Received: 3 August 2020 | Revised: 13 January 2021 | Accepted: 3 March 2021

DOI: 10.1002/asi.24469

RESEARCH ARTICLE

JASIST WILEY

Orientation tactics and associated factors in the digital library environment: Comparison between blind and sighted users

Iris Xie | **Rakesh Babu** | **Hyun Seung Lee** | **Shengang Wang** | **Tae Hee Lee**

School of Information Studies, University of Wisconsin–Milwaukee, Milwaukee, Wisconsin

Correspondence
Iris Xie, School of Information Studies, University of Wisconsin–Milwaukee, P.O. Box 413, Milwaukee, WI 53201, USA.
Email: hiris@uwm.edu

Funding information
Institute of Museum and Library Services, Grant/Award Number: LG-70-16-0038-16; University of Wisconsin-Milwaukee, Grant/Award Number: RGI & DIG

Abstract

This is the first study that compares types of orientation tactics that blind and sighted users applied in their initial interactions with a digital library (DL) and the associated factors. Multiple methods were employed for data collection: questionnaires, think-aloud protocols, and transaction logs. The paper identifies seven types of orientation tactics applied by the two groups of users. While sighted users focused on skimming DL content, blind users concentrated on exploring DL structure. Moreover, the authors discovered 13 types of system, user, and interaction factors that led to the use of orientation tactics. More system factors than user factors affect blind users' tactics in browsing DL structures. The findings of this study support the social model that the sight-centered design of DLs, rather than blind users' disability, prohibits them from effectively interacting with a DL. Simultaneously, the results reveal the limitation of existing interactive information retrieval models that do not take people with disabilities into consideration. DL design implications are discussed based on the identified factors.

1 | INTRODUCTION

Digital libraries (DLs) have been widely developed in recent decades as important information retrieval (IR) systems that provide access to various digitized resources (Li & Liu, 2019). A DL is an online collection of digitized or born-digital items, equipped with an interactive interface to enable diverse user communities to find desired information effectively. Universal accessibility and usability are among the key goals that DLs pursue to provide digital materials to their users; these are yet to be fulfilled for many vulnerable patrons (Jaeger et al., 2010), such as the blind. A blind user interacts with computers nonvisually by listening to a verbal rendition of text content created by screen reader software (Borodin et al., 2010; Vigo & Harper, 2014; Yoon et al., 2016). This research is motivated by the belief that current DL designs do not help blind users to orient themselves within a DL. Existing DLs are sight-centered by design and characterized by complex structures, heterogeneous content formats, and layered system dimensions, which run counter to the nonvisual, linear interaction approach of blind DL users (Babu & Xie, 2017; Xie, Babu, Lee, Castillo, et al., 2020). Unsupportive DL design potentially discourages blind users from ever returning to a DL in search of desired information. If DLs aim to become the gateway of universal access to information for all, DL designs must accommodate the unique needs and behaviors of both sighted and blind users when they initially interact with DLs.

To familiarize themselves with a new IR system, users adopt various orientation tactics to understand how to accomplish their tasks. An orientation tactic is defined as a move or moves that users of an IR system take to

familiarize themselves during initial interactions with the system. Understanding orientation tactics employed by users contributes to constructive implications for system design. The majority of tactics studies have focused on search tactics in non-DL environments, including some of them involving novice users (Vigo & Harper, 2014; Walsh & Hall, 2015); yet research on orientation tactics of users is scarce. It has been further noted that various types of factors impact how users select their tactics when interacting with IR systems (Chen & Macredie, 2010; Lu et al., 2017), and existing interactive IR models (Bates, 1989; Belkin, 1993; Pharo, 2004; Saracevic, 1997; Vakkari, 2001; Xie, 2008) and models of disability (Grue, 2011; Tøssebro, 2004) provide a theoretical foundation to re-examine factors behind the tactics.

There has been IR literature on search tactics of novice users (Hsieh-Yee, 1993; Niu & Kelly, 2014), behavioral differences between blind and sighted users (Vigo & Harper, 2014; Walsh & Hall, 2015), and factors influencing search behaviors (Chen & Macredie, 2010; Lu et al., 2017). However, to the best of our knowledge, none of the existing studies has taken all of these perspectives into consideration in one single study; the purpose of this study is to understand the orientation tactics of novice users consisting of both blind and sighted groups and the factors behind these tactics in the context of DLs. This paper builds on the authors' preliminary analysis of the orientation tactics employed by the two groups (Xie, Babu, Lee, Wang, & Lee, 2020).

2 | LITERATURE REVIEW

2.1 | Search tactics applied by sighted and blind users

Search tactics is a key research area in library and information science. Bates (1979) classified the concept of an information search tactic as a move that searchers make to fulfill their goal. She distinguished four types of tactics: monitoring tactics, file structure tactics, search formulation tactics, and term tactics. Researchers have conducted studies to identify search tactics in varying contexts. Unsurprisingly, the majority of these studies are based on empirical data from sighted users. Based on the search process, Ellis (1989) discovered six tactics used by social sciences researchers, including starting, chaining, browsing, differentiating, monitoring, and extracting. Similarly, He et al. (2016) presented tactics more closely related to search processes: formulating/refining a query, executing a search, examining results, extracting information, organizing results, and reviewing history. Contextualizing their study in an image-based DL, Han and Wolfram (2016) uncovered 11 types of tactics, including single item view, page of results request, simple search, advanced search, printing/viewing an image, metadata search, etc.

Focusing on user search tactic patterns in DLs, Xie and Joo (2010) identified 13 types of search tactics consisting of identifying a search lead, creating a search statement, modifying a search statement, evaluating individual item(s), evaluating search results, keeping a record, accessing forward, accessing backward, learning, exploring, organizing, monitoring, and using. Differentiating system- and user-related tactics, Xie et al. (2017) further categorized tactics into three groups, namely, user-dominated tactics (creating, exploring, evaluating), system-dominated search tactics (monitoring, organizing, accessing), and balanced search tactics (modifying, learning). Focusing on search tactics to address specific tasks, Rutter et al. (2019) identified 77 search tactics which constituted three main categories: CONTROL for controlling search flows, SELECT and USE for evaluating search results and applying retrieved information, and MANAGE for managing task resolutions.

In addition to the search tactics of sighted users, some researchers have paid growing attention to tactics employed by blind and visually impaired (BVI) users in IR contexts. Information searching on the Web that heavily relies on image and visual elements is gaining popularity (Sahib et al., 2014; Vigo & Harper, 2013), creating difficult situations for BVI users when searching and accessing information online. Various BVI users' coping and search tactics have been uncovered. Jobst (2009) explored screen reader users' Web navigation tactics, finding that they tended to utilize a more linear navigation style and scrolling more often than searching. Trewin et al. (2010) looked into tactics employed by visually impaired users when navigating both familiar and unfamiliar web pages. For familiar web pages, participants jumped to the end of the page and used block or page headings; for unfamiliar pages, participants listened to the headings or focused on specific kinds of page elements. To browse more efficiently and find the desired information, screen reader users also employed heading navigation and keyword search tactics (Borodin et al., 2010). Some studies concentrated on coping tactics of BVI users. Lazar et al. (2007) found that, when confronting frustrations using the Internet, blind users utilized coping tactics, such as giving up, relying on previous experience, asking for help, and retrying. For visually impaired users, Vigo and Harper (2013) identified more coping tactics: asking for assistance, impulsively clicking, exploration tactics, narrowing a search, gaining orientation, re-doing, not operating or delegating on assistive technologies, and giving up.

While no studies have compared the search tactics applied by both blind and sighted groups when using DLs, a few have compared search behaviors of BVI and sighted users in other IR contexts. Bigham et al. (2007) investigated browsing behaviors of BVI and sighted users by focusing on probing and timing. Noticeably, BVI participants used more probing behaviors than sighted ones and invested more time on average for each page viewed compared to their sighted counterparts. Sahib et al. (2012) examined search behaviors of visually impaired and sighted participants at different stages of the search process. They found that sighted users tended to issue broad search queries, while BVI users preferred lengthy, complex queries to represent their information need. While forming search queries, sighted users were more aware of search help features than screen reader users. Heading-to-heading navigation and link-to-link navigation were most popular among BVI users when exploring search results; sighted users viewed significantly more search results and external links. BVI users reformulated queries less frequently than their sighted counterparts.

