Research Article Open Access

Sara Behimehr, Hamid R. Jamali*

Relations between Cognitive Biases and Some Concepts of Information Behavior

https://doi.org/10.2478/dim-2020-0007
received March 6, 2020; accepted April 13, 2020.

Abstract: Information behavior, as a part of human behavior, has many aspects, including a cognitive aspect. Cognitive biases, one of the important issues in psychology and cognitive science, can play a critical role in people's behaviors and their information behavior. This article discusses the potential relationships between some concepts of human information behavior and cognitive biases. The qualitative research included semistructured face-to-face interviews with 25 postgraduate students who were at the writing-up stage of their research. The participants were selected using a purposeful sampling process. Interviews were analyzed using the coding technique of classic grounded theory. The research framework was the Eisenberg and Berkowitz information behavior model. The relationships that are discussed in this article include those between the principle of least effort on the one hand and availability bias and ambiguity aversion on the other; value-sensitive design and reactance; willingness to return and availability bias; library anxiety and ambiguity aversion, status quo bias, and stereotypical bias; information avoidance and selective perception, confirmation bias, stereotypical bias, and conservatism bias; information overload and information bias; and finally, filtering and attentional bias.

Keywords: cognitive biases, information behavior, information seeking, information behavior model

1 Introduction

Information behavior is a complex part of human behavior. As Spink (2010, p. 2) pointed out, to bring our understanding of information behavior into the general framework of the cognitive, evolutionary, and behavioral sciences, we need to use the approaches and findings of these fields. Those scientific areas provide frameworks to explore how human behavior has evolved and how it develops over a lifetime. One of the phenomena encountered in the cognitive sciences is cognitive biases. Pioneering works by Tversky and Kahneman (1974) paved the way for understanding the role of cognitive biases in our decision-making and judgments. Research has shown that humans use some simplifying strategies or rules of thumb, known as heuristics, when making decisions. Heuristics, as the standard rules that implicitly direct our judgment, are – in a way – mechanisms that help us to cope with the complex decision-making environments. In general, heuristics are helpful, but their use sometimes leads to severe errors (Bazerman and Moore, 2012, p. 6). They help to deal with complexity and ambiguity; however, under many circumstances, they lead to predictably faulty judgments known as cognitive biases. Cognitive biases are mental errors caused by our simplified information-processing strategies (Heuer, 2007, p. 111). Such biases exist because fast thinking (known as System 1 thinking) unconsciously evaluates any given situation and attempts to pattern-match it to a previous situation from our past experiences (Ehrlinger, Readinger, and Kim, 2016, p. 14). Being aware of a bias does not necessarily result in a more accurate perception. Therefore, cognitive biases are very difficult to overcome (Heuer, 2007, p. 112).

Many cognitive biases have been identified[1] by researchers over the past few decades. Several researchers have described the impacts of cognitive biases on information behavior. For instance, Kayhan (2015)

***Corresponding author: Hamid R. Jamali,** School of Information Studies, Charles Sturt University, Wagga Wagga, Australia, Email: h.jamali@gmail.com
Sara Behimehr, Department of Library and Information Science, Kharazmi University, Tehran, Iran, Email: behimehr.sara@gmail.com

1 There are different lists of cognitive biases in the literature. The list compiled by Benson and illustrated by John Manoogian (2016) includes about 180 such biases.

states that users might fall prey to different cognitive biases during a Web search. Moreover, White (2013, p. 1) states that biases are present in information retrieval in situations wherein searchers seek or are presented with information that significantly deviates from true likelihoods. The presence and impact of cognitive biases on information behavior have been confirmed by several studies, such as that by Schmutte and Duncan (2014).

However, cognitive biases have not received much attention from library and information science (LIS) researchers. We conducted a qualitative study on cognitive biases in the information behavior of graduate students during their research projects (thesis or dissertation) and identified several different biases that could occur during information behavior (Behimehr, 2019). It appeared from the data that the role and impact that cognitive biases play in information behavior are somewhat similar to some of the well-known concepts and principles of information behavior. Knowing how several aspects of information behavior can be related to cognitive biases can be helpful, both in terms of theoretical foundations of information behavior and in terms of advancing research into the design and delivery of information systems and services. Given the age of fake news and misinformation, information professionals need to play a more active role in increasing awareness of cognitive biases and mitigating their risk, both in their own practice and for their users (Jamali, 2019). Therefore, this paper, drawing on some of the findings of the qualitative study, discusses such probable relationships between cognitive biases and information behavior concepts. The question the study seeks to answer is what potential interaction or relationship, if any, might exist between the concepts of information behavior and cognitive biases?

2 Literature Review

Research, such as the studies done by Tversky and Kahneman (1974), on human judgment, heuristics, and biases were among the early works on biases. In information science, while cognitive biases have not received much attention in the domain of human information behavior, there have been studies on relevant concepts such as uncertainty (e.g., works by Kuhlthau, 1993; Ingwersen, 1996; and Wilson, Ford, Ellis, Foster, & Spink, 2002), which plays an important role in information behavior.

