Research Report

Counter-regulation online: Threat biases retrieval of information during Internet search

Hannah Greving [a,*], Kai Sassenberg [a,b,1]

[a] Knowledge Media Research Center, Tübingen, Germany
[b] University of Tübingen, Germany

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ABSTRACT

The Internet is one of the main information sources. It is frequently used to gather information in self-relevant domains, such as health. Self-relevant information is likely to be accompanied by certain affective and motivational states. For instance, individuals may be afraid to be seriously ill and, thus, feel threatened. Threat is known to elicit preferential processing of positive information. Therefore, we predicted that under threat more positive search terms are retrieved from memory and more positive information is retrieved from already encoded online information than in a control condition. Two experiments supported this prediction. Thus, information processing during Internet search is positively biased under threat. This positive bias can satisfy coping needs, but can at the same time have a negative impact on subsequent behavior and decisions.

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1. Introduction

The Internet serves nowadays as prime non-human information source (e.g., Fallows, 2008; Purcell, 2011; Purcell, Brenner, & Rainie, 2012) and is frequently searched through for information. On the Internet, a huge amount of heterogeneous information is available across a seemingly unlimited array of domains. Importantly, Internet searches often target information in self-relevant domains (i.e., information affecting how the own situation or the self are evaluated). The Internet serves, for instance, as central information source for health issues (Fox, 2011; Fox & Duggan, 2013a; Morahan-Martin, 2004). Queries regarding health are, in fact, conducted that frequently that, for instance, influenza epidemics spreading out in the US could be identified merely on the basis of search engine log files (Ginsberg et al., 2009).

Internet search for self-relevant information is likely to be accompanied by affect and emotions (e.g., Fox, 2011; Fox & Duggan, 2013a; Morahan-Martin, 2004; see also Lo & Parham, 2010; Sassenberg & Greving, 2014). For instance, while individuals search for health-related information, they may be afraid to be seriously ill and feel threatened. We aimed at investigating the impact

of threat, beyond the health domain, on information search on the Internet, because previous research provides clear evidence that threat biases information processing. To be more precise, threat leads to preferential processing of positive information across different domains and tasks (i.e., positive bias; e.g., Jonas et al., 2014; Rothermund, Voss, & Wentura, 2008; Schwager & Rothermund, 2013a, 2014; Shepperd, Malone, & Sweeny, 2008; Taylor, 1991). Thus, threat is also very likely to bias information search on the Internet. Yet, research on Internet search has mostly focused on cognitive mechanisms (e.g., Fu & Pirolli, 2007; Pirolli, 2007; Pirolli & Card, 1999), cognitive input-factors (e.g., prior knowledge; Rouet, Ros, Goumi, Macedo-Rouet, & Dinet, 2011), search processes (e.g., Gerjets, Kammerer, & Werner, 2011; Walraven, Brand-Gruwel, & Boshuizen, 2013), and characteristics of the search interface (e.g., Kammerer & Gerjets, 2012, 2014). However, the impact of affective states on the search process and outcomes has not been investigated so far (for overviews see Brand-Gruwel, Wopereis, & Walraven, 2009; Kammerer & Gerjets, 2011). Thus, research on the biasing influence of threat on Internet search behavior has not received significant attention yet. In our lab, we have recently started to address this gap and have demonstrated that the *internalization* of information during Internet search is positively biased under threat (Greving, Sassenberg, & Fetterman, 2014). Yet, the ultimate outcomes of Internet searches are determined not only by the internalization of information (i.e., the encoding), but also by the *externalization* of information (i.e., retrieval), that is, the generation of search terms and the recall of information after the Internet search has been completed (e.g., Brand-Gruwel et al.,

* Corresponding author at: Knowledge Media Research Center, Schleichstr. 6, 72076 Tübingen, Germany. Tel.: +49 7071 979 243; fax: +49 7071 979 200.
  E-mail addresses: h.greving@iwm-kmrc.de (H. Greving), k.sassenberg@iwm-kmrc.de (K. Sassenberg).
¹ Address: Knowledge Media Research Center, Schleichstr. 6, 72076 Tübingen, Germany. Tel.: +49 7071 979 220; fax: +49 7071 979 200.

2009). Therefore, the current research addresses the impact of threat on these two steps of the Internet search process. Understanding how threat influences the externalization of information in the context of Internet search is highly relevant because (a) search terms heavily impact the search outcome and (b) retrieval of information from memory is the key determinant of subsequent behavior and decisions (cf. Fox & Duggan, 2013a,b; Fox & Jones, 2009) and plays an important role for the acquisition of knowledge in general (e.g., Karpicke & Blunt, 2011; Karpicke & Roediger, 2008). In sum, the research question that the current research sought to answer is how threat (compared to a neutral state) influences the retrieval of search terms from memory and the retrieval of already encoded online information (i.e., the externalization of information during Internet search). Thus, this research adds to and expands recent research by investigating the impact of threat on externalization steps of Internet search that have not been studied so far.