Novice users differ from experienced ones in applying different types of search tactics. Compared with experienced users, novices are more likely to encounter difficult situations when interacting with IR systems. Their tactics include relying on their own terms (Hsieh-Yee, 1993; Liu & Wacholder, 2017), refining search queries (Marchionini, 1989), undertaking repetitive actions (Debowski, 2001), activating hyperlinks (Savolainen & Kari, 2006; Thatcher, 2008), and interacting with system help features (Niu & Kelly, 2014). As Walsh and Hall (2015) noted, novice users might casually explore what is available during their initial interactions with digital collections; therefore, understanding novice users' orientation tactics should not be limited to information search and evaluation. However, the aforementioned comparative studies have not examined orientation tactics of novice users of IR systems. This study is the first to systematically investigate orientation tactics of novice users, both sighted and blind, in the context of DLs.

2.2 | Interactive IR models, models of disability, and factors associated with users' interactions with IR systems

Several interactive IR models have been developed to describe the interactive and iterative processes of IR (Berget et al., 2020; Xie, 2018). Interactive IR research forms its unique focus and specialty by incorporating research from IR, human information behavior, and human-computer interaction (Kelly & Sugimoto, 2013). Taking the leading roles, Belkin's (1993) episode model of interaction with texts, Saracevic's (1997) stratified interaction model, and Ingwersen and Järvelin's (2005) integrated information seeking and retrieval (IS&R) framework concentrate on interaction with text, interaction at different levels, and interaction among cognitive structure of diverse human actors respectively. In addition to the major interactive IR models, researchers have also created models emphasizing a specific aspect. For example, Bates' (1989) berry-picking model emphasizes the dynamic nature of the IR process, and Pharo's (2004) search situation and transition model and Xie's (2008) planned-situational interactive IR model further illustrate how the social-organizational context, tasks, user information infrastructure, and system factors influence the interactive process. Additionally, Vakkari's (2001) theory of the task-based IR process highlights the role of tasks in the IR process.

The interactive IR models discussed above indicate that information searching is affected by various types of factors, mainly including system factors (e.g., interface design, system features, computational mechanism, and resources), user factors (e.g., user knowledge structure, education, and demographic background), task factors (e.g., complexity and stages of task), interaction factors (e.g., interaction outcomes), and contextual factors (e.g., social and organizational contexts). Although some existing models have the potential to be applied in examining people with impairments (Berget et al., 2020), none of them are derived from empirical research involving people with disabilities, in particular blind users.

Disability is the umbrella term embracing a wide range of physical and cognitive impairments. Literature shows that there are different models that support various perspectives on disability. Among the most common models are the medical model, the social model, and the gap model (Berget & MacFarlane, 2020; Kleynhans & Fourie, 2014; Tøssebro, 2004).

From a biomedical perspective, the medical model is grounded in "an undue emphasis on clinical diagnosis," focusing on "physical or intellectual characteristics" of individuals with impairments (Brisenden, 1986, p.173). According to the causes of different types of disabilities, such as diseases and individual impairments, medical/therapeutic services and treatments are regarded as essential to coping with disability in the individual model (Kearney & Pryor, 2004). In contrast, the social model is "the dominant paradigm in researching and understanding disability" (Dewsbury et al., 2004, p.145). It maintains that disability is a product of social and institutional discrimination and exclusion (Dewsbury et al., 2004; Terzi, 2004). Within the social framework, action is required to create more inclusive and accessible

environments (Kleynhans & Fourie, 2014). The gap model concentrates on the solution, viewing disability as a mismatch between individuals' capabilities and demands from society and associated institutions (Grue, 2011; Tøssebro, 2004). To bridge the gap, both individual and sociostructural dimensions of disability should be considered (Shakespeare, 2004), implying that system improvement and efforts on user education/training could play a vital role in helping BVI users in the IR context.

Different models of disability shed light on potential factors for the ways that users interact with IR systems. Previous research has identified system, user, interaction, and task-related factors. System factors play an important role in affecting users' information searching and retrieval. According to Lin and Belkin (2005), there are multiple system factors, such as organization/presentation of content, maintenance/collection of content, search environment, and system features, that influence users' information seeking processes. Xie and Joo (2012) found that the availability and the design of system features impact users' choices of search tactics. In terms of DLs, their complexity lies in not only the considerable scale of digital collections but also the heterogeneous content formats and complicated interface design, which pose more challenges for users and further affect their search behaviors (O'Day & Nardi, 2003; Xie et al., 2018). Recent research also indicates system features (e.g., search aid features) impact users' search query reformulation behaviors (Lu et al., 2017).

Researchers agree that user factors mainly involve users' personal knowledge, such as domain knowledge, system knowledge, IR knowledge, and their previous experience (Chen & Macredie, 2010; Kim, 2009; Vakkari, 2016; Xie & Joo, 2012). Kim (2009) noted that users' attributes, such as domain knowledge and system knowledge, influence how they accomplish certain tasks. Focusing on navigation behavior, Chen and Macredie (2010) found that prior system knowledge is a contributing factor that affects how users with high or low knowledge benefit from different navigation patterns. Other user factors, such as their vision, could also change how users interact with IR systems. As shown in the previous section, BVI users exhibited unique search tactics compared with their sighted counterparts (Borodin et al., 2010; Jobst, 2009; Vigo & Harper, 2013).

Interaction represents the dynamic process involving users and IR systems. DL interactions comprise user actions and feedback from systems (Albertson, 2015). Generally, users modified their search queries based on search results (Choi, 2013). Specifically, Xie and Cool (2009) discussed how different types of interaction outcomes (e.g., too many results, too few results) affected the occurrence of help-seeking situations. Also noteworthy, BVI users have to rely on assistive technologies, such as screen reader software, to interact with IR systems nonvisually. Their linear and sequential mode of interaction greatly influences their search and navigation behaviors (Borodin et al., 2010; Jobst, 2009; Lazar et al., 2007; Vigo & Harper, 2014; Yoon et al., 2016).

Task factors are also significant in influencing users' interactions with IR systems. Research indicates that different task types (known-item search, specific information search, exploratory search) influence users' information search behaviors (Xie et al., 2018). Simultaneously, task complexity affects information searching and retrieval (Byström, 2002; Li & Belkin, 2010; Talja & Nyce, 2015; Wildemuth et al., 2018).

3 | RESEARCH QUESTIONS AND ASSOCIATED HYPOTHESES

While previous research has identified search tactics by both blind and sighted users in different IR contexts, none of them have compared types of orientation tactics applied by the two groups during their initial interactions with a DL. Most importantly, none of them has further examined the factors behind the selection of the tactics. The research questions addressed by this study are:

- Q1. What are the types of orientation tactics that blind and sighted users apply during their initial interactions with a DL?
- Q2. Is there a difference between the blind and sighted group in their application of various types of orientation tactics during their initial interactions with a DL?
- Q3. Is there a difference in applying the top five orientation tactics between the blind and the sighted group during their initial interactions with a DL?
- Q4. What are the types of factors that influence blind and sighted users in using the most frequently applied tactic respectively during their initial interactions with a DL?

Throughout the study results, the term *tactics* refers to orientation tactics.

4 | METHODOLOGY

4.1 | Sampling

Sixty participants, 30 blind and 30 sighted, were recruited from the Midwestern United States. To recruit blind participants, fliers were distributed to local blind

associations; to recruit sighted participants, fliers were distributed through local public listservs. Both groups of participants were required to meet the following prerequisites: (a) 18 years of age or older, (b) minimum 3 years of experience searching for information on the Internet, (c) first-time DL users, and (d) comfortable verbalizing their thoughts in English. For the blind group, two more requirements were added: (a) blind and (b) nonvisual computer users who utilize screen reader software.

Among the 60 participants, valid data were collected from 28 blind participants and 27 sighted participants. Table 1 presents participant demographics. In both groups, males and females constituted approximately 50% of the participants. On average, the blind and sighted participants had 13.5 and 16.8 years of experience using the Internet, respectively. All blind participants used screen readers, averaging 13.6 years of experience using a primary screen reader.

All blind and sighted participants were invited to the iSchool usability lab of a state university. Six blind participants were unable to travel to the university lab, so data collection was conducted in an off-site location. The same data collection procedures were performed in both locations. Each participant received a $100 gift card as a token of appreciation.

4.2 | Data collection

American Memory Digital Collections (AMDC) was selected for its content, which is of interest to both blind and sighted participants, and for its various types of help features. Participants were instructed to familiarize themselves with AMDC for 10 min before conducting the assigned search tasks. This paper focuses on the orientation process. JAWS 12.0 was chosen as the screen reader for its popularity among blind participants (WebAIM, 2019). JAWS 15.0 was used for the last six blind participants. No discernable difference was observed between the two versions.