Cognitive biases have received more attention from researchers in many areas, such as information systems (e.g., Kirs, Pflughoeft, & Kroeck, 2001; Arnott, 2006) and health information (e.g., Lau & Coiera, 2007, 2009; Schweiger, Oeberst, & Cress, 2014). There are two reviews of research on cognitive biases in information systems (Fleischmann, Amirpur, Benlian, & Hess, 2014; Mohanani, Salman, Turhan, Rodriguez, & Ralph, 2017). The reviews showed that biases were studied in the areas of management, usage, and development of information systems.

Studies on cognitive biases in health information are related to information behavior. A few of them have aimed to identify the impacts of cognitive biases in the process of searching for information. For instance, Lau and Coiera (2007) conducted a retrospective analysis (on 75 clinicians) and a prospective experiment (on 227 undergraduate students) in the health information context and found that individuals may experience cognitive biases, such as anchoring, exposure, and order biases while searching for health information, and these biases may influence the quality of decision-making during and after using information retrieval systems. The presence and influence of cognitive biases in the process of looking for information have been confirmed by several other studies. For instance, Keselman, Browne, and Kaufman (2008) found that selective perception and confirmation biases play a part in Web searching for health information searches. Several researchers have focused on one specific cognitive bias in the process of searching for information and try to understand that in detail. Jonas, Schulz-Hardt, Frey, and Thelen (2001) and Kayhan (2015) also investigate the impact of confirmation bias in health information seeking.

While studies such as those mentioned here have explored the presence and impact of cognitive biases, other studies investigate debiasing strategies to reduce or eliminate the negative impacts of cognitive biases. Providing tag clouds that implicitly reveal experts' evaluation of information (Schweiger, Oeberst, & Cress, 2014) and technical debiasing strategies such as manipulating Google's knowledge graph (Ludolph, Allam, & Schulz, 2016) are among the debiasing strategies studied. The effectiveness of debiasing strategies has been confirmed in several studies, such as those by Lau and Coiera (2009) and Huang, Hsu, and Ku (2012). For instance, Huang, Hsu, and Ku (2012) have found that computer-mediated counterargument can reduce the effects of confirmation bias.

Although studies on health information by researchers in health sciences highlight the role that cognitive biases can play in information behavior and there is a need for debiasing strategies to be used to reduce their impact, in the LIS, little has been published on the topic of cognitive biases. Among the few publications on cognitive biases

in the LIS field, there is an editorial (Blakesley, 2016) that explains the several behaviors of users of academic libraries through the lens of some cognitive biases, such as the status quo and anchoring biases. For instance, status quo bias might be the reason why users are usually unwilling to use a new catalog. The current study is an attempt to contribute to the thin LIS literature on cognitive biases.

3 Method

This qualitative study used the grounded theory as the research method. The research population included all graduate students of Kharazmi University (Tehran, Iran) who were at the dissertation/thesis stage and, therefore, needed to look for and use the information for their research. Face-to-face semistructured interviews were conducted with 25 students who were chosen through a purposeful sampling process. Recruitment was done by distributing notes through bulletin boards on campus. Interviewees were chosen from among those who initially expressed their interest, in a way to maximize diversity in terms of gender, research stage, and discipline. The participants included 20 PhD students and 5 Master's students. They were between 25 and 38 years of age, with an average age of 32 years. They consisted of 14 female and 11 male students from a range of disciplines, including LIS, mathematics, literature, geography, business administration, international relations, law, accounting, economics, management, and geology.

The interview questions covered the six stages of the Big6™ Skills for Information Literacy. This model, which is known as the Eisenberg and Berkowitz information behavior model, was adopted as the framework for the study and also to guide the interviews. The Big6 creates "metacognition," a state of awareness by students of their mental states and processes during information problem-solving (Lowe & Eisenberg, 2005, p. 64). The model encompasses six stages of information problem-solving, ranging from task definition to evaluation (Lowe & Eisenberg, 2005, p. 65).

1. Task definition:
   - Define the problem.
   - Identify the information needed.
2. Information-seeking strategies:
   - Determine all possible sources.
   - Select the best source.
3. Location and access:
   - Locate source.
   - Find information within the source.
4. Use of information:
   - Engage (e.g., read, hear, and view).
   - Extract relevant information.
5. Synthesis:
   - Organize the information from multiple sources.
   - Present the information.
6. Evaluation:
   - Judge the result (effectiveness).
   - Judge the process (efficiency).

This model was adopted because its stages roughly cover the stages in a research process, through which students might pass for doing a project (dissertation/thesis). The Big6 provides a logical set of steps, which are known as information literacy skills and which can basically address students' information needs and behavior in a flexible way. Lowe and Eisenberg (2005, p. 66) described it as a flexible process that includes the necessary elements for solving problems and completing tasks, and it has the potential for the study of human information behavior. They believed that the Big6 model is not always a linear process and can be applied to any information situation, academic or everyday information problems, needs, or situations. Using this model as the framework for the interviews helped to follow the students' information behavior process in the context of looking for information to conduct their research projects. Furthermore, following the six main steps helped the interviewees to focus and illustrate the details of their information-seeking process. Based on the model, the interviews consisted of several main questions about participants' information needs, information-seeking strategies, locating and accessing information, using information, synthesizing information, and evaluating their information-seeking process.

