Journal of Experimental Psychology: Applied
2015, Vol. 21, No. 3, 287–299

1076-898X/15/$12.00 http://dx.doi.org/10.1037/xap0000053

Counter-Regulating on the Internet: Threat Elicits Preferential Processing of Positive Information

Hannah Greving
Leibniz-Institut für Wissensmedien, Tübingen, Germany

Kai Sassenberg
Leibniz-Institut für Wissensmedien, Tübingen, Germany, and University of Tübingen

Adam Fetterman
Leibniz-Institut für Wissensmedien, Tübingen, Germany

The Internet is a central source of information. It is increasingly used for information search in self-relevant domains (e.g., health). Self-relevant topics are also associated with specific emotions and motivational states. For example, individuals may fear serious illness and feel threatened. Thus far, the impact of threat has received little attention in Internet-based research. The current studies investigated how threat influences Internet search. Threat is known to elicit the preferential processing of positive information. The self-directed nature of Internet search should particularly provide opportunities for such processing behavior. We predicted that during Internet search, more positive information would be processed (i.e., allocated more attention to) and more positive knowledge would be acquired under threat than in a control condition. Three experiments supported this prediction: Under threat, attention is directed more to positive web pages (Study 1) and positive links (Study 2), and more positive information is acquired (Studies 1 and 3) than in a control condition. Notably, the effect on knowledge acquisition was mediated by the effect on attention allocation during an actual Internet search (Study 1). Thus, Internet search under threat leads to selective processing of positive information and dampens threatened individuals' negative affect.

Keywords: threat, Internet search, counter-regulation, self-relevant domain, knowledge acquisition

The Internet is the most frequently used nonhuman source for gathering information (e.g., Fallows, 2008; Purcell, 2011; Purcell, Brenner, & Rainie, 2012). The vast information available on the Internet extends to nearly every domain. Importantly, among them are domains containing self-relevant information (i.e., information that affects the evaluation of one's own situation or oneself). For instance, a common domain of self-relevant information concerns an individual's own health. Indeed, the Internet is one of the main sources of information for health-related issues (e.g., Fox, 2011; Fox & Duggan, 2013; Morahan-Martin, 2004).

Although common and useful, Internet search in self-relevant domains is likely accompanied by affect and emotion. For example, when seeking health-related information, an individual may be fearful of serious illness and feel threatened. Thus, the entire process of information search in self-relevant domains and its outcomes may be affected by emotional factors, such as threat. In the current studies, we sought to investigate the impact of threat on search-engine-based information search on the Internet.

Previous work has shown that negative affective states lead to the preferential processing of positive information. According to the counter-regulation hypothesis, such imbalanced processing can occur when more attention is directed toward information reducing the threat (Rothermund, Voss, & Wentura, 2008; Schwager & Rothermund, 2013a, 2014). Information processing cannot reduce actual threat, but it can reduce subjective threat and the affect associated with it (i.e., it can have palliative effects; cf. Jonas et al., 2014). This is most obvious when threat in one domain is reduced by focusing on positive information in another domain, which allows one to gain a positive view of the self or one's current situation. Research on threat and information processing has not yet investigated these processes in relation to Internet search (e.g., Kammerer & Gerjets, 2012, 2014). However, we suggest that, given the self-directed nature of search-engine-based information search on the Internet, a similar preference for positive information will occur in this context as well. Therefore, the current research set out to study the impact of threat (compared with challenge or a neutral state) on Internet search via search engines. In doing so, we address the often diagnosed imbalance between the omnipresence of the Internet in people's everyday life and the scarce

This article was published Online First June 22, 2015.

Hannah Greving, Leibniz-Institut für Wissensmedien, Tübingen, Germany; Kai Sassenberg, Leibniz-Institut für Wissensmedien and University of Tübingen; Adam Fetterman, Leibniz-Institut für Wissensmedien.

We thank Gulniza Abdrakhmanova, Tobias Ampferl, Nina Anger, Oliver Baierl, Angelika Bertsche, Lea Bodner, Elena Hafner, Sandra Herrmann, Philipp Huber, Dorothée Hoppe, Marie Mückstein, Carolin Sanzenbacher, Lara Scatturin, Konstantin Schmid, Steffen Schmidgall, Lara Schuler, Aylin Sönmez, Philipp Weber, Katharina Wengel, and Hannah Wolf for their help with experiment preparation, data collection, and data coding. The authors are also grateful to Margarete Ocker for proofreading the manuscript.

Correspondence concerning this article should be addressed to Hannah Greving, Leibniz-Institut für Wissensmedien, Schleichstraße 6, 72076 Tübingen, Germany. E-mail: h.greving@iwm-tuebingen.de

psychological knowledge about how Internet use affects human memory and cognition (e.g., Sparrow & Chatman, 2013). In addition, the current research also contributes theorizing about counter-regulation by (a) considering experienced threat, rather than anticipated gains as a negative affective state (cf. Rothermund et al., 2008; Rothermund, Gast, & Wentura, 2011); and (b) studying counter-regulation effects across a longer time interval than most research has done so far (minutes rather than seconds).

Information Processing During Internet Search

Internet users are highly confident about their abilities to find valid information on the Internet and trust this information as being accurate (Purcell et al., 2012; Ward, 2013). Contrary to Internet users' *perceived* ease of finding valid information on the Internet (Purcell et al., 2012; Ward, 2013), the wealth of information available makes Internet search a complex and iterative process with several necessary behavioral steps. Brand-Gruwel, Wopereis, and Walraven (2009) have identified three steps that they suggest are central for search-engine-based information search on the Internet. The first step includes *searching information*, in which individuals primarily select links from search engine result pages. The second step involves *looking at information* or scanning briefly the information presented on web pages. Finally, the third step includes *processing information*, which involves the thorough processing and understanding of the information.[1] This complex process is then repeated in iterative fashion. Because of the complexity of the Internet search process, Internet users often do not succeed in identifying valid information (Walraven, Brand-Gruwel, & Boshuizen, 2013) because they mostly rely on titles, summaries, and order of search engine results (Gerjets, Kammerer, & Werner, 2011; Rouet, Ros, Goumi, Macedo-Rouet, & Dinet, 2011).

In all, although Internet users perceive themselves as competent information searchers and perceive the information they find as valid and trustworthy, evidence suggests that their perception may be wrong. Already having difficulties in finding accurate information when motivated to do so, Internet users may perform even less successfully when motivated by emotion and affect. We suggest that emotion and affect can influence any of the aforementioned steps of the Internet search process (i.e., searching information, looking at information, and processing information). In terms of emotion and affect, we specifically focus on threat.