Multiple methods were applied to collect data: questionnaires, think-aloud protocols, and transaction logs. First, participants completed a questionnaire regarding their demographic information, Internet experience, and search skills. Second, participants were instructed to "think aloud" during their orientation with the DL. Each participant was given instructions with examples of prompts for verbalizing. Research has demonstrated that think-aloud protocol is an effective approach in usability studies with screen reader subjects (Stefano et al., 2010). Morae 3.1 was used to capture the interaction process and associated verbal think-aloud, which was then

TABLE 1 Participants' demographic data

Category	Sighted		Blind	
	N	Percentage	*N*	Percentage
Age				
18–29	3	11.1	4	14.3
30–39	10	37.0	1	3.6
40–49	3	11.1	4	14.3
50–59	4	14.8	11	39.2
60+	7	25.9	7	25.0
Not specified			1	3.6
Ethnicity				
Caucasian	24	88.9	23	82.1
Non-Caucasian	3	11.1	5	17.9
Frequency of internet use				
Occasionally use			1	3.6
Often use			5	17.8
Daily	27	100.0	22	78.6
Information search skills				
Beginner			1	3.6
Intermediate	14	51.9	15	53.5
Between intermediate and advanced	3	11.1		
Advanced	9	33.3	11	39.3
Expert	1	3.7	1	3.6

Starting at the top of the webpage here now *I'm gonna arrow down through the site* **to see what's on the page.** <same page link amem slash index.> *and the index link<list of 7 item.*
Lack of overview of page composition
The Library of Congress American Me. list of. The Library of Congress American memory visited link graphic Home.> As I go through this, I'm just gonna use the down arrow through the whole site.<link graphic Browse. link graphic About. link graphic Help. link graphic Contact. search all collections. blank.> (PB20)

Regular font	Think aloud data
< >	Log data
Italicize	Orientation tactic
Bold and underline	Factor
Bold	Label of factor
( )	Participant number

FIGURE 1 Coding example of exploring DL structure

Types of Tactics	Definitions	Examples
Checking current location (CL)	Figuring out the present position that a user is at	If I were going to explore, I would approach it, starting over a couple of times. So, if I'm going to start, I make sure I'm at the top. < Wrapping to top. Escape. Escape. American.> (BP13)
Exploring DL features (EF)	Discovering and learning DL features	I'll probably click on the help, uh, just to see what it says here in the help screen. So, um, looks like there's a FAQs, search help, how to view, um...Could put in my report that I'm a big fan of FAQs. (SP26)
Exploring DL structure (ES)	Scanning the structure of a DL at its main page to get familiar with a DL	When I get to a website that I'm unfamiliar with I like to just use my up and down arrow keys to kind get the navigation down <blank. heading level 1 Browse Collections by Topic. list of 8 items…. link Maps.> just hitting down arrow. (BP23)
Examining search results (ER)	Browsing the results of a search	Oh, okay, well, um, I'm... I chose the Edward Curtis site because, um, I've always been interested in Native Americans and photography as well, and so I was... So photographic images, but now I'm going, okay, well where I'm trying to get to these images. Also scrolling down to see what's down here. (SP10)
Performing a search (PS)	Using the basic and advanced search tools to find information in a DL	I'm interested in, um, the, uhh, removal of Potawatomi from Waukesha. Umm. {Subject types in 'Removal of Potawatomi from Waukesha WI.'} (SP2)
Reading DL information (RI)	Scanning information about a DL, in particular about its history, purpose, audience, etc.	Let's see. I'm looking at the mission and history of the site. (SP15)
Skimming DL content (SC)	Browsing or reading the topics available in a DL including looking specifically at the topics available in the topic section on the DL or specific sections, such as today's history	More browse options. Browse section. Curious what sort of things are in here. (SP13)

FIGURE 2 Types of tactics, definitions, and examples

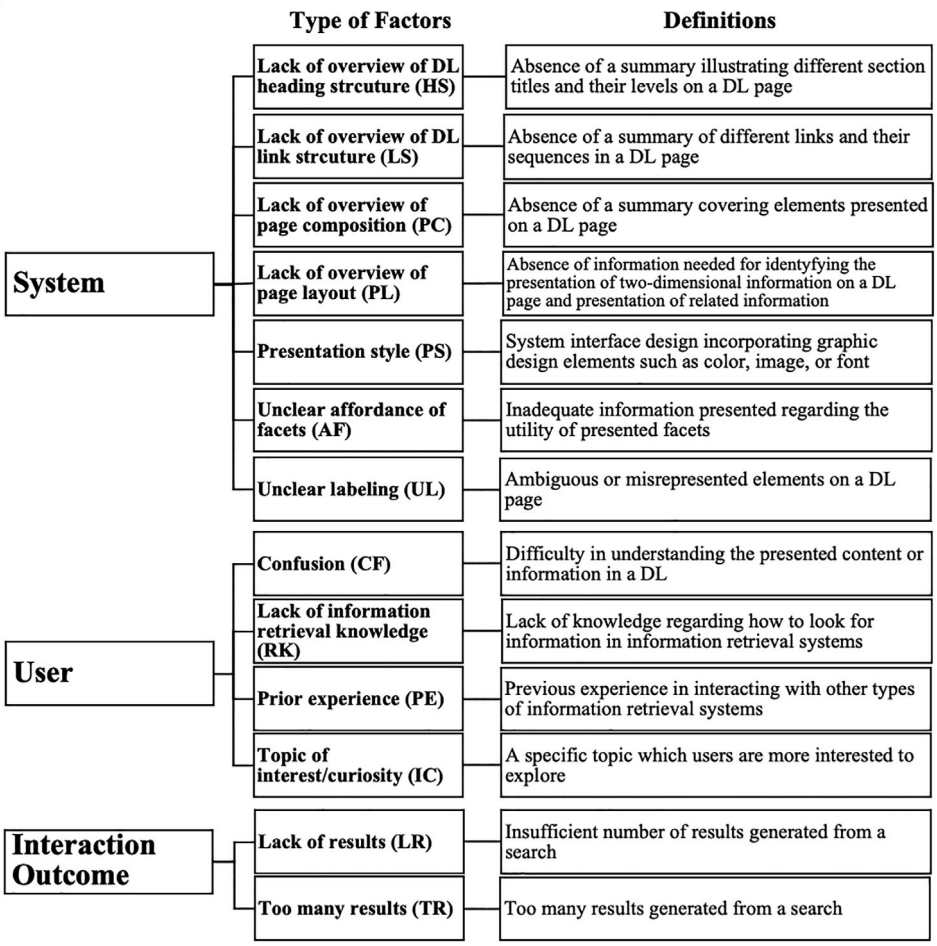

FIGURE 3 Types of factors and associated definitions

transcribed. Think-aloud protocols and transaction logs provided the primary data sources for this study.

4.3 | Data analysis

The unit of analysis is each tactic. Qualitative data collected from think-aloud protocols and transaction logs were examined for each research question. Open coding, the process of breaking down, examining, comparing, conceptualizing, and categorizing unstructured textual transcripts (Strauss & Corbin, 1990), was used for the analysis of types of tactics and factors that influence the application of diverse tactics by the two groups. Figure 1 shows a coding example of *exploring DL structure*. For RQ1, seven types of tactics emerged from the data. Figure 2 presents the coding scheme of types of tactics, associated definitions, and examples. For RQ2, researchers calculated the frequency and percentage of tactics applied by the two groups during their initial interactions with the DL. A Chi-square test was used to analyze the difference between the two groups and their application of various types of tactics. For RQ3, a Shapiro–Wilk test was first applied to check the normality of the two groups. Since not all data were normally distributed, a Mann–Whitney test was conducted instead of a *T*-test to assess the differences in the application of the top five tactics. For RQ4, 17 types of factors associated with system, user, and interaction outcome that led to each type of tactic were identified via open coding. Figure 3 presents the coding scheme of types of factors and associated definitions. Since this study only focuses on the orientation task, task factors were not identified. The Results section provides examples of each type of factor.

Two independent coders analyzed the tactics and factors generated from the 55 participants. According to Holsti's (1969) formula, the inter-coder reliability of tactics and factors identified between the two coders was 0.90 and 0.97 respectively. Any differences in coding were discussed by two coders until an agreement was reached.