Before interviews, participants received an information sheet and signed a consent form. Before starting the interview, they were asked to think of real actions they had taken for their research and answer the questions based on their lived experiences. Interviews consisted of a series of questions (overall, between 16 and 21 questions) grouped based on the six stages in the Big6 model, plus a few overall questions at the end about their decision-making during their research. Questions included items related to interaction with information in the context of students' projects, successful and unsuccessful search, and information access experiences, as well as students' actions and decision-making throughout the six stages of the model. For instance, for locating and accessing the stage, we asked them how they located and got access to the information resources they had identified and how they made decisions in that regard. Or for the use

of information, we asked them what they did with the information they found, what type of information they considered to use, whether they ignored or avoided any information, and why. The interviews were recorded and transcribed for analysis, and they lasted, on average, for about 50 min. The data collection was continued until the researchers felt that the point of saturation had been reached. To ensure saturation, while the data analysis and constant comparison were being conducted alongside the data collection, after 22 interviews, the researchers felt that the incidents and behavior that the interviewees were reporting – and, therefore, the themes in the analysis – were recurring, and few new concepts were emerging. Three more interviews were conducted after this point to ensure that theoretical saturation was achieved. Of course, cognitive biases are complex phenomena, and if investigated fully, it would require a larger sample and many more interviews; however, as Aldiabat and Le Navenec (2018) have pointed out, the homogeneity of the sample, in that the participants were all graduate students (and not well-established researchers), might have helped achieve the saturation faster with fewer interviews. Fictional first names have been used in the interview quotations in the "Findings" section so that the gender of the participants is clear to readers.

The data were analyzed based on the classic grounded theory, coding with two main stages of coding: substantive coding and theoretical coding (based on Glaser's approach; Glaser & Strauss, 1967). The data analysis included the following steps:

- Interviews were transcribed, usually not long after the interviews, when the researcher had a fresh memory of the interview.
- In the substantive coding stage, which entails open and selective coding, interviews were read line by line for open coding and comparison of incidents. Codes were assigned to data based on what was happening in the data and what the participant was facing.
- Then, at the next stage, the initial core categories were identified and abstracted, and codes were compared.
- Finally, the relationship between concepts was established and elaborated. Moreover, at the final stage, codes and their incidents were matched with biases and stages of information seeking.
- Memos were used, and illustration of a mental map of the concepts helped the researchers to identify the incidents of cognitive biases and explore any possible relationship between all concepts.

The data analysis process was nonlinear. However, in this study, as the aim was not to develop a theory and because a framework (Big6) was already in use, the research aims, the framework, and the definition of biases played important roles in the process. As an example of the process of data analysis, an excerpt from one of the interviews is presented below:

> *... once I've found the information I'm looking for, I start reading and taking notes. For using the information, I check if the information is useful for my work. If there is some piece of information in the work that is important for my thesis and somehow supports the idea, model, or hypothesis in my thesis, I would highlight it and it catches my interest and I make sure I make note of it¼*

For the excerpt above, initially, codes such as those for a decision about the use of information, a tendency to favor supporting information, and the effect of the user's mentality on selecting the information were assigned. During the next stage, it was determined whether the incident was related to the fourth stage of Big6 (use of information) and that was assigned as a code. Similarly, the codes changed to inclination toward information that is aligned with own views. At the final stage, the comparison of codes with the definition of the biases resulted in coding the data as the incidence of confirmation bias during Stage 4 of information seeking.

Based on the aims of the study, the main focus during the coding was on identifying any meaningful connection between the principles and concepts of information behavior and cognitive biases, based on their roles in students' information behavior. Identification of biases was based on definitions of biases and matching the examples of the behavior of students with the definitions of biases. In other words, a cognitive bias in participants' information behavior was determined when a logical match appeared between the nature, meaning, and concept of the cognitive bias on the one hand and any action, decision, behavior, attitude, and thought that the participants had explained in the steps of information seeking in the interview on the other hand.

To ensure the credibility of the findings, a few actions were taken, including conducting data analysis twice with a 2-month interval to compare the results. Member checking (the interviewees were asked to check if their interviews were sound) and external audit (a second researcher went through the data and the outcome of the analysis) were also used. The result of all these processes demonstrated the credibility of the researchers' findings and interpretations.

4 Findings

The probable relationships between some of the cognitive biases and a few concepts and theories of human information behavior are examined in this research, and the results are illustrated in Figure 1. The examination is based on analyses of the research data, and the definition and features of each of the information behavior concepts and cognitive biases have been considered during the analysis process. Figure 1 shows how each concept is related to one or a few cognitive biases. The cognitive biases that are indicated in Figure 1 are relevant in the explanation and interpretation of several information behavior concepts. For instance, the principle of least effort is related to availability bias and ambiguity aversion bias, or it is shown that information bias might be a cause of information overload. Each of the concepts and related biases are explained below.