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). In contrast, when individuals have enough personal resources to meet high situational demands, they experience challenge (Blascovich & Tomaka, 1996). Negative affective states, like threat, are known to affect information processing. The literature on the counter-regulation principle (Rothermund, 2011) allows for the most straightforward predictions about the impact of threat on Internet search. According to this principle, attention is automatically allocated to information that is opposite in valence to one's current state: In a negative affective or motivational state, attention is automatically allocated to positive information, whereas in a positive affective or motivational state, attention is automatically allocated to negative information. Rothermund (2011) argues that focusing attention on information that is opposite in valence to one's current state is functional and adaptive because it prevents the escalation of motivational orientations and helps maintain goal commitment. In other words, when individuals in a negative affective state only focus on negative information, this focus exacerbates their negative affective state, resulting in an escalation of this state. On the contrary, focusing on positive information may prevent the negative emotion from becoming too extreme.

Research has provided substantial evidence for the counter-regulation principle. For instance, when anticipating a loss of money, participants directed their attention more toward positive information than participants anticipating a gain of money (Rothermund et al., 2008; Rothermund et al., 2011, Study 1). Moreover, participants also allocated their attention more to positive information when feeling good compared with when feeling bad (Schwager & Rothermund, 2013a).

Relevant to the present research question, the counter-regulation principle applies to outcomes beyond the perceptual level (i.e., attention). For example, in one case, participants in a negative state chose more risky options in a decision-making task because they focused more on positive information compared with participants in a positive state (Schwager & Rothermund, 2013b). In another case, participants who thought about a relationship stressor evaluated unknown faces as more trustworthy and showed more trusting behavior in a trust game than participants in a control condition (Koranyi & Rothermund, 2012). More recently, research has shown that the attention effects generalize to threat and challenge as instantiations of negative and positive affective states, respectively (e.g., Sassenberg, Sassenrath, & Fetterman, 2015).

Rothermund (2011) stresses the flexible character of the counter-regulation principle. Therefore, it should especially occur in self-directed contexts that give individuals numerous opportunities to regulate, such as the Internet. The Internet is characterized by a vast variety of information and, thus, searching the Internet requires a high degree of self-directedness. Yet, this self-directedness provides room for numerous factors to influence information processing, such as counter-regulation effects under threat. So far, evidence for such effects on the Internet is lacking.

The Current Research

Taken together, the counter-regulation principle suggests that threat leads to the preferential processing of positive information, and the self-directed nature of Internet search, in turn, provides the perfect breeding grounds for such preferences to become influential. Within the multistep process of search-engine-based Internet search (Brand-Gruwel et al., 2009), we expect that the searching-information step (i.e., the selection of links) and the looking-at-information step (i.e., web-page-looking times) are highly likely to

[1] Next to these three steps, Brand-Gruwel et al. (2009) have identified two additional steps, that is, *define information problem* (preceding the steps) and *organize and present information* (resulting from the steps). These steps focus more on the preparation and the outcome of the Internet search (Brand-Gruwel et al., 2009), and thus we do not consider them here, but we do so elsewhere (Greving & Sassenberg, 2015).

be affected by the preference for positive information expected to result from threat.

Based on the counter-regulation principle, we predict that when individuals select links, threatened individuals should be more likely to allocate their attention to positive links because positive information should grab threatened individuals' attention more. Moreover, just as potential positive outcomes influenced decision making among individuals in a negative state (Schwager & Rothermund, 2013b), so should positive web pages hold attention in threatened individuals. Therefore, we hypothesized that threatened individuals would select more positive links and look longer at positive web pages than individuals in a corresponding control condition.[2]

When individuals under threat spend more time focusing their attention on positive stimuli, this should also affect the processing-information step (i.e., the knowledge acquired during Internet search; Brand-Gruwel et al., 2009), because attention is a prerequisite for encoding and memory (e.g., Chun & Turk-Browne, 2007; Craik, Govoni, Naveh-Benjamin, & Anderson, 1996; see also Johnson & Proctor, 2004). Therefore, we hypothesized that threatened individuals would acquire more positive information during Internet search and recall more positive information after conducting an Internet search than individuals in a corresponding control condition. Evidence for this hypothesis would be provided by an indirect effect of threat, via looking times at positive web pages, on the recall of positive information.

These predictions were tested in three studies. Study 1 examined the effect of threat on information search regarding a self-relevant topic (here, passing an exam) on the entire Internet to optimize external validity and tested two steps. We investigated the looking-at-information step and the processing-information step. Study 2 and 3, in contrast, tested isolated steps of the Internet search process using controlled and preprogrammed materials for reasons of internal validity. In particular, we investigated the searching-information step (Study 2) and the processing-information step (Study 3). We experimentally manipulated threat either integrally (i.e., related to the search topic)—in the context of exams (Study 1) or own health (Study 2)—or incidentally (i.e., unrelated to the search topic; Study 3). In the case of the integral manipulation of threat, the preference for positive information could result in the actual regulation of threat, in that information about the means to reduce the threat is acquired. The actual reduction of threat might be subject to the application of these means, more or less, soon after the information search. However, in the case of the incidental manipulation, the threat experience could be reduced in a palliative sense (see Jonas et al., 2014), which would imply an improved affect (i.e., reduced threat), even though nothing new has been learned and the actual reason for the threat remains unchanged. Participants were recruited from the same population, but close care was taken that none of them participated in more than one study reported here.

Study 1: Looking at and Processing Information on the Entire Internet

Study 1 examined the influence of threat on information search behavior (i.e., the looking-at-information step) during an actual information search on the entire Internet and on the recall of information afterward (i.e., the processing-information step). It was hypothesized that participants under threat would recall more positive information after the Internet search than participants in a corresponding control condition. This would be the case because threatened participants would also look longer at positive web pages than participants in the control condition. Longer looking times at positive web pages should thus mediate the impact of threat on the recall of positive information. In this study, a challenge condition served as control condition, as this is a common control condition in research on threat (Blascovich & Tomaka, 1996; Sassenberg et al., 2015).

Method

Participants and design. Ninety undergraduate students (64 female; *M* age = 24.03, *SD* = 5.35; range = 18 to 53 years) participated in a study with two conditions (threat vs. challenge) in exchange for €8 (approximately $11). Participants were randomly divided in half between conditions ($n = 45$ per condition).

Procedure and materials. The study was conducted in a laboratory equipped with semiprivate cubicles, and all instructions and measures were displayed on the computer screen. After having signed the consent form, affective state was manipulated. Instructions asked participants to think about a current upcoming exam that they appraised as either threatening or challenging. In this study, we used an integral manipulation of affective state. Participants in the threat (challenge) condition received the following instructions:

> Please think about an important upcoming exam which you are concerned about at the moment, which is highly demanding, and which you will have great difficulties to pass according to your own expectations (. . ., but which you will be able to pass according to your own expectations).