5 | RESULTS

5.1 | Types of tactics applied by the blind and sighted groups

The findings reveal seven types of tactics utilized by blind and sighted participants: *checking current location* (*CL*),

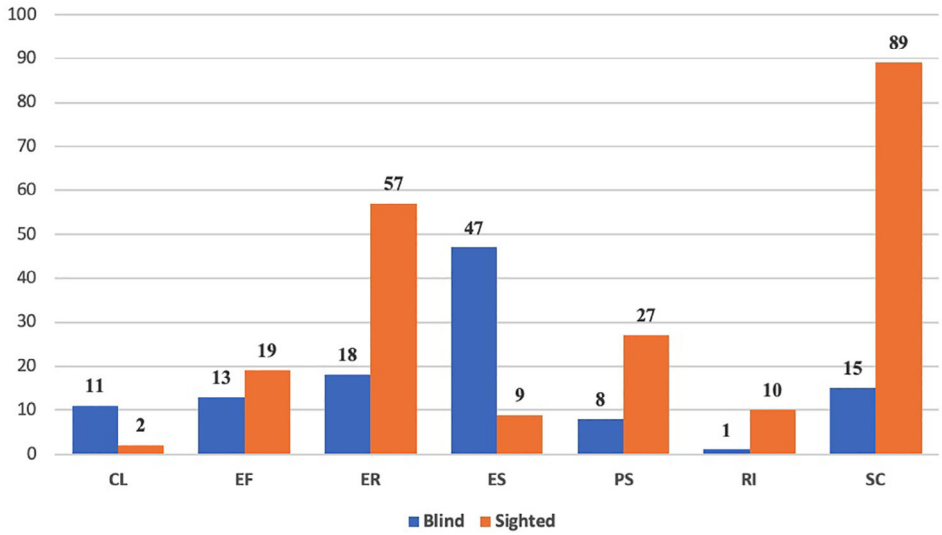

FIGURE 4 Frequency of tactics applied by blind and sighted groups [Color figure can be viewed at wileyonlinelibrary.com]

exploring DL structure (*ES*), *performing a search* (*PS*), *reading DL information* (*RI*), *skimming DL content* (*SC*), *exploring DL features* (*EF*), and *examining search results* (*ER*). Figure 4 presents the frequency of each type of tactic by blind and sighted groups. *ES* (47), *ER* (18), and *SC* (15) were the three most frequently applied tactics during blind participants' initial interactions with the DL. In contrast, for sighted participants, *SC* (89), *ER* (57), and *PS* (27) were the top three frequently applied tactics during their initial exploration of the DL.

5.2 | Differences in applying tactics between the blind and sighted groups

This section reports the results of a chi-square test which shows (Table 2) that there was a significant difference between the two user groups in applying various types of tactics, χ^2 (6, $N = 326$) = 102.746, $p < .01$. Results indicate that blind users focused on different types of tactics as their sighted counterparts in their initial interactions in the DL.

Mann–Whitney tests were performed to further determine whether there is a significant difference in applying a specific tactic between the two groups (Table 3). Two tactics (*CL*, *RI*) are not included because of their low frequency applied by all the participants. A Mann–Whitney test result of *ER* reveals that the frequency of applying *ER* was greater for the sighted user group (Mdn = 2, $M = 2.11$) than for the blind user group (Mdn = 0, $M = 0.64$), $U = 178$, $p = .00$. For *EF*, a Mann–Whitney *U* test indicates that there is no significant difference in applying *EF* between the blind (Mdn = 0, $M = 0.46$) and the sighted groups (Mdn = 1, $M = 0.7$), $U = 309$, $p = .19$. For *ES*, the result demonstrates that the frequency of applying *ES* was greater for the blind (Mdn = 1.5, $M = 1.68$) than the sighted group (Mdn = 0, $M = 0.33$), $U = 77$, $p = .00$. For *PS*, a Mann–Whitney *U* test indicates that the frequency of applying *PS* was greater for the sighted group (Mdn = 1, $M = 1$) than for the blind user group (Mdn = 0, $M = 0.29$), $U = 261$, $p = .02$. Finally, a Mann–Whitney test shows that the frequency of applying *SC* was greater for the sighted group (Mdn = 3, $M = 3.3$) than for the blind group (Mdn = 0, $M = 0.54$), $U = 87$, $p = .00$.

5.3 | Factors affecting different tactics applied by the blind and sighted groups

Based on the Mann–Whitney results, four tactics showed significant differences between the two groups: *ER*, *ES*, *PS*, and *SC*. While the most frequently applied tactic by blind users was *ES*; *SC* was the most frequently employed by sighted users. This section presents factors associated with *ES* and *SC*.

5.3.1 | Factors associated with exploring DL structure

ES includes an action planned or executed to understand the composition of the current DL page, particularly the sequence in which its content is presented. Blind participants applied *ES* 47 times, which was significantly greater than the nine times sighted participants applied it. The analysis further revealed that the application of this tactic might be motivated by system, user, or a combination of factors. Qualitative analysis identified six types of system factors consisting of lack of overview of DL link structure (LS), lack of overview of page composition (PC), lack of

TABLE 2 Chi-square test of tactics applied by the blind and sighted groups

Tactics	Blind ($N = 113$)	Sighted ($N = 213$)	Statistics
Checking current location (CL)	9.73%	0.94%	$\chi^2 = 102.75$
Exploring DL features (EF)	11.50%	8.92%	d.f. = 6
Examining search results (ER)	115.93%	26.76%	$p < .01$
Exploring DL structure (ES)	41.59%	4.23%	
Performing a search (PS)	7.08%	12.68%	
Reading DL information (RI)	0.88%	4.69%	
Skimming DL content (SC)	13.27%	41.78%	
Total	100.00%	100.00%	

TABLE 3 Mann–Whitney test results of tactics applied by the blind and sighted groups

Tactics	Group	*N*	Mean rank	Sum of ranks	Mann–Whitney *U*	*p* value
Examining search results (ER)	Blind	28	21	584	178	.00
	Sighted	27	35	957		
	Total	55				
Exploring DL features (EF)	Blind	28	26	715	309	.19
	Sighted	27	31	826		
	Total	55				
Exploring DL structure (ES)	Blind	28	39	1,086	77	.00
	Sighted	27	17	455		
	Total	55				
Performing a search (PS)	Blind	28	24	873	261	.02
	Sighted	27	32	667		
	Total	55				
Skimming DL content (SC)	Blind	28	18	493	87	.00
	Sighted	27	39	1,047		
	Total	55				

overview of heading structure (HS), lack of overview of page layout (PL), unclear labeling (UL), and unclear affordance of facets (AF) as well as two types of user factors including prior experience (PE) and lack of information retrieval knowledge (RK) behind *ES* usage.

Among system factors, LS (10) was the most frequently associated with *ES*. During initial interactions with the DL, blind participants attempted to understand the DL structure by looking exclusively at links presented on the first page of the DL. They applied this tactic by repeatedly using the Tab Key, by navigating through the links, or repeatedly pressing the Arrow key within a set of links. The failure to present the general overview of links triggered participants to initiate *ES* when entering the DL. For example, BP6 used Insert-F7 to access a link list and understand available links and their order within the DL page due to the absence of a summary link structure (Figure 5, 5.1).

PC (9) was ranked second based on frequency data among system factors. The elements in a DL include page and section titles, site logo, images, forms, and link texts. The overview of page composition helps users perceive the usefulness of the DL page by identifying what is available on the page. BP18 had to use the Arrow key to arrow down from top to bottom of the DL's first page because of the absence of information illustrating the different elements that constitute the DL page (Figure 5, 5.2), making it difficult for the participant to grasp the general idea of page contents.