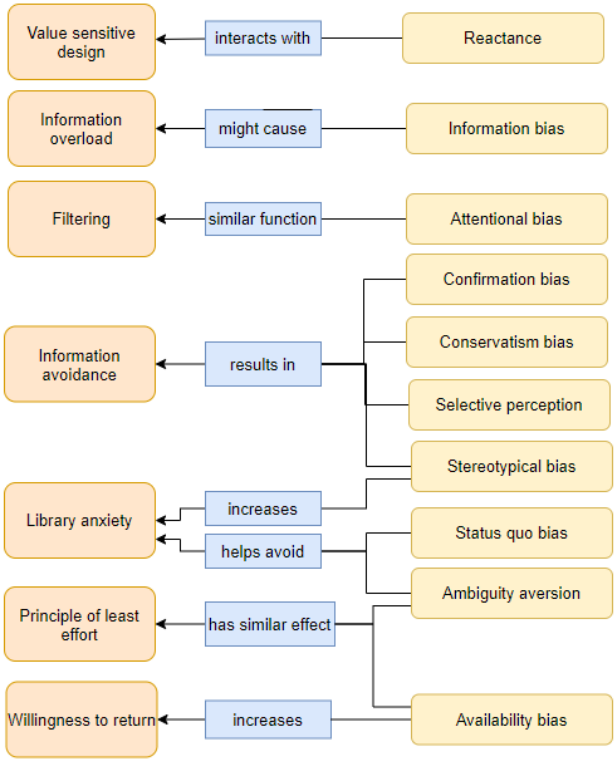

Figure 1. Relations between cognitive biases and concepts of information behavior

4.1 Principle of Least Effort – Availability Bias and Ambiguity Aversion Bias

The principle of least effort is a general and pervasive theory in information seeking. As Bates (2005) stated, this principle is probably the most solid result in all information behavior research. People prefer easy-to-use accessible sources to sources of known high quality that are less easy to use and/or less accessible. Past research also shows that ease of access is a preference for users when it comes to making an effort to get hold of information (Jamali, 2008; Tenopir et al., 2016). However, cognitive biases might interact with this principle or have a similar outcome. Availability bias is a "mental shortcut that allows people to estimate the probability of an outcome based on how prevalent or familiar that outcome appears in their lives" (Pompian, 2006, p. 94). Due to this bias, users who have a successful experience using an information source or center, and remember it more easily, choose to use the same source as it has greater availability in their memory. They prefer familiar, readily available sources, and avoid putting effort into trying new sources of information. One of the interviewees said, "I have many friends in my university and other universities. I always ask them my questions, the questions that are related to my research or questions about information-finding methods. At first, I ask them and it has been a good solution and always has worked for me." Another bias that might have a similar effect is ambiguity aversion. Ambiguity aversion bias indicates that people hesitate in situations of ambiguity (Pompian, 2006, p. 129). Interviews showed that students tend to avoid topics and information centers that can result in difficult circumstances. They avoid things that can cause ambiguity and minimize their effort by avoiding challenges.

4.2 Value-sensitive Design – Reactance

Humans have different beliefs and values, and this will influence people's information behavior (Friedman & Freier, 2005). Value-sensitive design particularly emphasizes values that have moral importance and implications, such as trust, intellectual property, universal usability, and moral responsibility (Friedman & Freier, 2005, p. 368). Interviews showed that when interviewees' right to access certain information was threatened, it affected their information behavior, and they become more determined to obtain the forbidden information since they felt their freedom (a human value) was threatened. In other words, when participants felt that they were prevented and banned from accessing some information and sources, regardless of the reason, they showed reactions and became keener to access the sources. This reaction, which influences information

behavior, illustrates Reactance, which is a cognitive bias. Reactance states that when people feel coerced into a certain behavior, they will react against the coercion, often by demonstrating an increased preference for the behavior that is restrained, and may perform the behavior opposite to that desired (VandenBos, 2007). Therefore, somehow the impact of human values on information behavior appears in the frame of cognitive bias (reactance). For example, David said, "in our society and under current circumstances, censorship of books, movies, and information is common, but in my opinion, it is more common that people have learned how to find a way to obtain the information that is needed. So, if there is any information that we want, we will find it at any cost." Research (Jamali & Shahbaztabar, 2017) has shown that Internet filtering (censorship) results in anxiety and negative feeling, and it increases people's willingness to access the information that is filtered by the authorities. It can be considered a natural process that humans tend to fight for freedom of choice, so reactance is observable in their behavior.

4.3 Willingness to Return Theory – Availability Bias

Durrance (1989, 1995) described willingness to return in his research as users' tendency to return to a library when they are satisfied with the services and when they get answers to their questions. In general, willingness to return means that people are willing to return to the same librarian, library, information center, database, and any other information sources with which they have been satisfied in the past. This principle seems to have an overlap with availability bias, which appeared at Stage 3 of information behavior (i.e., finding and accessing information). Availability bias makes users reuse an information service or source that they have successfully used in the past. Interviews showed instances where participants frequently used information sources that they had successfully used in the past, and they were the first sources they would remember to use.