This manipulation is modeled after the appraisal dimensions that constitute threat and challenge according to Blascovich and Tomaka (1996). In both conditions, participants had to describe this exam preparation situation and how they felt in that situation in a few sentences (for a similar approach, see Sassenberg et al., 2015).

To check whether the described situation (and with that the threat and challenge) was real, participants had to respond to one item ("Is the situation that you have described regarding your upcoming exam a real situation?") on a 9-point scale ranging from 1 (*no*), to 5 (*somewhat*), to 9 (*yes*). The responses were heavily skewed, but 34 participants indicated that the described situation was at least to some extent made up. Only 56 marked "9," indicating "Yes, the situation was real," although we explicitly asked participants during the manipulation to think about and report an *existing* situation. For threat regulation to occur, it is, however, crucial that motivational intensity is high (e.g., Rothermund et al., 2011; Schwager & Rothermund, 2014). Therefore, we will include this information in the analysis reported in the results section. The 56 participants who

[2] We acknowledge that to grab one's attention, in the case of link selection, and to hold one's attention, in the case of web-page-looking times, are two slightly different processes. Still, in both cases, attention needs to be allocated to relevant information. Therefore, we assume that, in terms of attention allocation, the selection of links and the looking times at web pages are conceptually equal to each other.

had reported real situations were distributed equally across the conditions (28 in each condition, $\chi^2 = 0$, $df = 1$).

After the manipulation, participants completed an information search task on the entire Internet. In this task, participants were to inform themselves for 10 min about "information about exam preparation." After participants confirmed that they had read the instructions, a web browser with a search engine page opened automatically. To record participants' searching behavior, the computer screens were videotaped (i.e., with Camtasia Studio 8). When time was up, participants were automatically transferred to the next measures. A filler task followed that took about 5 min. This task was included in order to prevent recency effects in the subsequent free-recall task. In particular, participants were confronted with a drawing from a neuropsychological test (Andrewes, 2001, p. 169). Their task was to count all triangles formed by the lines in the drawing. Then, the free-recall task asked participants to write down what they recalled about exam preparation. Finally, participants were debriefed, paid, and dismissed.

Measures.

Valence of looked-at web pages. To determine the valence of the web pages, we used the valence of the links that referred to the web pages, as we assumed that positive links refer to more positive web pages, whereas negative links rather refer to more negative web pages. Two independent raters rated the valence of the links on an 11-point Likert scale ranging from 1 (*very negative*), to 6 (*neutral*), to 11 (*very positive*). The interrater reliability based on the ratings of the links was $r(88) = .96$. On average, participants selected $M = 7.14$ links ($SD = 4.29$, range = 0 to 20; valence: $M = 7.68$, $SD = 1.30$, range = 2.94 to 11). The total time spent on positive web pages (looking time at positive web pages) was computed by summing the time spent on web pages of links that were rated between 7 and 11 on the 11-point Likert scale. Similarly, the total time spent on negative web pages (looking time at negative web pages) was computed by summing the time spent on web pages of links that were rated between 1 and 5 on the 11-point Likert scale. We opted to use these two categories because the distribution of the ratings on the 11-point scale was multimodal and thus suggested that the raters had actually categorized the links as positive or negative rather than evaluating them on a continuous dimension.

Valence of recalled information. In order to determine the valence of the information participants recalled, their answers to the free-recall task were coded by two independent raters. In our coding scheme, we differentiated between approach strategies for exam preparation (e.g., make and use a time schedule; use file-cards/mind-maps/memory-hooks; make summaries; learn in groups; exercise/relax/eat-healthy), and avoidance strategies for exam preparation (e.g., avoidance of alcohol/cigarettes/private-stress/the-Internet; do not study only during the last-week/at-night). Approach strategies indicate selective attention to positive outcomes because they aim to target positive end states (i.e., approach goals, e.g., Elliot & Covington, 2001; Elliot, Eder, & Harmon-Jones, 2013; Elliot & Thrash, 2002). For example, "make and use a time schedule" aims at focusing attention toward behaviors that lead to a positive end state (i.e., passing the exam). In contrast, avoidance strategies are indicators for attention to negative outcomes because they are concerned with negative end states (i.e., avoidance goals, e.g., Elliot et al., 2013; Elliot & Covington, 2001; Elliot & Thrash, 2002). For instance, "avoidance of alcohol" is concerned with focusing attention away from behaviors that lead to a negative end state (i.e., failing the exam). Therefore, these approach and avoidance strategies served as proxies for positive and negative information, respectively. The interrater reliabilities based on the count of recalled positive and negative exam preparation strategies were $r(90) = .93$ and $r(90) = .88$, respectively. On average, participants recalled $M = 6.56$ ($SD = 4.71$, range = 0 to 22) positive exam preparation strategies, and $M = 3.25$ ($SD = 2.85$, range = 0 to 16) negative exam preparation strategies.

Results

Manipulation check. Before running the main analyses, we checked whether our manipulation was successful. After the manipulation, participants indicated the situational demands of the exam and their personal resources for dealing with it. In line with the definition of threat and challenge (Blascovich & Tomaka, 1996), a mixed analysis of variance (ANOVA) with appraisal (situational demands vs. personal resources) as a within-subjects factor and affective state (threat vs. challenge) as a between-subjects factor revealed a significant interaction, $F(1, 88) = 6.58$, $p = .012$, $\eta_p^2 = .070$. Participants in the threat condition did not describe the exam as significantly more demanding ($M = 7.31$, $SD = 1.28$) than participants in the challenge condition ($M = 6.76$, $SD = 1.80$), $F(1, 88) = 2.86$, $p = .095$, $\eta_p^2 = .031$, but they felt less able to deal with the exam ($M = 5.53$, $SD = 1.59$) than participants in the challenge condition ($M = 6.29$, $SD = 1.39$), $F(1, 88) = 5.75$, $p = .019$, $\eta_p^2 = .061$. Thus, the manipulation was successful.

Main analyses. We hypothesized that participants in the threat condition would recall more positive information after the Internet search than participants in the challenge condition. In order to test this prediction, we conducted a mixed ANOVA with affective state (threat vs. challenge) as a between-subjects factor and valence of recalled information (positive vs. negative) as a within-subjects factor. The results revealed that there was no main effect for affective state, $F(1, 88) < 1$, n.s., but there was a main effect of valence of recalled information, $F(1, 88) = 51.74$, $p < .001$, $\eta_p^2 = .370$. Participants recalled more positive information ($M = 6.56$, $SD = 4.71$) than negative information ($M = 3.25$, $SD = 2.85$). Yet, there was no evidence for the predicted interaction effect, $F(1, 88) = 1.89$, $p = .172$.