HS (6) was the third system factor. Heading structure helps blind participants understand the availability and organization of sections and identify shortcuts to the desired section on a DL page. The overview of heading structure assists users in determining the kinds of sections on a page and their arrangement. Participants utilized the H Key to listen to heading levels and assigned

5.1	*Right now I'm listening to links. The feature I like to listen to when I go through links is the link list dialog. So I can just hit insert-F7 to bring that up.* **Right now I'm just looking to see what links are available on this website.** *<Linklist dialog. Links list view. Ask a librarian. 35 of 37. To move. Teachers. A. The Library of Congress.>* (BP6) **Lack of overview of DL link structure**
5.2	So what I'm gonna do is *I'm gonna do an insert down arrow just* **to read some of the site as to get an idea as to what's on here.** *<link graphic Library of Congress. link The Library of Congress greater American Memory home heading level 1. browse collections by topic. list of 8 items…link tech technology comma>* (BP18) **Lack of overview of page composition**
5.3	<...Collection highlights heading level 1.> *What I'm doing is, I'm hitting H* **to see the different headings of the website.** *<Heading level 1 collection highlights. Today in history heading level 3 link. Heading level 3 link today in history*. Wrapping to top> (BP3) **Lack of overview of DL heading structure**
5.4	**Let's see about tables**. *<There are no tables on this page.>Okay, no tables. Let's see…<There are no check boxes on this page.>No check boxes. Okay*. I think I'm okay so far. I know what's on the screen a little bit (BP11). **Lack of overview of page layout**
5.5	**<link graphic images slash arrow underline green.> I have no idea what that means.** *laughs* **link graphic images slash underline arrow green It's a lot of description there but what is it?** <link More Browse Options. link graphic images slash arrow underline orange ...> *I'm still doing down arrow* (BP27). **Unclear labeling**
5.6	<search button. list end. link the Library of Congress. greater American Memory Home. blank. heading level 1 Browse Collections by Topic. list of 8. link Advertising… link Women's History.> **Ok. goes like A to Z<list end.> and then there are links related to each topic? which is good <link graphic images slash arrow underline green. link More Browse Options.> more browse options That's what I was thinking what happens if I need something is not listed here? but it says more options?** <link graphic images slash arrow underline orange.> Huh. It says orange which is good! *<link List all Collections … link link Legal.>* what I did was *I'm verbalizing just go through all the* you *know information from with the down arrow* (BP21). **Unclear affordance of facets**

FIGURE 5 Examples of system factors for exploring DL structure [Color figure can be viewed at wileyonlinelibrary.com]

labels or Insert-F6 to access the heading list. Lack of an overview of heading structure left BP3 puzzled about the DL structure. By repeatedly pressing the H key, she located section headers and heading levels in the DL to explore the DL structure (Figure 5, 5.3).

PL occurred 5 times when applying *ES*. The overview of page layout allows users to recognize the page presentation of the DL page, such as the number of columns in a table or the existence of an index and relative placement of information within the page. Blind participants applied diverse methods to check page layout, such as using the Table command, Shift-Tab Key, or Shift-H key. BP11 used the Table command to check whether there is a table on the page (Figure 5, 5.4).

UL, which occurred 4 times, may result in difficulty recognizing the purpose or function of an element, causing users to delve into the DL page to understand an element within the DL context. BP27 encountered a label announcing a color description and found it difficult to comprehend its function. He arrowed down through the components of the DL and listened to the screen reader to figure out how the unclear label fit into the overall structure of the DL (Figure 5, 5.5).

The frequency of AF (3) was the lowest among system factors influencing *ES*. In this factor, a facet refers to a particular aspect that could be used as a criterion to organize the contents of a DL, such as by topic, time period, or location. Unclear about the affordance of the facets, BP21 had to use the Arrow key to browse the structure of the topic section on the DL page. This tactic helped him comprehend that the topics appeared in alphabetical order and that there were additional browsing options (Figure 5, 5.6).

Compared with system factors, there are fewer user factors behind the application of *ES*. PE (17) served as the major user factor driving participants to apply this tactic. For blind participants, PE is the basis for them to pursue certain steps or actions to explore a system during their first interaction. BP30 stated that he had a general way to start an exploration when visiting an unfamiliar site (Figure 6, 6.1).

A participant's insufficient retrieval knowledge also played a role in applying *ES*. RK is related to unfamiliarity with an IR system, which prompts participants to scan the structure of the DL. BP27 used Page up twice and was unaware that she was at the top of the page. She expressed a feeling of confusion and then arrowed down the DL page to comprehend the structure of the DL (Figure 6, 6.2).

In several cases, more than one factor prompted participants to apply *ES*. BP23 was influenced by both system factor HS and user factor PE. The absence of the

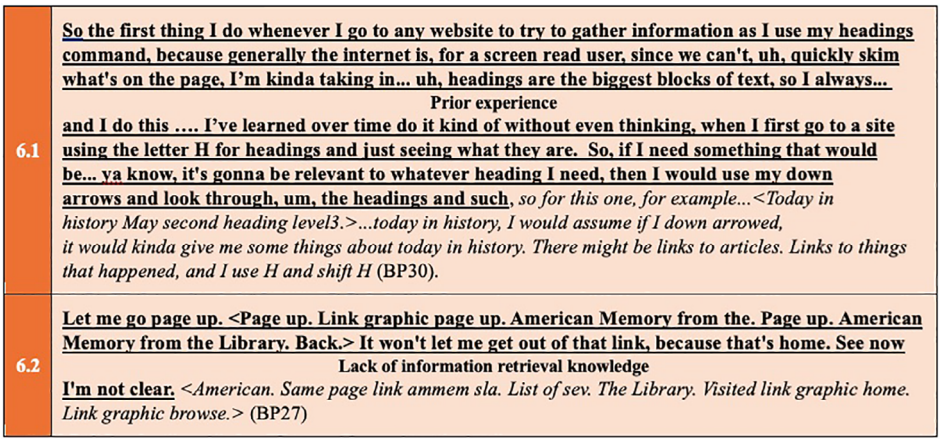

FIGURE 6 Examples of user factors for exploring DL structure [Color figure can be viewed at wileyonlinelibrary.com]

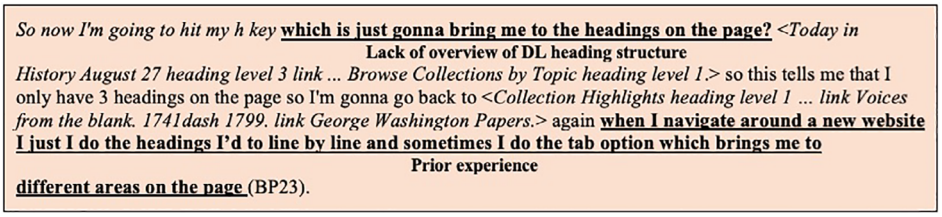

FIGURE 7 An example of combined system and user factors for exploring DL structure [Color figure can be viewed at wileyonlinelibrary.com]

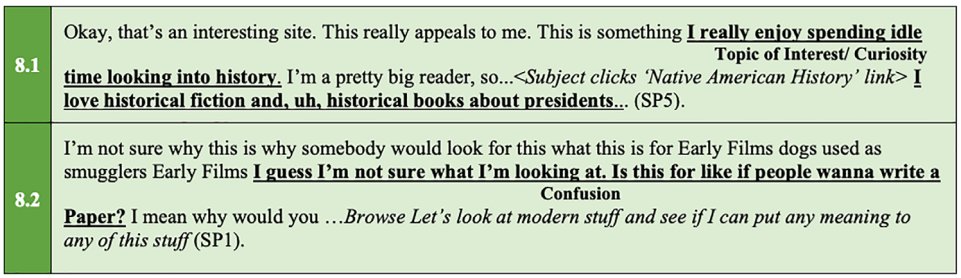

FIGURE 8 Examples of user factors for skimming DL content [Color figure can be viewed at wileyonlinelibrary.com]

overview of heading structure and the participant's prior experience navigating unfamiliar websites led to her using the H key to understand the heading levels and organization in the initial interaction with the DL (Figure 7).

5.3.2 | Factors associated with skimming DL content

For sighted participants, the frequency in employing the *SC* tactic was significantly greater than their blind counterparts. The result of the qualitative analysis revealed two types of user factors consisting of topic of interest/ curiosity (IC) and confusion (CF), two types of interaction outcomes including too many results (TR) and lack of results (LR), and one type of system factor—presentation style (PS) behind *SC*.

IC (35) was the most frequently utilized user factor affecting *SC*. Compared to blind participants, the sighted participants were able to quickly get a visual overview of the DL page, which established a foundation for them to investigate the content of interest. SP5 sought historical books that piqued her interest and selected a specific collection of Native American History to skim through from the available items (Figure 8, 8.1).

CF (3) was ranked second based on frequency data. The difficulty in understanding the presented information triggered participants to skim through collections in the DL. SP1 expressed her confusion regarding early films about dogs as smugglers. This factor led her to read various content in the DL to make sense of it (Figure 8, 8.2).

In addition to user factors, interaction outcome factors influenced sighted participants' choice of tactics. LR appeared three times when sighted participants used *SC*. An insufficient number of results caused participants to

9.1	And I didn't **really didn't see anything on there**. *I'm gonna go to I'm gonna go to Cities and Towns* (SP6). **Lack of results**
9.2	**I...it might take me a while to get through this** if something in the title, um, would... would attract me. **Too many results** And, again, I'm not there for anything specific. *California Missions* (SP30).