4.4 Library Anxiety – Ambiguity Aversion, Status quo Bias, and Stereotypical Bias

Mellon (2015) found that sometimes students felt overwhelmed while looking for information in a library. Katopol (2005, p. 235) states: "Mellon found that students talked about their feeling about the library itself. They reported feeling lost, afraid to approach the library staff, unable to find their way around the library. Mellon labeled these collected feeling of discomfort 'library anxiety'." Library anxiety is a complicated issue in information behavior, and it can lead to a failure in the information behavior process. Library anxiety can be related to cognitive biases in different ways. Due to ambiguity bias in Steps 2 and 3 of information behavior, participants avoid ambiguous situations and circumstances with unknown outcomes; therefore, in a way, participants avoid anxiety too. In other words, ambiguity bias makes participants choose subjects that seem less ambiguous and avoid unfamiliar sources and centers even when they might be potentially useful. When participants are choosing a subject for their research, they avoid choosing a topic that does not have a rich literature and avoid research locations with which they are not familiar. They do not tend to use information sources that are new to them and they have no prior experience of using them. Therefore, in decision-making during information-seeking processes, participants avoid ambiguous situations, and it helps them avoid library anxiety. Likewise, status quo bias makes participants reluctant to change their usual information-seeking strategies, and it influences their preference to choose information sources and centers with which they are already familiar. Status quo bias is an emotional bias that predisposes people facing an array of choice options to elect whatever option ratifies or extends the existing condition (i.e., the "status quo") in lieu of alternative options that might bring about change (Pompian, 2006, p. 248). People can avoid change for a wide range of reasons; however, they often avoid change since change can be unpleasant. Changing a routine method of obtaining information and facing a new situation can lead to anxiety and because of status quo bias, participants can avoid library anxiety. It can be interpreted that library anxiety makes students avoid change in their information behavior, the same outcome as that of status quo bias.

Stereotypical bias means that our memory is distorted toward stereotypes (Moosa and Ramiah, 2017, p. 171). This bias can be related to the concept of library anxiety in a different way. Users interacting with a librarian may be anxious because they are concerned the librarian might judge them based on stereotypes (for instance, based on their field of education, gender, and so on). The fear of stereotypical judgments can make users nervous, and participants are worried about being judged based on stereotypes in information centers. Stereotypical bias can cause library anxiety as it is revealed in a quote from one of the interviewees. "People think that we are callous and heartless people since we are mathematicians. Many

times, when a librarian finds out my field, I always think he is not eager anymore to have a long conversation with me and answer all of my questions with detail. I mean he might think within himself that I am not sociable since I am a mathematician. It has happened to me in my life in many situations, including information centers," Jason states.

4.5 Information Avoidance – Selective Perception, Confirmation Bias, Stereotypical Bias, and Conservatism Bias

Chatman (1987) discovered that people of some social communities avoided information even when it was accessible and potentially useful to them. This discovery placed avoiding information on the information behavior research map (Fidel, 2012, p. 41). Undoubtedly, information avoidance is a complicated issue and can have many causes. Among the reasons that can result in information avoidance are cognitive biases such as selective perception, confirmation bias, stereotypical bias, and conservatism bias. Selective perception is a process in which people choose to attend to one or a few stimuli from the myriad array of stimuli presented to the senses at any one time (VandenBos, 2007). Selective perception can cause an increase in the tendency to choose topics, resources, or information centers that seem more aligned with participants' expectations. Case (2007) pointed to the concept of selective exposure to explain information avoidance. He stated that "we tend to notice those things that support our beliefs and ignore evidence that does not. Akin to selective exposure, this tendency is called selective perception" (p. 175). Therefore, when participants are involved with selective perception, they tend to avoid a piece of information if it is not congruent with their prior knowledge, beliefs, and opinions.

As stated above, stereotypical bias distorts the memory toward stereotypes. Interviews showed that students considered English sources superior to Persian sources in terms of scientific quality, which is a stereotype in the country, and as a result, they avoided Persian sources when they could. Confirmation bias is a tendency to selectively search for or interpret information in such a way that confirms one's preconceptions or hypotheses (Wilke & Mata, 2012, p. 532). On the other hand, conservatism bias is when people stick to their prior views at the expense of acknowledging new information (Pompian, 2006, p. 119). Both of these make users avoid information. There was evidence of the presence of these biases in the interviews. For instance, many students tended to look for information that confirmed their research findings or their expectations.

4.6 Information Overload – Information Bias

Information overload refers to an excessive amount of information or when we have too much information about something that makes it difficult to decide. Rogers (1986) defined it as "the state of an individual or system in which excessive communication inputs cannot be processed, leading to a breakdown" (p. 181). Many factors can cause information overload. For instance, living in the information age, mass media and social media make information overload a prevalent phenomenon. Information bias might be one of the causes of information overload. Information bias is the tendency to request unnecessary or unhelpful information, especially in times of uncertainty (Mohanani, Salman, Turhan, Rodriguez & Ralph, 2017, p. 21). In the interviews, many interviewees showed the tendency to do excessive searches with the desire to find every piece of information that could exist on the topic and with the assumption that more information is always better. Sarah pointed out in the interview: "I think it can be concluded that when you search more and more to find the information, you can get unlimited sources of information and it is the miracle of our age. However, I can say I usually get confused."

