern of navigation, $ps < 0.05$.

Further, navigation profiles differed in the number of evidentiary justifications included in students' responses, $F(4, 192) = 3.84$, $p < 0.01$, $\eta^2 = 0.07$, reflecting a small to medium effect. Again, post-hoc analyses using Tukey's HSD determined that the only significant difference was that student following a limited navigation profile included significantly fewer evidentiary justifications in their responses (M = 3.77, SD = 3.34) than did students following a distributed (M = 7.13, SD = 4.91), discriminating (M = 7.44, SD = 4.92), or other (M = 9.44, SD = 6.29) profile of text navigation, $ps < 0.05$.

4. Conclusions and implications

This study examined the manifestation of sampling and satisficing profiles of text navigation in a multiple text, rather than hypertext, context (Duggan & Payne, 2009; Reader & Payne, 2007). A number of intriguing findings emerged.

4.1. General navigation

Generally, the observations Reader and Payne made with regard to students' text navigation held true in this study (2007). For instance, the time devoted to text use decreased as students accessed successive sources in the library and, to some extent, text use could be described as *exhaustive*, with 46.19% of students (n = 91) visiting all six of the sources available. Table 3 includes data on students' text access. Further, consistent with findings from Reader and Payne, participants, excluding those following a primary pattern of navigation, devoted less than 50% of total access time to visiting the text they most preferred (2007).

Additionally, text access could be characterized as *systematic*, with revisits occurring only after each library text had been visited at least once. Among students revisiting texts (29.44%, n = 58), students' source revisit first occurred, on average, at the fifth text accessed (M = 5.07, SD = 1.60). In fact, for 29.31% of students revisiting texts (n = 17), the first revisit occurred at the seventh text accessed, indicating that students began to revisit texts only after all of the other library sources had been viewed.

Such a systematic approach to text access differed from the sampling navigation profile described by Reader and Payne (2007). Rather than a text being revisited after all other sources had been briefly previewed (i.e., sampled), in this study, each of the texts accessed, before a particular source was revisited, were used for substantial periods of time. This suggests that text access prior to students' revisits was used for information exploitation rather than simply exploration. Indeed, in this study, text revisits seemed to serve a different function than they did in Reader and Payne's work (2007). Specifically, while Reader and Payne suggest that students may revisit texts to familiarize themselves with the resources available, in this study, the duration of text revisits, their limited

Table 3
Frequency text visits and revisits.

Text	Accessed At Least Once		Accessed More Than Once	
	N	Percent	N	Percent of Those Visiting
Blog Post	121	61.42%	9	7.44%
Analysis Essay	156	79.19%	19	12.18%
Newspaper	186	94.42%	29	15.59%
Public Opinion	156	79.19%	13	8.33%
Twitter	151	76.65%	6	3.97%
Wikipedia	151	76.65%	12	7.95%
No. of Texts Accessed	**Unique Texts Accessed**		**Texts with Revisits**	
	N	**Percent**	**N**	**Percent**
Zero	3	1.52%	3	1.52%
One	4	2.03%	4	2.03%
Two	12	6.09%	10	5.08%
Three	29	14.72%	27	13.71%
Four	30	15.23%	25	12.69%
Five	28	14.21%	28	14.21%
Six	91	46.19%	62	31.47%
Seven	N/A		21	10.66%
Eight	N/A		10	5.08%
Nine or More	N/A		7	3.55%

number, and their occurrence fairly late in students' navigation suggest that they were an indicator of students' engagement in verification or corroboration (2007). Revisits may have helped students to gain additional information on a second visit, once an initial understanding of a particular text had been developed, or to corroborate information found in a previously accessed text.

4.2. Sampling

Limited evidence for a sampling approach to text navigation was identified. Students did not seem to explore available source offerings prior to selecting a preferred text. We were somewhat surprised by students' lack of exploration given that library texts were presented only according to document type (e.g., newspaper, Wikipedia), evidencing a limited information scent (Card et al., 2001). Nevertheless, students may have shied away from adopting a sampling approach to text navigation for at least two reasons. First, there was no time limit to the task, so students may have felt free to devote substantial time to accessing any of the texts in the library, rather than feeling pressured to identify an optimal source on which to spend the majority of study time. Second, students may have been less focused on identifying an optimal source because they were responding to an open-ended (i.e., allowing for multiple, potentially valid responses) rather than discreet (i.e., having only one, optimal answer) task. While discrete questions may prompt students to seek out an optimal source, one including information specifically relevant to the target prompt, open-ended tasks are characterized by a variety of responses being considered valid and therefore a multitude of sources potentially offering valuable information that could be used in response composition. Task indications that there was not an optimal source to identify, among those available in the library, may have discouraged students' sampling while the plurality of available sources may have fostered a satisficing approach to text navigation.