This lack of support for our prediction might have resulted from the fact that only 56 (28 participants in each condition) of the 90 participant had clearly reported a real situation. To test this assumption, we included the type of situation as a factor in our analysis. To do so, we differentiated between those participants who clearly answered "yes" when asked about the situation (real situation) and those participants who indicated that this was, to a varying extent, not the case. We conducted a mixed ANOVA with affective state (threat vs. challenge) and type of situation (real vs. imagined) as between-subjects factors and valence of recalled information (positive vs. negative) as within-subjects factor. The analysis revealed again a main effect for valence of recalled information, $F(1, 86) = 48.00$, $p < .001$, $\eta_p^2 = .358$. There was a marginal interaction between affective state and type of situation, $F(1, 86) = 2.97$, $p = .089$, $\eta_p^2 = .033$, that was qualified by the three-way interaction between affective state, type of situation, and

valence of recalled information, $F(1, 86) = 5.13$, $p = .026$, $\eta_p^2 = .056$; all other Fs < 1.

To resolve this interaction, we conducted separate mixed ANOVAs for participants who had reported a real situation and those who had reported an imagined situation. For participants who had reported an imagined situation, the predicted Affective State × Valence of recalled information interaction was not significant, $F(1, 32) = 1.03$, $p = .318$, $\eta_p^2 = .031$. However, for those participants who reported a real situation, we found the expected Affective State × Valence of recalled information interaction, $F(1, 54) = 5.67$, $p = .021$, $\eta_p^2 = .095$. Participants in the threat condition recalled more positive information ($M = 7.88$, $SD = 5.38$) than participants in the challenge condition ($M = 5.25$, $SD = 3.36$), $F(1, 54) = 4.79$, $p = .033$, $\eta_p^2 = .082$, whereas no such difference was found for negative information (threat: $M = 2.86$, $SD = 1.60$; challenge: $M = 3.09$, $SD = 2.33$), $F(1, 54) < 1$, n.s. (see Figure 1). Hence, participants who reported, in line with our intention, a real situation behaved according to our prediction.

To test whether the effect of affective state on recall of positive information was, as we expected, driven by the attention toward positive information (i.e., the looking times at positive web pages), we conducted a mediation analysis for participants who reported real situations. To be more precise, we first calculated the correlations between the recall of information and the looking times at web pages. Looking times at positive web pages were indeed related to recall of positive information, $r(56) = .377$, $p = .004$. Then, we tested whether there was an interaction effect between affective state and valence of looked at web pages. We performed a mixed ANOVA with valence of web pages (positive vs. negative) as within-subjects factor, affective state (threat vs. challenge) as between-subjects factor, and the number of selected positive and negative links as covariate. We included this covariate into the analysis, as the total time spent on positive or negative web pages was certainly also determined by how *many* positive and negative web pages participants had visited. The results revealed significant main effects for valence of web pages, $F(1, 53) = 16.69$, $p < .001$, $\eta_p^2 = .240$, and affective state, $F(1, 53) = 6.99$, $p = .011$, $\eta_p^2 = .117$. These main effects were qualified by an interaction, $F(1, 53) = 4.01$, $p = .050$, $\eta_p^2 = .070$. Participants in the threat condition looked longer at positive web pages ($M = 278.24$ s, $SD = 144.03$) than participants in the challenge condition ($M = 198.58$ s, $SD = 154.86$), $F(1, 53) = 5.92$, $p = .018$, $\eta_p^2 = .101$, whereas no such difference was found for looking times at negative web pages (threat: $M = 17.95$ s, $SD = 55.82$; challenge: $M = 11.43$ s, $SD = 34.90$), $F(1, 53) < 1$, n.s. (see Figure 2).

In a last step, we tested whether the effect of threat on the recall of positive information was mediated by positive web-page-looking times. This mediation analysis was performed by means of the bootstrapping procedure using the SPSS macro provided by Preacher and Hayes (2008). In this analysis, we controlled for recall of negative information and looking times at negative web pages. The critical confidence interval of the indirect effect did not contain zero ($B = .3699$, 95% CI [.0194, 1.3299]; see also Figure 3). This indicates that the effect of affective state on the recall of positive information was mediated by positive-web-page-looking times.

Discussion

Study 1 illustrated that an information search on the Internet is influenced by threat. Participants under threat recalled more positive information because they looked longer at positive information (i.e., web pages) compared with participants in the challenge condition. Moreover, the effect of threat on the recall of positive information was mediated by positive web-page-looking times. Thus, counter-regulation occurs under threat during and after information search on the entire Internet.

However, Study 1 has two shortcomings. First, roughly one third of the sample indicated that they did not report a real situation during the manipulation. When we included this variable as a factor into our analyses, it qualified the predicted effect. Support for our prediction was only found for those participants who had reported a real situation, but not for those who did not follow the instructions. On the one hand, including this factor shows that the

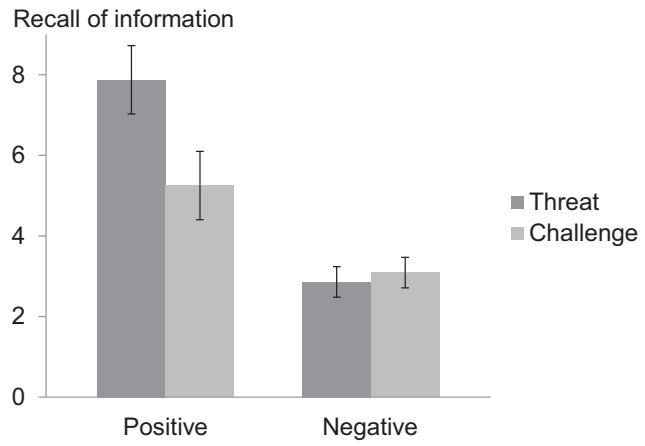

Figure 1. Means for recall of positive and negative information as a function of affective state (threat vs. challenge) for participants reporting a real situation (Study 1; $N = 56$). The error bars represent one standard error above and below the mean.