4.7 Filtering – Attentional Bias

Humans consciously and unconsciously use filtering techniques to manage large amounts of information. Filtering is "processing only information that is identified as having 'high priority'" (Miller, 1960). The reason is that we have limited attention capacity, and when we encounter too much information, we cease to pay prompt and careful attention to some of it (Case, 2007, p. 104). The research findings indicated that due to the role of attentional bias, participants pay more attention to certain aspects of information (e.g., author's reputation or affiliation), and this bias in attention influences their choices. Attentional bias is basically "a failure to look for evidence against an initial possibility, or a failure to consider alternative possibilities" (Baron, 2008, p. 188). This bias, similar to many other biases, helps people decide and choose quickly. Attentional bias is likely to interact with filtering techniques and has a similar function.

5 Discussion and Conclusions

The presence and the role of cognitive biases in our information behavior have been shown in various studies in the past (e.g., Lau & Coiera, 2009; White, 2013, Schweiger, Oeberst, & Cress, 2014; Ludolph Allam & Schulz, 2016; Behimehr, 2019), and certain cognitive biases, such as confirmation bias (Kayhan, 2015), selective perception (Keselman, Browne, & Kaufman, 2008), and status quo bias (Blakesley, 2016), have received more research attention. However, the interaction and relation of cognitive biases with a few phenomena and principles of information behavior have not received much attention. Both information behavior and cognitive biases are complex issues. A better understanding of information behavior requires attention to all factors involved in it. This article discusses several probable relationships that might exist between a few principles and concepts of information behavior and cognitive biases.

Research on information behavior not only looks at behavior but also investigates why certain behaviors occur. Studying cognitive biases can help understand both information behavior and causes of certain behaviors. The relationship between cognitive biases and phenomena, principles, or concepts of information behavior can be of different types. Figure 1 shows the relationships that are discussed in this paper. Sometimes, a cognitive bias might result in an outcome similar to that of an information behavior principle, sometimes a cognitive bias can be the cause of certain behavior, and occasionally, there could be several interactions between them. For instance, reactance might result in the type of outcome that value-sensitive design tries to explain, which is a reaction (in the form of increased determination and desire) to a restriction that undermines our values. In other cases, cognitive biases and information behavior principles might have similar functions and overlap in their outcome. This is the case, for instance, for the principle of least effort and availability bias and ambiguity aversion. These two biases might result in behaviors that are aligned with the principle of least effort. Willingness to return and availability bias also have similar functions. Availability bias can lead to a willingness to return. Some of the cognitive biases can be the cause of certain phenomena in information behavior. Information bias can result in information overload. A person who experiences information bias might collect too much information. Biases such as selective perception, confirmation bias, stereotypical bias, and conservatism bias can be the cause of information avoidance. The presence of stereotypical bias among information professionals can increase the library anxiety of users.

Some cognitive biases might have a general relation with certain information behaviors. Blakesley (2016) argued there might be a link between status quo bias and users' hesitation to use new library information systems. Our research also showed that due to status quo bias and ambiguity aversion, students were not keen on changing their way of information seeking or trying new and unfamiliar sources of information. This, in a way, is a mechanism for avoiding library anxiety. If they do not experience such biases, they might try new ways of information seeking or information sources and might have more success in meeting their information needs. Case (2007, p. 104) quotes Abraham Maslow (1963, p. 122) for a connection between knowledge and avoidance of responsibility. Maslow stated that "we can seek knowledge in order to reduce anxiety and we can also avoid knowing in order to reduce anxiety." Finally, some cognitive biases might serve as mechanisms for various strategies we deploy in our information behavior. Attentional bias serves as a mechanism for information filtering. This is not to say that the outcome of such biases that occur when engaging with information is positive but to note the role that they play when encountering and interacting with information.

Another core concept in the field of LIS is relevance (Saracevic, 1975), and relevance might be influenced by many cognitive biases. Over the past few decades, much research has been done on how people make relevance judgments and what factors (such as the feeling of uncertainty and values) influence their decisions (Mizzaro, 1997). However, cognitive biases have been ignored in this context. Biases such as confirmation bias, conservatism bias, negativity bias, attentional bias, and bandwagon are a few examples of biases that might play a role in the relevance judgment of users. For instance, negativity bias might make people evaluate negative information more relevant to their needs compared to positive information. This bias indicates that negative information tends to influence evaluations more strongly than positive information (Ito, Larsen, Smith, & Cacioppo, 1998, p. 887). As cognitive biases are about the way we process information for our quick decision-making, they all might play a role in our relevance judgment, and this is an area that researchers need to explore.