More generally, prior research, even in hypertext contexts, with time limits and discrete tasks driving search, has found limited evidence for a sampling approach to text navigation (Reader & Payne, 2007; Wilkinson et al., 2012). Within multiple text contexts, where students are asked to understanding complex issues based on information presented across multiple sources (Britt & Rouet, 2012), sampling, as a navigational approach, may be particularly unlikely to manifest. Such tasks, inherently, require students to draw on and integrate information from multiple sources, rather than relying on a single optimal text. Indeed, Britt and Rouet (2012) characterize multiple texts tasks as so complex that no single text offers sufficient information to understand them, meaning that no optimal source may exist.

4.3. Satisficing

Predominantly, students in this study can be said to have adopted a satisficing approach to text navigation. Trace data point to the adoption of satisficing-based patterns of navigation for a number of reasons. First, students did not seem to be *selective* in their information access, rarely briefly visiting and quickly rejecting an initially accessed texts in favor of a more preferable option. In fact, students' most preferred sources, as determined through time allocation, were most commonly accessed first or second during text navigation. Second, duration of text access was generally associated with students' ratings of text usefulness, providing evidence for students' use of those texts considered to meet a particular threshold of acceptability.

There are at least two explanations for students' adoption of a satisficing pattern of navigation. First, given that students generally accessed their most preferred sources early on during navigation, participants may have been adept at using information scent, in this case document type, for selecting texts (Card et al., 2001). Alternately, students' navigation may simply have been focused on *information accumulation*. Dominant patterns of navigation were marked by students visiting a fairly large number of texts and devoting a comparatively large proportion of time to initially visited texts, while using texts accessed later in navigation for progressively more limited periods of time. These results indicate that students seemed to be interested in gathering information broadly, from as many texts as possible. Further, as suggested by Stahl, Hynd, Britton, McNish, and Bosquet (1996), this access pattern seems to point to students developing an initial conception of the target issue, based on the first few texts accessed, and progressively enriching this emergent understanding until saturation is achieved, while drawing on additional texts for progressively less time.

4.4. Navigation profiles

Within the broader satisficing profile of text navigation, four discernable navigation patterns were identified. These included: (a) students *limited* in their text access, (b) those relying on a *primary* source during navigation, (c) participants *distributing* their access time equally across texts visited, and (d) students *discriminating* in their text access, evidencing preferential time allocation. Similar patterns of navigation have been documented in the literature.

Prior work has identified a group of students generally disengaged from source access; here, these students were classified as *limited* in their text navigation, elsewhere these students have been referred to as *apathetic users* (Lawless & Kulikowich, 1996; Lawless et al., 2002). Lawless et al. (2002) classified 16.67% of their participants as apathetic users ($n = 10$); in this study, a similar percentage of students were determined to be limited in their text access (13.20%, $n = 26$). In earlier work, these students have been characterized as exhibiting low motivation, however, an alternate explanation for this user profile emerges from the data in this study. Students following a limited pattern of text navigation were also found to rate library texts as significantly less useful than did students following other navigation paths. Lower usefulness ratings may, indeed, indicate motivational deficits or students' unwillingness to engage in multiple source use. Alternately, students following a limited navigation profile may have been less skilled in multiple source use and therefore less able to exploit the information available in library texts – resulting in lower ratings of text usefulness. Consistent with a skill-deficit explanation of the limited navigation profile, students following this pattern of text access exhibited performance deficits on the outcome measures examined. Nevertheless, skills have long been associated with motivation, suggesting these two explanations may be closely intertwined (Baker & Wigfield, 1999; Bong & Skaalvik, 2003; Schunk, 1991).

Distributed and discriminating profiles of text navigation have likewise been identified in prior research. Indeed, these two profiles seem to reflect the distinction drawn between text navigation that is fairly systematic, uniform, and focused on information gathering (i.e., distributed) and navigation that reflects more deliberate and selective text access (i.e., discriminating; Jenkins et al., 2003; Juvina & Van Oostendorp, 2006; Macgregor, 1999). This distinction may further be associated with differences in strategy use. Bråten and Strømsø (2011) suggest that multiple source use strategies may be decomposed into lower level strategies, addressing information accumulation (e.g., *I tried to remember as much as possible from all the texts that I read*), and higher level strategies, reflecting cross-textual elaboration (e.g., *I tried to find ideas that recurred in several texts; I tried to note disagreements among the texts*). While the systematic approach to information