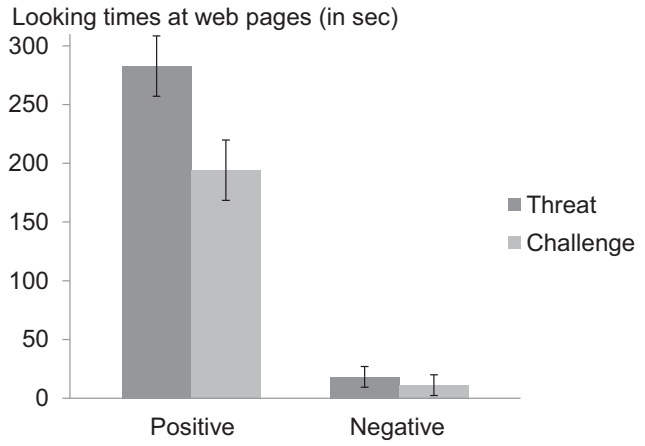

Figure 2. Means for looking times at positive and negative web pages as a function of affective state (threat vs. challenge) for participants reporting a real situation (Study 1; $N = 56$). The error bars represent one standard error above and below the mean.

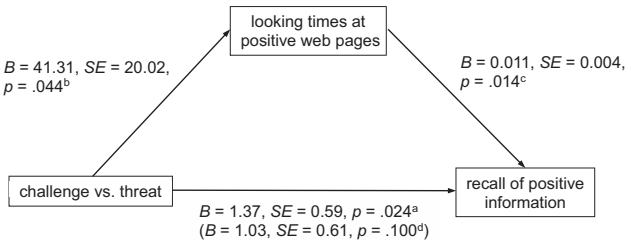

Figure 3. Mediation analysis containing affective state (challenge = −1 vs. threat = 1), looking times at positive web pages as mediator, and recall of positive information as dependent variable for participants reporting a real situation (Study 1; $N = 56$). [a] Regression analysis controls for recall of negative information; [b] Regression analysis controls for looking times at negative web pages; [c] Regression analysis controls for looking times at negative web pages and recall of negative information; [d] Regression analysis controls for looking times at positive and negative web pages and recall of negative information.

effects were contingent on the fact that participants needed to remind themselves about an actual rather than a made-up threat. This fact underlines that the effects reported here are about the impact of threat as an affective state (and not as a cognitive activation; cf. Rothermund et al., 2011). On the other hand, including such a post hoc factor is less than ideal—even though it is highly plausible. The excluded and the included participants might still differ between conditions. In the current case, the stronger individuals' self-efficacy, the more easy it should be for them to report a challenging situation (i.e., sufficient resources), and the less easy to report a threatening situation (i.e., insufficient resources).

Second, positive and negative information was assessed rather indirectly by approach and avoidance strategies, respectively. Even though approach strategies clearly indicate a focus on the positive (i.e., positive end states or approach goals), and avoidance strategies indicate a focus on the negative (i.e., negative end states and avoidance goals; e.g., Elliot & Covington, 2001; Elliot et al., 2013), and these strategies come with a higher sensitivity for positive and negative events, respectively (Matschke & Sassenberg, 2010, 2012; Strachman & Gable, 2006), a more direct assessment would be preferable.

Study 2 sought to make up for these shortcomings. We used a well-established feedback-based, rather than a self-report, manipulation (Croyle & Ditto, 1990; Ditto & Lopez, 1992). This should ensure that all participants experience an actual threat. Moreover, we selected a set of materials rather than letting participants search the entire Internet. This allowed for the presentation of positive and negative information directly (rather than indirect indicators of these variables).

Study 2: Searching Information

Studies 2 and 3 used more controlled settings relative to Study 1, which had been conducted in a more naturalistic context. To this end, Study 2 focused on the selection of positive and negative links (i.e., the searching-information step). It was hypothesized that participants under threat would select more positive links than participants in a corresponding control condition.

Method

Participants and design. Forty-one (35 female) undergraduate students participated in a study with two conditions (threat vs. control) in exchange for €6 (approximately $8). The mean age was 21.34 years ($SD = 3.99$, range = 18 to 40 years).

Procedure and materials. The study was conducted in a laboratory equipped with semiprivate cubicles, and all instructions and measures were displayed on the computer screen. The study was purportedly about a health-psychology research question and conducted in cooperation with the local university hospital. To increase credibility of the cover story, several medical items were placed within the laboratory in a clearly visible manner. Moreover, two experimenters in doctor's coats and nametags conducted the study. In doing so, the participants were led to believe that they would be tested for the intolerance of a (fictitious) food additive by means of a simple saliva test. This procedure was adopted from Ditto and collaborators (Croyle & Ditto, 1990; Ditto & Lopez, 1992).

After having signed the consent form, participants learned that the aim of the study was to test them for an intolerance of a food additive. Next, the saliva test was introduced as a test that has been used in many other studies to identify the intolerance. Subsequently, participants self-administered the saliva test with "test" strips, which were actually thick strips of normal paper; then, the experimenters collected the strips in Petri dishes. After the strips were supposedly analyzed, participants received their diagnosis on the computer screen, which is how the affective state (threat vs. control) was manipulated. Participants in the threat condition ($n = 20$) received the following feedback:

> During the analysis of your saliva test, INTOLERANCE to the food additive E150i was diagnosed. The test shows that your saliva contains no glibutin enzyme, which breaks down the food additive E 150i. CONSUMING FOOD which contains the food additive E 150i is, therefore, CRITICAL for you. (capitalization as in the original text)

In contrast, participants in the control condition ($n = 21$) learned the following: "An error occurred during processing. The analysis will take some more minutes."

Next, participants were to inform themselves about the intolerance and engaged in a link selection task. In this task, participants were confronted with 16 links about the intolerance. These links were presented in a 4 × 4 table to avoid order effects that occur when links are presented in a vertical list (Kammerer & Gerjets, 2012, 2014). Fonts were similar to typical fonts of results of search engines on the Internet. Of these 16 links, eight links contained positive information (e.g., positive side effect: healthier diet; NAET – a promising medical treatment; frequency of incidence overestimated), and the other eight links contained negative information (e.g., abstinence – black list of forbidden food; café and restaurant visits – goodbye; weakened immune defense – increased sensitivity; see the Appendix for all presented links). Positive and negative links were distributed in a pattern similar to a checkerboard pattern, in which the top-most-left link was a positive link. Participants were to select eight links for which they wanted to read documents with further information. As participants had to select a fixed number of links, and we presented only positive and negative links, the number of selected negative links could be inferred from the number of selected positive links. Hence, in the

analysis reported in the results section, the number of selected positive links served as dependent variable. After the link selection, participants were thoroughly debriefed, paid, and, finally, dismissed.