We need to note that bias is not always present. As Heuer (2007, p. 112) states, "When psychological experiments reveal the existence of a bias, this does not mean that every judgment by every person will be biased.

It means that in any group of people, the bias will exist to a greater or lesser degree in most judgments made by most of the group". Bias in a decision-making context does not mean being prejudicial and unwilling to have an open mind; rather, it refers to an unconscious inclination toward a particular outcome or belief, which can affect how humans search for and process information (Schmutte & Duncan, 2014, p. 69). Confirmation and full understanding of such relationships require carefully designed research studies. This study was an attempt to raise the issue for further research in this domain and was not conclusive in any sense. Future studies should also find out about the severity of the impact of cognitive biases on information behavior and examine the significance of their impact. It should be noted that what is presented in this paper was based on the information-seeking behavior of students in a qualitative study, and no generalization was intended. Future research can use the relationships proposed here as hypotheses.

References

Aldiabat, K. M., & Le Navenec, C. L. (2018). Data saturation: The mysterious step in grounded theory methodology. *Qualitative Report, 23*(1), 245-261.

Arnott, D. (2006). Cognitive biases and decision support systems development: A design science approach. *Information Systems Journal*, *16*(1), 55-78.

Baron, J. (2008) . *Thinking and deciding* (4th ed.). Cambridge: Cambridge University Press.

Bates, M. J. (2005). An Introduction to metatheories, theories and models. In K. E Fisher, S. Erdelez & L. McKechine (Eds.), *Theories of Information Behavior* (pp. 1-24). New Jersey, USA: Information Today.

Bazerman, M. H., & Moore, D. A. (2012). *Judgment in managerial decision making* (8th ed.). New Jersey: Wiley.

Behimehr, S. (2019). *A study of cognitive biases in scientific information behaviour of graduate students In Kharazmi University* (Doctoral dissertation). Kharazmi University, Iran.

Benson, B. (2016). *Cognitive bias cheat sheet*. Better Humans. Retrieved November 22, 2017, from https://betterhumans.coach.me/cognitive-bias-cheat-sheet-55a472476b18

Blakesley, E. (2016). Cognitive bias and the discovery layer. *The Journal of American Librarianship,* 42(3), 191.

Case, D. O. (2007). *Looking for information* (2nd ed.). Amsterdam, Netherlands: Elsevier.

Chatman, E. A. (1987). The information world of low-skilled workers. *Library & Information Science Research, 9*(4), 265-283.

Durrance, J. C. (1989). Reference success: Does 55% rule tell the whole story? *Library Journal, 114*(7), 31-36.

Durrance, J. (1995). Factors that influence reference success: What makes questioners willing to return? *The Reference Librarian, 23*(49-50), 243-265.

Ehrlinger, J., Readinger, W. O., & Kim, B. (2016). *Decision-making and cognitive biases*. Retrieved December 17, 2017, from https://www.researchgate.net/publication/301662722_Decision_Making_and_Cognitive_Biases.

Fidel, R. (2012). *Human information interaction: An ecological approach to information behavior.* London: The MIT Press.

Fleischmann, M., Amirpur, M., Benlian, A., & Hess, T. (2014, June). *Cognitive biases in information systems research: A scientometric analysis*. Paper presented at the Proceedings of the European Conference on Information Systems (ECIS) 2014, Tel Aviv, Israel. Retrieved from http://aisel.aisnet.org/ecis2014/proceedings/track02/5

Friedman, B. & Freier, N. G. (2005). Value sensitive design. In K. E Fisher, S. Erdelez & L. McKechine (Eds.), *Theories of Information Behavior* (pp. 368-372). New Jersey, USA: Information Today.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Aldine.

Heuer, R. J. (2007). *Psychology of intelligence analysis* (2nd ed.). New York: Central Intelligence Agency.

Huang, H. H., Hsu, J. S. C., & Ku, C. Y. (2012). Understanding the role of computer-mediated counter-argument in countering confirmation bias. *Decision Support Systems, 53*(3), 438-447.

Ingwersen, P. (1996). Cognitive perspectives of information retrieval interaction: Elements of a cognitive IR theory. *The Journal of Documentation*, *52*(1), 3–50.

Ito, T. A., Larsen, J. T., Smith, N. K., & Cacioppo, J. T. (1998). Negative information weighs more heavily on the brain: The negativity bias in evaluative categorizations. *Journal of Personality and Social Psychology, 75*(4), 887-900.

Jamali, H. R. (2008). What is not available online is not worth reading? *Webology*, *5*(4), Article 63. Retrieved from http://www.webology.org/2008/v5n4/a63.html

Jamali, H. R. (2019). The battle against cognitive bias. *Incite*, *40*(9/10), 14.

Jamali, H. R., & Shahbaztabar, P. (2017). The effects of internet filtering on users' information-seeking behaviour and emotions. *Aslib Journal of Information Management*, *69*(4), 408-425.