access, reflected in students' adoption of a distributed profile of text navigation, may coincide with the engagement of strategies related to information accumulation, the discriminating profile of text navigation may reflect students' use of strategies related to cross-textual elaboration. Cross-textual elaboration strategies are associated with students' consideration of the relations between texts (Bråten & Strømsø, 2011). Indeed, students following a discriminating pattern of text navigation also accessed texts' document information, like author and publisher, to a greater extent than did students classified into all of the other navigation profiles. Accessing document information is indicative of students' efforts to evaluate texts in order to integrate and reconcile discrepancies across sources (e.g., Britt & Aglinskas, 2002; Strømsø, Bråten, & Britt, 2010).

Prior research has not found patterns of text navigation indicative of the primary navigation profile identified in this study. While reliance on a single source has previously been found to be characteristic of a sampling approach to text access (Reader & Payne, 2007), in this study reliance on a primary source typically did not occur after alternate sources had first been sampled.

4.5. Navigation profiles and multiple text use

The four navigation profiles identified in this study were associated both with students' text use behaviors (e.g., total number of texts accessed) and with ratings of text usefulness. Despite the four profiles differing with regard to these process-related factors, limited differences in task performance were found across patterns of navigation. Indeed, the only profile that demonstrated differential task performance was the limited text use navigation profile. The lack of an association between navigation style and performance may be explained in a number of ways. First, the relation between students' text use and task performance may be distal and indirect. Indeed, the performance metrics used in this study reflected the quality of students' response composition and may have been based on non-text-use related factors, like writing skills, to a considerable extent. More importantly, the nature of the task and the inclusion of only task-relevant texts in the library may have ensured that, regardless of navigation approach, students could have used any of the information garnered from library texts in formulating a written response. Prior research has likewise found students' navigation to be associated with task performance only to a limited extent (e.g., Jenkins et al., 2003).

This study contributes to the literature on multiple text navigation in at least three ways. First, this study examines the relative prevalence of sampling and satisficing navigation profiles in a multiple text, rather than hypertext, context, where texts are neither semantically nor hierarchically related to one another. Further, this study served to validate a number of more general conclusions regarding students' source navigation previously documented in studies of hypertext navigation. For instance, as has been found in prior research (Reader & Payne, 2007; Stahl et al., 1996), students' time allocation was commonly concentrated among texts accessed early in navigation, while text revisits occurred fairly late in navigation, after other sources in the digital library had been visited at least once. Second, this study identified four distinct sub-profiles of satisficing approaches to text navigation. These profiles have been echoed in prior research and, here, were found to be distinctly associated with other process measures of multiple text use (e.g., number of texts accessed) and, to a more limited extent, with performance. Third, students' navigation and time allocation across texts were explicitly associated with ratings of texts usefulness, offering among the first empirical investigations of students' determinations of texts' acceptability for task completion. More generally, analyses in this study integrated a cadre of source use variables to connect students' navigation behaviors to their perceptions of available texts.

4.6. Limitations

Despite these strengths, a number of limitations must be acknowledged. First, this was an exploratory study to characterize students' navigation in a multiple text context. Further work is needed to determine the extent to which the interpretations forwarded in this study are accurate as well as to understand the consistency of students' navigation across tasks and contexts. In particular, an experimental approach is necessary to determine the extent to which different task conditions may prompt students to engage different navigational strategies and to further establish that differences in navigation are, indeed, associated with other multiple text use behaviors, ratings of text usefulness, and task performance. Moreover, the cut off points used to classify students into different navigation profiles were determined in this study using a data-driven approach. Further replication should consider students' profile membership based on a-priori established standards. Second, only a limited number of texts and document types were examined in this study. While this was a necessary delimitation, it also limits the conclusions we are able to draw and the generalizability of these findings to students' information use and navigation in open, Internet contexts. A necessary direction for future work is to examine the stability of the identified navigation profiles under different text and task conditions and with different samples. Finally, more qualitative methods may be needed to further interpret students' paths of access. Studies categorizing students' navigation in hypertext systems have adopted qualitative methods and have suggested that, rather than classifying students into particular navigation styles, as was done in this study, it may be more appropriate to examine students' navigation as guided by a variety of approaches throughout task completion (e.g., Macgregor, 1999; Jenkins et al., 2003). However, more work is needed to determine the extent to which this is the case. Ultimately, results from this study discern not only specific patterns in students' text access and time allocation but also the extent of individual variation in how students perceive and interact with multiple texts.

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