Results and Discussion

It was hypothesized that participants in the threat condition would select more positive links than participants in the control condition. To test this prediction, a *t* test for independent samples was performed. There was a significant difference between participants in the threat condition and participants in the control condition, $t(39) = -2.04$, $p = .048$. Participants in the threat condition selected more positive links ($M = 4.30$, $SD = 1.53$) than participants in the control condition ($M = 3.38$, $SD = 1.36$).

Study 2 supported our hypothesis and illustrated that participants experiencing health threat selected more (i.e., allocated more attention to) positive links than participants whose health was not threatened. Thus, when health threatened individuals select relevant links, they tended to select more positive links. Study 2 provides, in other words, evidence for a counter-regulation effect under threat for the searching-information step of Internet search (Brand-Gruwel et al., 2009). It also conceptually replicated the finding of Study 1 for the looking-at-information step, with threat leading to more allocation of attention to positive information (searching-information step).

One might criticize the control condition of Study 2, because it was not purely neutral. In fact, it might have raised some uncertainty in participants, as they did not receive the results of the test before selecting links. However, a condition without a test or with a positive outcome would have reduced the relevance of the link selection and, thereby, would have created a confound. In comparison, the current control condition seemed to us to be the most conservative control condition, as uncertainty is a mildly negative state (e.g., Lind & Van den Bos, 2002; Van den Bos & Lind, 2002). All in all, these considerations made us return to a manipulation comparing threat and challenge in Study 3.

Study 3: Processing Information

Study 3 investigated the influence of threat on the processing-information step, that is, on the acquisition of information in a more controlled setting than Study 1. It was hypothesized that participants under threat would acquire more positive information than participants in a corresponding control condition. Study 3 also explored whether participants under threat would regulate their affective state during information search. For that purpose, we did not manipulate threat versus challenge in relation to the search goal (i.e., integrally), but rather independent of the search goal (i.e., incidentally). Because of this independence, the information acquired could not contribute directly to the regulation of threat. However, the information search could serve as a palliative regulation of threat (cf., Jonas et al., 2014), because focusing on positive information could contribute to emotional coping. To explore whether this type of affect regulation occurs, measures of affective state were taken after the information processing phase in this study. Evidence for successful regulation would be provided if the affective state would be as positive, or even more positive, following information search for those in the threat condition versus those in the control condition.

Method

Participants and design. Forty-one (26 female) undergraduate students participated in a study with two conditions (threat vs. challenge) in exchange for €6 (approximately $8). The mean age was 24.37 years ($SD = 3.85$, range = 19 to 34 years).

Procedure and materials. The study was conducted in a laboratory equipped with semiprivate cubicles, and all instructions and measures were displayed on the computer screen. After having signed the consent form, participants filled out the premeasure of affect. Next, the affective state (threat vs. challenge) manipulation followed. The threat condition contained 21 participants, and the challenge condition had 20 participants. A similar procedure as in Study 1 was applied. However, here we asked for less specific situations so that participants would be more easily able to report a real situation. The instructions requested participants to think about a current personal situation. Participants in the threat (challenge) condition received the following instructions:

> Please think about a situation or task of your studies that is highly demanding at the moment, and that you are not able to deal with (. . ., but that you are very well able to deal with)."

In both conditions, participants described the situation and how they felt in that situation in a few sentences. To incidentally manipulate participants' affective state, the manipulation and the rest of the materials were presented as different studies to participants.

In another study using the exact same manipulation, we included the same manipulation check as in Study 1. A mixed ANOVA with appraisal (situational demands vs. personal resources) as a within-subjects factor and affective state (threat vs. challenge) as a between-subjects factor revealed a significant interaction effect, $F(1, 83) = 22.78$, $p < .001$, $\eta_p^2 = .215$. In line with our intention and the results of Study 1, demands did not differ between conditions, $F(1, 83) < 1$, n.s., but participants in the threat condition reported to have significantly less resources available to deal with these demands ($M = 3.79$, $SD = 1.52$) than participants in the challenge condition ($M = 5.45$, $SD = 1.09$), $F(1, 83) = 33.46$, $p < .001$, $\eta_p^2 = .287$ (Greving & Sassenberg, 2014). This pattern of results is exactly in line with the appraisal patterns constituting threat and challenge (Blascovich & Tomaka, 1996).

After the manipulation, participants received the instruction to inform themselves about living organ donation as if they were preparing a presentation for class. We chose living organ donation as a topic because it is highly self-relevant, as nearly everyone can be a donor and because most people lack knowledge about this topic. Moreover, it can be presented in a neutral way and in a clear positive or negative way, which was highly important for the composition of our materials. They received 16 texts (lengths of 76 to 99 words) that they should read as if these texts were the outcome of their own Internet search. We chose a set of separate texts because this resembles Internet searches in which information from a number of sources needs to be considered. From the 16 texts, four texts comprised neutral information (e.g., the history of living organ donation; organ transplant law), six texts comprised positive information (e.g., living organs are in a better state; organ recipient receives a second lifetime as a gift), and another six texts comprised negative information (e.g., organ donors are on sick leave for 6 to 8 weeks; organ donors are restricted in their daily

lives because of operation complications). These texts were presented in a random order. In order to prevent recency effects for the subsequent free-recall task, participants then performed the same filler task as in Study 1. Thereafter, they were asked to write down what they recalled from the texts they had read. Then, the postmeasure of affect and participants' current motivational state were assessed. After that, participants' evaluation of living organ donation was measured, and, finally, participants were debriefed, paid, and dismissed.

Measures.

Valence of acquired information. Information acquisition was assessed with two pairs of measures. The first pair of measures comprised the information that participants recalled from the texts on living organ donation. In order to determine the valence of the recalled information, participants' answers to the free-recall task were coded by two independent raters. For the coding scheme, 192 meaningful pieces of information were extracted across the 16 texts and were classified into neutral (60 pieces), positive (66 pieces), or negative (66 pieces) information. The raters marked the pieces of information participants had recalled regarding the neutral, positive, and negative categories. The interrater reliability based on the counts of pieces of information for each category ranged from $r(41) = .90$ to $r(41) = .95$. Means across the raters were computed. The number of positive and negative pieces of information participants had recalled served as indicators for recalled information. On average, participants recalled $M = 5.87$ ($SD = 3.89$, range = 0 to 14.5) positive pieces of information and $M = 7.27$ ($SD = 3.98$, range = 0.5 to 18.5) negative pieces of information.

As second pair of measures for information acquisition, the evaluation of living organ donation was assessed because cognitive and evaluative processes both contribute to information acquisition (e.g., Duckworth, Bargh, Garcia, & Chaiken, 2002; Petty, Wegener, & Fabrigar, 1997; Wood, 2000). In order to assess positive and negative aspects of evaluation, the benefits (positive evaluation) as well as the risks (negative evaluation) that participants perceived with respect to living organ donation were measured separately. Both measures were assessed on a 9-point Likert scale ranging from 1 (*low*) to 9 (*high*). These measures were unrelated to each other, $r(51) = -.06$, n.s.