FIGURE 9 Examples of interaction outcome factors for skimming DL content [Color figure can be viewed at wileyonlinelibrary.com]

First thing I see is a picture of George Washington. I dunno, I guess I just... **I look at the pictures** and **bold font. Colors stand out, like this orange. Today in history perks my interest.** But it's... I can't read it on here, **Presentation style** **Topic of interest** so it's, like, saying to hit the link if I wanna see what happened in history today. <*Subject clicks on 'today in history' link.*> (SP27)

FIGURE 10 An example of system and user factors for skimming DL content [Color figure can be viewed at wileyonlinelibrary.com]

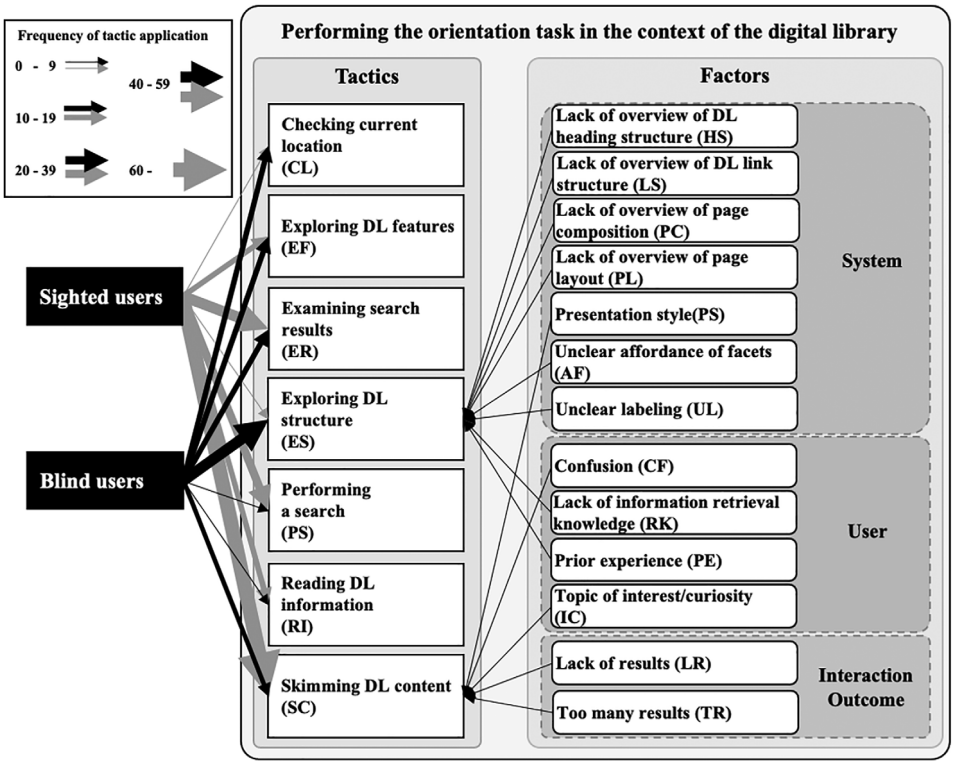

FIGURE 11 Orientation tactics applied by blind and sighted users and associated factors

browse alternative collections. SP6 was unable to find what she wanted to read during the previous action. This led her to skim through a different DL collection (Figure 9, 9.1).

Only one incident presented the TR factor. SP30 encountered such a large quantity of results that she could not look closely at every item. TR influenced her to skim through the contents of the California Mission collection (Figure 9, 9.2).

PS was the only system factor that led to the application of *SC*, and it only occurred twice. PS is closely related to visual elements that define the discoverability of content on a DL page. SP27 illustrated how the font and color, as well as the topic, attracted his attention and led him to identify the "Today in history" section of the DL page and browse the content of the related collections (Figure 10).

6 | DISCUSSION

6.1 | Theoretical implications

This is the first study to investigate the types of tactics applied by blind and sighted users during their interactions with a DL. Even though researchers of this study cannot develop an interactive IR model taking into consideration both blind and sighted users based on the findings of the study because of space and sample limitations, the results (Figure 11) offer some insightful data that can be considered as the first step to build a theoretical model in the future. The theoretical significances of the study are threefold: (a) the identification of substantial differences in applying orientation tactics between the two groups; (b) the identification of differences of factors

behind the employment of diverse tactics between the two groups; and (c) association of the findings with interactive IR models and models of disabilities. First, the results of this study show that blind and sighted users exhibit significant differences in applying tactics when trying to familiarize themselves with a DL. Compared to previous research on web navigation tactics (Jobst, 2009; Trewin et al., 2010), navigation and search tactics (Borodin et al., 2010) and coping tactics (Vigo & Harper, 2013, 2014), this study extends the differences uncovered in prior studies of web sites to the DL environment and from search tactics to orientation tactics. Few studies have compared tactics performed by blind and sighted user groups. Results of previous studies indicate that blind users employed tactics of probing, finding new information, and reviewing existing information more often than sighted users in non-DL web environments (Bigham et al., 2007; Sahib et al., 2012). The findings of this study show that, on one hand, sighted users could quickly grasp the DL structure during their initial orienting interaction so they have more time concentrating on exploring DL content by using more *skimming DL content* (*SC*), *examining search results* (*ER*), *performing a search* (*PS*), and *reading DL information* (*RI*) than blind users. On the other hand, blind users had to focus on figuring out DL structure and their locations by applying *exploring DL structure* (*ES*) and *checking current location* (*CL*) more than their counterparts. Both groups employed a comparable number of *exploring DL features* (*EF*).

For the second and third points, the critical question is what factors lead to the application of different types of tactics by the two groups. Most previous research on factors has concentrated on sighted users, specifically users' knowledge and experience (Chen & Macredie, 2010; Kim, 2009; Vakkari, 2016; Xie & Cool, 2009; Xie & Joo, 2012), system design (Lu et al., 2017; Xie & Joo, 2012) and interaction outcome (Xie & Cool, 2009; Xie & Joo, 2012). The interactive IR models have highlighted system, user, interaction, contextual factors (Bates, 1989; Belkin, 1993; Pharo, 2004; Saracevic, 1997; Vakkari, 2001; Xie, 2008). For BVI users, system factors related to a linear mode of interaction were mainly identified (Borodin et al., 2010; Jobst, 2009; Lazar et al., 2007; Vigo & Harper, 2014; Yoon et al., 2016). While the medical model blames individual impairments (Brisenden, 1986; Kearney & Pryor, 2004), the social model indicates that social discrimination and exclusion are the cause for blind users' selection of specific tactics (Dewsbury et al., 2004; Kleynhans & Fourie, 2014). The findings of this study support the social model, showing that more system factors than user factors affect blind users' application of *ES*. Six types of system factors including lack of overview of DL link structure (LS), lack of overview of page composition (PC), lack of overview of heading structure (HS), lack of overview of page layout (PL), unclear labeling (UL), and unclear affordance of facets (AF) mainly influenced the application of the tactic. The AMDC represents the typical sight-centered design so that blind users have to browse DL structure before they start when sighted users can directly skim DL contents. Since AMDC only offers an overview of the DL link structure, page composition, heading structure, and page layout that are visible to sighted users but not to blind users, blind users need to explore them sequentially. The sight-centered design of the DL neglects the needs of blind users, prohibiting them from quickly grasping and understanding the DL structure. Compared with previous research, this study discovers more specific system factors that lead to blind users to choose their top orientation tactic.

Even though user factors play a role in the application of *ES* for blind users, they are not directly related to an individual's impairments; rather, the two user factors are associated with their previous experience and IR knowledge using other types of IR systems. In contrast, sighted users' choice of *SC* was influenced by two user factors, two interaction outcomes, and one system factor. Among the user factors, Topic of interest/curiosity and Confusion were the main driving force. The two interaction outcome factors were lack of results and too many results. Compared with factors for blind users, only one system factor, presentation style, emerged for sighted users.

The results of the study not only support the social model of disability rather than the medical model but also contribute to the creation of new interactive IR models that incorporate both sighted and blind users' tactics and associated factors. First, the interactive IR models need to consider that sighted and blind users focus on the applications of different types of tactics in their interaction with DLs. Second, although both user and system factors have been identified from the previous interactive IR models, interestingly, this study shows that the differences using diverse tactics between the two groups are not caused by the impairment of the blind users. Instead, it is the sighted-centered design that leads to the disparity. While both groups share the same user factors: IC and CF, it is the system factors, such as LS, PC, HS, PL, UL, and AF that sighted users can easily see but blind users have difficulty to master, which are behind the difference in tactic employment between the two groups. The irony is that, although existing interactive IR models take a user-centered approach rather than a system-oriented approach, they still take a sighted-centered approach without supporting people with disabilities, such as the blind. Interactive IR models also need to ensure that social discrimination and exclusion are avoided in system design and that accessible IR systems are created for all users.