Jonas, E., Schulz-Hardt, S., Frey, D., & Thelen, N. (2001). Confirmation bias in sequential information search after preliminary decisions: An expansion of dissonance theoretical research on selective exposure to information. *Journal of Personality and Social Psychology*, *80*(4), 557-571.

Katopol, P. (2005). Library anxiety. In K. E. Fisher, S. Erdelez & E. F. McKechnie (Eds.), *Theories of information behavior.* New Jersey: Information Today.

Kayhan, V. (2015, December). *Confirmation bias: Roles of search engines and search contexts*. Paper presented at the Thirty sixth International Conference on Information Systems CICIS, Association for Information Systems. Fort Worth, Texas, USA.

Keselman, A., Browne, A. C., & Kaufman, D. R. (2008). Consumer health information seeking as hypothesis testing. *Journal of the American Medical Informatics Association, 15*(4), 484-495.

Kirs, P. J., Pflughoeft, K., & Kroeck, G. (2001). A process model cognitive biasing effects in information systems development and usage. *Information & Management, 38*(3), 153-165.

Kuhlthau, C. C. (1993). A principle of uncertainty for information seeking. *Journal of Documentation*, *49*(4), 339–355.

Lau, A. Y. S., & Coiera, E. W. (2007). Do people experience cognitive biases while searching for information? *Journal of the American Medical Information, 14*(5), 599-608.

Lau, A. Y. S., & Coiera, E. W. (2009). Can cognitive biases during consumer health information searches be reduced to improve decision making? *Journal of American Medical Informatics Association, 16*(1), 54-65.

Lowe, C. A., & Eisenberg, M. B. (2005). Big6 skills for information literacy. In K. E Fisher, S. Erdelez & L. McKechine (Eds.), *Theories of information behavior* (pp. 63-68). New Jersey, USA: Information Today.

Ludolph, R., Allam, A., & Schulz, P. J. (2016). Manipulating Google's Knowledge Graph box to counter biased information processing during an online search on vaccination: Application of a technological debiasing strategy. *Journal of Medical Internet Research, 18*(6), e137.

Maslow, A. H. (1963). The need to know and the fear of knowing. *The Journal of General Psychology, 68*(1), 111-125.

Mellon, C. (2015). Library anxiety: A grounded theory and its development. *College & Research Libraries, 76*(3), 276-282.

Miller, J. G. (1960). Information input overload and psychopathology. *American Journal of Psychiatry, 116*(8), 695-704.

Mizzaro, S. (1997). Relevance: The whole history. *Journal of the American Society for Information Science, 48*(9), 810-832.

Mohanani, R., Salman, I., Turhan, B., Rodriguez, P., & Ralph, P. (2017). Cognitive biases in software engineering: A systematic mapping and quasi-Literature review. *arXiv preprint:* 1707.03869. Retrieved January 6, 2018, from https://arxiv.org/abs/1707.03869

Moosa, I. A., & Ramiah, V. (2017). *The financial consequences of behavioural biases: An analysis of bias in corporate finance and financial planning*. Cham, Switzerland: Palgrave Macmillan.

Pompian, M. M. (2006). *Behavioral finance and wealth management: How to build optimal portfolios for private clients*. New Jersey: Wiley.

Rogers, E. M. (1986). *Communication technology: The new media in society*. New York: The Free Press.

Saracevic, T. (1975). Relevance: A review of and a framework for the thinking on the notion in information science. *Journal of the American Society for Information Science, 26*(6), 321-343.

Schmutte, J., & Duncan, J. R. (2014). Making independence decisions under the code of professional conduct. *The CPA Journal, 84*(10), 68-70.

Schweiger, S., Oeberst, A., & Cress, U. (2014). Confirmation bias in web-based search: A randomized online study on the effects of expert information and social tags on information search and evaluation. *Journal of Medical Internet Research, 16*(3), e94.

Spink, A. (2010). *Information behavior: An evolutionary instinct* (Vol. 16). New York: Springer Science & Business Media.

Tenopir, C., Levine, K., Allard, S., Christian, L., Volentine, R., Boehm, R., . . . Watkinson, A. (2016). Trustworthiness and authority of scholarly information in a digital age: Results of an international questionnaire. *Journal of the Association for Information Science and Technology*, *67*(10), 2344-2361.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185*(4157), 1124-1131.

VandenBos, G. R. (Ed.) (2007). *APA dictionary of psychology*. American Psychological Association, Washington, DC. Retrieved December 11, 2017, from https://dictionary.apa.org/anchoring-bias

White, R. (2013, July). *Beliefs and biases in web search*. Paper presented at the 36th International ACM SIGIR: Conference on Research and Development in Information Retrieval, Dublin, Ireland.

Wilke, A., & Mata, R. (2012). Cognitive bias. In V. S. Ramachandran (Ed.), *The Encyclopedia of Human Behavior* (Vol. 1, pp. 531-535). London: Elsevier.

Wilson, T. D., Ford, N. J., Ellis, D., Foster, A. E., & Spink, A. (2002). Information seeking and mediated searching: Part 2: Uncertainty and its correlates. *Journal of the American Society for Information Science and Technology, 53*(9), 704-715.