Affective state. The affective state was again assessed using two pairs of measures. First, affect was measured with 10 items from the Positive and Negative Affect Schedule (Krohne, Egloff, Kohlmann, & Tausch, 1996; Watson, Clark, & Tellegen, 1988). The same items were assessed before the manipulation (premeasure) and after the free recall (postmeasure). Positive affect (pre, $\alpha = .82$; post, $\alpha = .84$) and negative affect (pre, $\alpha = .66$; post, $\alpha = .75$) were each assessed with five items (positive affect: *attentive, elated, interested, excited, active;* negative affect: *hostile, upset, scared, nervous, guilty*) on a 9-point Likert scale ranging from 1 (*not at all*) to 9 (*extremely*).

Second, current motivational state was measured using nine items adopted from different stress appraisal measures (Peacock & Wong, 1990; Roesch & Rowley, 2005). Four items assessed the positive motivational state ($\alpha = .70$; e.g., "I feel motivated" and "I feel challenged") and five items the negative state ($\alpha = .82$; e.g., "I feel helpless" and "I feel that it is beyond my control"). All items were assessed on a 7-point Likert scale ranging from 1 (*does not apply at all*) to 7 (*completely applies*).

Results

Acquired information. It was hypothesized that participants in the threat condition would acquire more positive information about living organ donation than participants in the challenge condition. To test this prediction, we conducted a mixed ANOVA with measure (recall vs. evaluation) and valence (positive vs. negative) as within-subjects factors and affective state (threat vs. challenge) as between-subjects factor. As the two pairs of measures were assessed on different scales, all four variables were *z*-standardized before performing the analysis. The analysis revealed no main effects, all Fs $(1, 39) < 1.3$, n.s. There was also no significant three-way interaction between these three variables, $F(1, 39) = 2.14$, $p = .151$. Thus, the effects did not differ between recall and evaluation. Importantly, we found the predicted Affective State × Valence interaction, $F(1, 39) = 9.81$, $p = .003$, $\eta_p^2 = .201$. Participants in the threat condition acquired more positive information about living organ donation ($M = 0.30$, $SE = 0.14$) than participants in the challenge condition ($M = -0.31$, $SE = 0.14$), $F(1, 39) = 9.30$, $p = .004$, $\eta_p^2 = .193$, whereas no such difference was found for negative information (threat: $M = -0.13$, $SE = 0.15$; challenge; $M = 0.14$, $SE = 0.15$), $F(1, 39) = 1.58$, n.s. (see Figure 4). All other interactions were not significant, all Fs $(1, 39) < 1$, n.s. (for information about the separate measures, see Table 1).

Affective state. We explored whether participants in the threat condition successfully regulated their affective state during reading and recall. Successful regulation would be indicated by the same or an even more positive affective state in participants in the threat condition (compared with the challenge condition).[3]

A mixed ANOVA was performed with measure (affect vs. motivational state) and valence (positive vs. negative) as within-subjects factors and affective state (threat vs. challenge) as between-subjects factor. The measures were again *z*-standardized before performing the analysis. There were no main effects of measure and valence, Fs $(1, 39) < 1$, n.s. However, there was a main effect of affective state, $F(1, 39) = 5.84$, $p = .020$, $\eta_p^2 = .130$. Participants in the threat condition expressed, irrespective of valence, a stronger affective state ($M = 0.17$, $SE = 0.10$) than participants in the challenge condition ($M = -0.18$, $SE = 0.10$). The three-way interaction was not significant, $F(1, 39) < 1$, n.s., indicating that effects were homogenous across measures (i.e., affect and motivational state). In line with the idea of threat regulation, there was a significant interaction effect between affective state and valence, $F(1, 39) = 12.45$, $p = .001$, $\eta_p^2 = .242$. Participants in the threat condition felt more positive ($M = 0.51$, $SE = 0.17$) than participants in the challenge condition ($M = -0.54$, $SE = 0.17$), $F(1, 39) = 19.38$, $p < .001$, $\eta_p^2 = .332$. The negative measures did not differ between conditions, $F(1, 39) = 2.08$, $p = .157$ (see Figure 5). All other interactions were nonsignificant, all Fs $(1, 39) < 1$, n.s. (for information about the separate measures, see Table 1).

[3] Before the manipulation, participants experienced more positive ($M = 5.81$, $SD = 1.35$) than negative ($M = 1.80$, $SD = 0.95$) affect, $F(1, 39) = 201.24$, $p < .001$, $\eta_p^2 = .838$. Yet affect did not differ between experimental conditions on the premeasure of affect, both Fs < 1.2, n.s. Therefore, we used the postmeasure of affect and the current motivational state to test for the regulation of affective state.

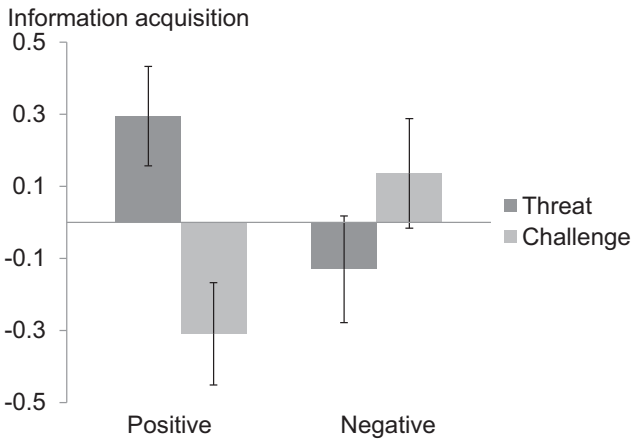

Figure 4. Means for positive and negative information acquisition about living organ donation as a function of affective state (threat vs. challenge; Study 3; $N = 41$). The error bars represent one standard error above and below the mean.

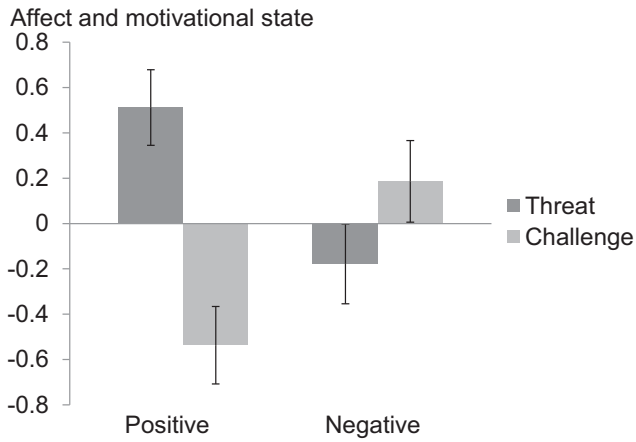

Figure 5. Means for positive and negative affect and motivational state as a function of affective state (threat vs. challenge; Study 3; $N = 41$). The error bars represent one standard error above and below the mean.