6.2 | Practical implications

Unlike the medical and social models, the gap model of disability intends to bridge the gap between individuals' abilities and societal and institutional demands (Grue, 2011; Shakespeare, 2004; Tøssebro, 2004). The results of this study not only identify the gap between DL design and the needs of blind users but also yield important practical implications. Knowledge about preferred tactics helps researchers accurately understand user needs in orientating within a DL. Conversely, knowledge about the associated factors can assist designers in improving DL design to attract blind users to use DLs.

Here we discuss the practical implications of the tactic most frequently applied by blind users—*ES*—and the top four factors that motivate the choice of this tactic. LS was identified as a critical factor associated with *ES*. To assist in exploration, three design strategies might be useful. First, every link should have a meaningful label that clarifies its destination. Second, links that serve similar purposes should be collocated in a clearly delineated part of a DL page. Third, a help feature should trigger screen readers to verbalize a summary of the link structure. These features would likely assist blind users in identifying different categories of links and their relative location on the page, and in determining how to directly access a relevant link.

Another important factor that influenced the choice of *ES* was PC. Our findings imply that gaining an overview of a DL page composition is not a straightforward task for blind, first-time DL users. Due to the linear information processing imposed by nonvisual interaction, a blind user is likely to spend extra effort in acquiring this information. To assist blind, a useful design strategy could be to provide a help feature that triggers screen readers to verbalize a summary of page composition: page title, section titles, text content, links, form elements, images, videos, etc. that make up a DL home page, and their general ordering.

The third factor behind the application of *ES* was HS. A heading structure represents how content is partitioned into sections, topic(s) covered in each section, and their relative locations. Three design strategies might be useful. First, divide DL home page content into logical sections, each revolving around a relevant theme. Second, assign a concise but meaningful title that embeds a heading tag. Third, add a help feature on the home page to trigger the screen reader to verbalize a summary of the heading structure.

PL was the fourth factor that motivated *ES*. Findings related to page layout imply that locating and recognizing two-dimensional information objects may be quite challenging for a first-time blind user. To help them acquire this knowledge, a useful design could be to offer a help feature that triggers the screen reader to announce an outline of two-dimensional information items available on the DL home page, the names of associated attributes, and shortcut (if any) to a specific two-dimensional information item. This measure is likely to help blind users in gaining necessary orientation information, such as how many columns a table has, or where a given link is located within the page relative to another.

7 | CONCLUSION

This study represents the first attempt at systematic examination of the initial interaction experiences of blind and sighted users with a DL to identify and compare orientation tactics applied and factors behind the choice of each tactic. The findings contribute to the field of library and information science theoretically and practically. Theoretically, the results support the social model of disability and further reveal the limitation of the existing interactive IR models—sighted-centered design without considering the tactics and associated factors of people with disabilities, in particular the blind. Practically, the study contributes knowledge about the different types of factors—system, user, or interaction—and the types of suggested help features. This research serves as the first stage of an iterative process to develop theories and design knowledge to construct DLs that offer a nonthreatening and engaging IR environment to blind users.

The study has its limitations. First, it examined only one DL representing a single design. Second, the number of participants and the amount of time that participants spent orientating to the DL might be insufficient for some to try certain tactics as frequently as they otherwise would. Future research should conduct a wider-scale investigation using diverse DL models (e.g., aggregated digital collections from one organization, federated DLs from multiple organizations, and a specialized DL dedicated to a specific multimedia format), recruiting more participants, and offering participants more orientation time to generate complete and statistically generalizable results. In addition, future research should design and validate recommended help features to better engage blind users during their initial interactions with a DL. Finally, further research needs to develop interactive IR models that encompass people with disabilities.

ACKNOWLEDGMENTS

The authors thank the Institute of Museum and Library Services (Leadership Grants for Libraries) and University of Wisconsin-Milwaukee (Research Growth Initiative Grant and Discovery and Innovation Grant) for funding for this project, as well as constructive comments provided by the reviewers.

REFERENCES

Albertson, D. (2015). Synthesizing visual digital library research to formulate a user-centered evaluation framework. *New Library World*, *116*(3/4), 122–135.

Babu, R., & Xie, I. (2017). Haze in the digital library: Design issues hampering accessibility for blind users. *The Electronic Library*, *35*(5), 1052–1065.

Bates, M. J. (1979). Information search tactics. *Journal of the American Society for Information Science*, *30*(4), 205–214.

Bates, M. J. (1989). The design of browsing and berrypicking techniques for the online search interface. *Online Review*, *13*(5), 407–424.

Belkin, N. J. (1993). Interaction with texts: Information retrieval as information-seeking behavior. In *Information retrieval'93: Von der Modellierung zur Anwendung* (pp. 55–66). Universitaetsverlag Konstanz.

Berget, G., & MacFarlane, A. (2020). What is known about the impact of impairments on information seeking and searching? *Journal of the Association for Information Science and Technology*, *71*(5), 596–611.

Berget, G., MacFarlane, A., & Pharo, N. (2020). Modelling the information seeking and searching behaviour of users with impairments: Are existing models applicable? *Journal of Documentation*, *77*(2), 381–400.

Bigham, J. P., Cavender, A. C., Brudvik, J. T., Wobbrock, J. O., & Ladner, R. E. (2007). WebinSitu: A comparative analysis of blind and sighted browsing behavior. In *Computers and Accessibility Proceedings of the 9th International ACM SIGACCESS Conference* (pp. 51–58). ACM.

Borodin, Y., Bigham, J. P., Dausch, G., & Ramakrishnan, I. V. (2010). More than meets the eye: A survey of screen-reader browsing strategies. In *Proceedings of the 2010 International Cross Disciplinary Conference on Web Accessibility* (pp. 1–10). ACM.

Brisenden, S. (1986). Independent living and the medical model of disability. *Disability, Handicap and Society*, *1*(2), 173–178.

Byström, K. (2002). Information and information sources in tasks of varying complexity. *Journal of the American Society for Information Science and Technology*, *53*(7), 581–591.

Chen, S. Y., & Macredie, R. (2010). Web-based interaction: A review of three important human factors. *International Journal of Information Management*, *30*(5), 379–387.

Choi, Y. (2013). Analysis of image search queries on the web: Query modification patterns and semantic attributes. *Journal of the American Society for Information Science and Technology*, *64*(7), 1423–1441.

Debowski, S. (2001). Wrong way: Go back! An exploration of novice search behaviours while conducting an information search. *The Electronic Library*, *19*(6), 371–382.

Dewsbury, G., Clarke, K., Randall, D., Rouncefield, M., & Sommerville, I. (2004). The anti-social model of disability. *Disability and Society*, *19*(2), 145–158.

Ellis, D. (1989). A behavioural approach to information retrieval system design. *Journal of Documentation*, *45*(3), 171–212.

Grue, J. (2011). Discourse analysis and disability: Some topics and issues. *Discourse and Society*, *22*(5), 532–546.

Han, H., & Wolfram, D. (2016). An exploration of search session patterns in an image-based digital library. *Journal of Information Science*, *42*(4), 477–491.

He, J., Qvarfordt, P., Halvey, M., & Golovchinsky, G. (2016). Beyond actions: Exploring the discovery of tactics from user logs. *Information Processing and Management*, *52*(6), 1200–1226.

Holsti, O. R. (1969). *Content analysis for the social sciences and humanities*. Addison-Wesley.

Hsieh-Yee, I. (1993). Effects of search experience and subject knowledge on the search tactics of novice and experienced searchers. *Journal of the American Society for Information Science*, *44*(3), 161–174.

Ingwersen, P., & Järvelin, K. (2005). *The turn: Integration of information seeking and retrieval in context*. Springer.

Jaeger, P. T., Bertot, J. C., & Franklin, R. E. (2010). Diversity, inclusion, and underrepresented populations in LIS research. *The Library Quarterly*, *80*(2), 175–181.

Jobst, J. E. (2009). *An exploratory study of screen-reader users navigating the web* [Doctoral dissertation, The University of Texas at Austin]. UT Electronic Theses and Dissertations. Retrieved from https://repositories.lib.utexas.edu/handle/2152/29611.