1.1. Information search on the Internet

The Internet provides a huge amount of heterogeneous information. In order to be able to navigate through this wealth of information in a productive way, individuals need to deal with the information provided and several models were proposed that describe and explain behavior during Internet search. The dominating cognitive model is described in the Information Foraging Theory (Pirolli, 2007; Pirolli & Card, 1999). This theory explains the cognitive mechanisms that underlie Internet search. It assumes that the selection and processing of information during Internet search is determined by the semantic similarity between an internal cognitive representation of current information needs and the textual cues on the Internet (e.g., keywords or trigger words in the title, summary, etc.). The stronger the semantic overlap between the cues contained in a particular search result and the Internet user's information needs, the higher is the likelihood that this particular search result will be selected and processed (Kammerer, Wollny, Gerjets, & Scheiter, 2009). Based on this semantic overlap, Internet search and navigation behavior have been computationally modeled (e.g., Fu & Pirolli, 2007; Pirolli, 2005). Other computational models of Internet search behavior likewise rely on informational relevance (e.g., Brumby & Howes, 2008; Miller & Remington, 2004).

In contrast to these computational models, other models represent Internet search behavior by means of search engines as a process on the behavioral level (cf., Wilson, 1999). Most of these models describe Internet search as an information problem solving process that can be segmented into several steps (e.g., Brand-Gruwel, Wopereis, & Vermetten, 2005; Brand-Gruwel et al., 2009; Gerjets et al., 2011; Rouet et al., 2011; Walraven et al., 2013; for an overview see Kammerer & Gerjets, 2011). Overall, these models identify similar steps of Internet search, which can be summarized as follows: First, preparing the information search by generating search terms from information mentally represented in memory. Second, searching information by selecting links from search engine result pages. Third, looking at information or scanning briefly the information presented on webpages. Fourth, processing information thoroughly and understanding the information on webpages. Finally, sense making of retrieved, encoded, and mentally represented information.

In order to being successful in finding information on the Internet, these steps need to be repeated in an iterative fashion (cf. Brand-Gruwel et al., 2005, 2009). As in any human–computer interaction, such a complex process involves the *internalization* of information (i.e., encoding) such as during link selection, scanning of webpages, and information acquisition, which serves the intention of finding new information (cf. Greving et al., 2014). Yet, it also involves the *externalization* of information (i.e., retrieval) such as during the generation of search terms and the retrieval of information already mentally represented in memory. As such, both the internalization and the externalization of information are highly relevant for successful Internet searches.

Although process models of Internet search have repeatedly stressed that Internet search is a complex process (e.g., Brand-Gruwel et al., 2005, 2009; Wilson, 1999; see also Kammerer & Gerjets, 2011), most individuals perceive the Internet as highly valid informational source (Fallows, 2008; Purcell et al., 2012). In fact, regarding their own abilities, individuals are quite confident to find valid information and they perceive information from the Internet, in turn, as highly trustworthy, accurate, and, by definition, true (Brand-Gruwel et al., 2009; Purcell et al., 2012; Ward, 2013). Yet, research on Internet search also demonstrates that the wealth and breadth of information available on the Internet often let individuals fail to identify valid and correct information (e.g., Gerjets et al., 2011; Kammerer & Gerjets, 2014; Rouet et al., 2011; Walraven et al., 2013). This is due to individuals' focus on surface cues (e.g., Kammerer & Gerjets, 2012, 2014; Rouet et al., 2011). However, if individuals have difficulties to acquire accurate information even when they are supposedly motivated by accuracy (e.g., Gerjets et al., 2011; Kammerer & Gerjets, 2014; Rouet et al., 2011; Walraven et al., 2013), biases in information processing under threat are likely to even more hinder successful Internet searches. First evidence has already earlier been provided for the influence of threat on the *internalization* of information during Internet search (Greving et al., 2014). In particular, that research has investigated the influence of threat on the selection of links, scanning of webpages, and acquisition of information during Internet search. It has demonstrated that threatened individuals selected more positive links, scanned positive webpages for a longer period of time, and acquired more positive information than non-threatened participants in a control condition (Greving et al., 2014). Thus, in this research, these internalization steps of Internet search were positively biased under threat.

However, the evidence of the internalization of information does not provide a complete picture, because Internet search also involves the *externalization* of information (i.e., retrieval; e.g., Brand-Gruwel et al., 2009; Kammerer & Gerjets, 2011). This is the case for the generation of search terms required to start the Internet search process, which heavily impacts on the search results. Externalizing (i.e., retrieving) information is similarly important with respect to the outcome of the Internet search process. The ultimate outcome is to have available in memory mentally represented information that can be externalized (i.e., retrieved from memory) after the Internet search has been completed. Retrieving information is a highly necessary component in acquiring knowledge (e.g., Karpicke & Blunt, 2011; Karpicke & Roediger, 2008) which takes place in a similar way during Internet search. The current research focused on the impact of threat on the externalization steps of the Internet search process rather than on the internalization steps that have already been investigated (Greving et al., 2014).

1.2. Threat and its effects on information processing

Threat is a negative affective state that is experienced when individuals appraise their resources as not sufficient to meet high situational demands (Blascovich & Tomaka, 1996). A broad range of research has investigated how individuals deal with information that has the *potential to cause* threat (e.g., Ditto & Lopez, 1992; Howell & Shepperd, 2012; Logan et al., 2013; Melnyk & Shepperd, 2012; Sweeny, Melnyk, Miller, & Shepperd, 2010). Yet, other lines of research have investigated how *threat* influences information processing. This research has consistently