Kearney, P. M., & Pryor, J. (2004). The international classification of functioning, disability and health (ICF) and nursing. *Journal of Advanced Nursing*, *46*(2), 162–170.

Kelly, D., & Sugimoto, C. R. (2013). A systematic review of interactive information retrieval evaluation studies, 1967–2006. *Journal of the American Society for Information Science and Technology*, *64*(4), 745–770.

Kim, J. (2009). Describing and predicting information seeking behavior on the web. *Journal of the American Society for Information Science and Technology*, *60*(4), 679–693.

Kleynhans, S. A., & Fourie, I. (2014). Ensuring accessibility of electronic information resources for visually impaired people: The need to clarify concepts such as visually impaired. *Library Hi Tech*, *32*(2), 368–379.

Lazar, J., Allen, A., Kleinman, J., & Malarkey, C. (2007). What frustrates screen reader users on the Web: A study of 100 blind users? *International Journal of Human-Computer Interaction*, *22*(3), 247–269.

Li, Y., & Belkin, N. J. (2010). An exploration of the relationships between work task and interactive information search behavior. *Journal of the American Society for Information Science and Technology*, *61*(9), 1771–1789.

Li, Y., & Liu, C. (2019). Information resource, interface, and tasks as user interaction components for digital library evaluation. *Information Processing and Management*, *56*(3), 704–720.

Lin, S. J., & Belkin, N. J. (2005). Validation of a model of information seeking over multiple search sessions. *Journal of the American Society for Information Science and Technology*, *56*(4), 393–415.

Liu, Y. H., & Wacholder, N. (2017). Evaluating the impact of MeSH (medical subject headings) terms on different types of searchers. *Information Processing and Management*, *53*(4), 851–870.

Lu, K., Joo, S., Lee, T., & Hu, R. (2017). Factors that influence query reformulations and search performance in health information retrieval: A multilevel modeling approach. *Journal of the Association for Information Science and Technology*, *68*(8), 1886–1898.

Marchionini, G. (1989). Information-seeking strategies of novices using a full-text electronic encyclopedia. *Journal of the American Society for Information Science*, *40*(1), 54–54, 66.

Niu, X., & Kelly, D. (2014). The use of query suggestions during information search. *Information Processing and Management*, *50*(1), 218–234.

O'Day, V. L., & Nardi, B. A. (2003). An ecological perspective of digital libraries. In A. P. Bishop, A. A. Van House, & B. P. Butterfield (Eds.), *Digital library use: Social practice indesign and evaluation* (pp. 65–84). MIT Press.

Pharo, N. (2004). A new model of information behaviour based on the search situation transition schema. *Information Research: An International Electronic Journal*, *10*(1), n1.

Rutter, S., Blinzler, V., Ye, C., Wilson, M. L., & Twidale, M. D. (2019). Search tactics used in solving everyday how-to technical tasks: Repertoire, selection and tenacity. *Information Processing and Management*, *56*(3), 919–938.

Sahib, N., Tombros, A., & Stockman, T. (2012). A comparative analysis of the information-seeking behavior of visually impaired and sighted searchers. *Journal of the American Society for Information Science and Technology*, *63*(2), 377–391.

Sahib, N., Tombros, A., & Stockman, T. (2014). Investigating the behavior of visually impaired users for multi-session search tasks. *Journal of the Association for Information Science and Technology*, *65*(1), 69–83.

Saracevic, T. (1997). The stratified model of information retrieval interaction: Extension and applications. *Proceedings of the 60th Annual Meeting of the American Society for Information Science*, *34*, 313–327.

Savolainen, R., & Kari, J. (2006). Facing and bridging gaps in Web searching. *Information Processing and Management*, *42*(2), 519–537.

Shakespeare, T. (2004). Social models of disability and other life strategies. *Scandinavian Journal of Disability Research*, *6*(1), 8–21.

Stefano, F., Borsci, S., & Stamerra, G. (2010). Web usability evaluation with screen reader users: Implementation of the partial concurrent thinking aloud technique. *Cognitive Processing*, *11*(3), 263–272.

Strauss, A., & Corbin, J. M. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Sage Publications.

Talja, S., & Nyce, J. M. (2015). The problem with problematic situations: Differences between practices, tasks, and situations as units of analysis. *Library and Information Science Research*, *37*(1), 61–67.

Terzi, L. (2004). The social model of disability: A philosophical critique. *Journal of Applied Philosophy*, *21*(2), 141–157.

Thatcher, A. (2008). Web search strategies: The influence of Web experience and task type. *Information Processing and Management*, *44*(3), 1308–1329.

Tøssebro, J. (2004). Understanding disability: Introduction to the special issues of SJDR. *Scandinavian Journal of Disability Research*, *6*(1), 3–7.

Trewin, S., Richards, J., Bellamy, R., John, B. E., Thomas, J., Swart, C., & Brezin, J. (2010). Toward modeling auditory information seeking strategies on the web. In *CHI'10 extended abstracts on human factors in computing systems* (pp. 3973–3978). ACM.

Vakkari, P. (2001). A theory of the task-based information retrieval process: A summary and generalisation of a longitudinal study. *Journal of Documentation*, *57*(1), 44–60.

Vakkari, P. (2016). Searching as learning: A systematization based on literature. *Journal of Information Science*, *42*(1), 7–18.

Vigo, M., & Harper, S. (2013). Coping tactics employed by visually disabled users on the web. *International Journal of Human-Computer Studies*, *71*(11), 1013–1025.

Vigo, M., & Harper, S. (2014). A snapshot of the first encounters of visually disabled users with the Web. *Computers in Human Behavior*, *34*, 203–212.

Walsh, D., & Hall, M. (2015). Just looking around: Supporting casual users initial encounters with digital cultural heritage. In M. Gäde, M. M. Hall, H. Huurdeman, J. Kamps, M. Koolen, M. Skov, E. Toms, & D. Walsh (Eds.), *Proceedings of the first international workshop on supporting complex search tasks* Retrieved from http://ceur-ws.org/Vol-1338/paper_6.pdf

WebAIM. (2019). *Screen Reader User Survey #8 Results*. Retrieved from https://webaim.org/projects/screenreadersurvey8/#finding.

Wildemuth, B. M., Kelly, D., Boettcher, E., Moore, E., & Dimitrova, G. (2018). Examining the impact of domain and cognitive complexity on query formulation and reformulation. *Information Processing and Management*, *54*(3), 433–450.

Xie, I. (2008). *Interactive information retrieval in digital environments*. IGI Global Inc.

Xie, I. (2018). Information searching and search models. In J. D. Mcdonald & M. Levine-Clark (Eds.), *Encyclopedia of library and information sciences* (4th ed.). CRC Press.

Xie, I., Babu, R., Castillo, M. D., & Han, H. (2018). Identification of factors associated with blind users' help-seeking situations in interacting with digital libraries. *Journal of the Association for Information Science and Technology*, *69*(4), 514–527.

Xie, I., Babu, R., Lee, T., Castillo, M., You, S., & Hanlon, A. (2020). Enhancing usability of digital libraries: Designing help features to support blind and visually impaired users. *Information Processing and Management*, *57*(3), 102110.

Xie, I., Babu, R., Lee, T. H., Wang, S., & Lee, H. S. (2020). Tactics applied by blind and sighted users: Initial exploration of a digital library. In *Proceedings of the ACM/IEEE Joint Conference on Digital Libraries in 2020* (pp. 445–446). ACM.

Xie, I., & Cool, C. (2009). Understanding help seeking within the context of searching digital libraries. *Journal of the American Society for Information Science and Technology*, *60*(3), 477–494.

Xie, I., & Joo, S. (2010). Transitions in search tactics during the Web-based search process. *Journal of American Society for Information and Science Technology*, *61*(11), 2188–2205.

Xie, I., & Joo, S. (2012). Factors affecting the selection of search tactics during the web-based searching process. *Information Processing and Management*, *48*(2), 254–270.

Xie, I., Joo, S., & Bennett-Kapusniak, R. (2017). User involvement and system support in applying search tactics. *Journal of the Association for Information Science and Technology*, *68*(5), 1165–1185.

Yoon, K., Dols, R., Hulscher, L., & Newberry, T. (2016). An exploratory study of library website accessibility for visually impaired users. *Library and Information Science Research*, *38*(3), 250–258.

How to cite this article: Xie I, Babu R, Lee HS, Wang S, Lee TH. Orientation tactics and associated factors in the digital library environment: Comparison between blind and sighted users. *J Assoc Inf Sci Technol*. 2021;1–16. https://doi.org/10.1002/asi.24469