Discussion

Study 3 supported our hypothesis by demonstrating that participants who appraised their current situation as threatening acquired more positive information with respect to living organ donation (i.e., recalled more positive information and evaluated living organ donation more positively) than participants who appraised their current situation as challenging. This suggests that counter-regulation effects occur during information acquisition under threat. It should be noted that this study used a scenario-based Internet search setting. Yet the actions participants undertook to proceed from one text to another were quite similar to actual Internet search behavior. Moreover, this study also replicated the finding of Study 1 regarding the processing-information step that was conducted on the Internet. Therefore, these studies optimally complement each other. Study 3 also provides evidence for the successful regulation of negative affect because threat led to a more positive affective and motivational state after the information acquisition compared with the challenge condition. Information search can reduce threat in a palliative way, and thus contributes to emotional coping.

Table 1
Means (Standard Deviations) for Information Acquisition, Separated by the Measures Recall of Information and Evaluation of Information, and Affective State, Separated by the Measures Affect and Motivational State, as a Function of Valence (Positive vs. Negative) and Affective State (Threat vs. Challenge; Study 3; N = 41)

	Information acquisition			
	Recall of information		Evaluation of information	
	Positive	Negative	Positive	Negative
Threat	6.60 (4.33)	7.05 (2.66)	6.48 (2.40)	5.33 (1.93)
Challenge	5.10 (3.29)	7.50 (5.07)	4.45 (2.11)	6.10 (1.68)
	Affective state			
	Affect		Motivational state	
	Positive	Negative	Positive	Negative
Threat	6.21 (0.84)	1.51 (0.82)	5.37 (0.86)	1.83 (0.86)
Challenge	4.92 (1.45)	1.78 (0.91)	4.00 (1.14)	2.20 (0.94)

General Discussion

Across three studies, the current research presents converging evidence that threatened individuals, compared with those in challenged or neutral states, preferably process positive information during the steps of the Internet search process. To be more precise, threatened individuals allocated more attention to positive information (i.e., selected more positive links and looked longer at positive web pages), and acquired more positive knowledge (i.e., acquired and recalled more positive information), compared with individuals in challenged or neutral states. The effect of threat on knowledge acquisition was mediated by the preferential processing of positive information. With these studies, we clearly demonstrated that threatened individuals are highly likely to prefer positive information during the searching-information, looking-at-information, and processing-information steps of the Internet search process (Brand-Gruwel et al., 2009).

Study 3 provided some evidence that the preferential processing of positive information reduced threat in a palliative way. After having processed preferentially positive information during Internet search, threatened individuals not only felt less bad, but even felt better, compared with challenged individuals. This amelioration is certainly restricted to the subjective affective level. It does not, by any means, provide evidence that this search behavior is functional in the sense that it reduces threat. Changes in the determinants of threat—that is, demands and resources—will at best be achieved on the subjective level in one Internet session. Reducing the actual source of threat has to be implemented beyond mere search behavior and information processing. In that sense, the preferential processing of positive information will, in most

cases, only serve as emotional coping with or palliative response to threat (in the sense of Jonas et al., 2014).

The current studies provide evidence for counter-regulation, as they show preferential processing of positive information by individuals in a negative state. Yet the results also advance counter-regulation research in two important ways. First, counter-regulation research has thus far focused on attention and its direct outcomes (Rothermund et al., 2008, 2011; Sassenberg et al., 2015; Schwager & Rothermund, 2013a, 2013b, 2014). Going beyond this research, the current studies provide evidence that counter-regulation effects occur not only in the direct context (i.e., attention) but also in a broader context with longer lasting effects (i.e., during steps of Internet search).

Second, counter-regulation research thus far has not tested the impact of threat on the preferential processing of positive information, but has rather focused on the impact of negative states other than threat. The only study that compared threat with challenge in the context of counter-regulation (Sassenberg et al., 2015) focused on attention to negative information and did not include positive information. Hence, the current research is the first to provide evidence that the counter-regulation hypothesis applies to the regulation of threat.

The results of the presented studies are also in line with the control-dependency principle, which is related to the counter-regulation principle (Rothermund, 2011). According to the control-dependency principle, when individuals perceive that they have low control, they turn to self-serving and positive information (Rothermund, Bak, & Brandtstädter, 2005; Rothermund, Brandtstädter, Meiniger, & Anton, 2002; see also Brandtstädter & Rothermund, 2002). Threatened individuals are not only in a negative affective state (e.g., Blascovich & Tomaka, 1996; Jonas et al., 2014)—they also lack the resources to deal with a situation, and thus have low control within that situation (Blascovich & Tomaka, 1996). Because of the close relation between threat and control, these effects are hard to disentangle.

The preferential processing of positive information shown by the current findings seems inconsistent with anecdotal evidence that searching on the Internet for information regarding one's own health issues or other threatening topics might lead to an even stronger feeling of threat. Such effects, in line with theorizing about the impact of vigilance (e.g., in a prevention focus, Sassenberg et al., 2015; Sassenberg & Hansen, 2007), were not found here—potentially because of the relatively young sample. Younger people tend to be eager and promotion-focused rather than vigilant and prevention-focused (Ebner, Freund, & Baltes, 2006). We recommend that further research should explore regulatory focus as moderating factor.

Beyond the counter-regulation considerations, the current work also has implications for the Internet search literature. Models on Internet search have mainly conceptualized Internet search based on cognitive mechanisms (e.g., Brand-Gruwel et al., 2009; Fu & Pirolli, 2007). The current studies show that affective states, in the context of Internet search, might influence and be influenced by the preferential processing of positive information. Here, we showed that threat influenced the primary steps of Internet search. This means that Internet search is susceptible to affective states, and, therefore, future research and models on Internet search should take threat and other affective states into account.

The current research strongly benefits from its different study approaches. Study 2 and 3 used strictly controlled materials in controlled laboratory settings. This allowed for testing the effects on information processing as a direct and exclusive consequence of manipulating threat. In that sense, these studies allowed us to make internally valid statements about the effects of threat. Study 1, on the other hand, resembled an actual information search on the Internet. Therefore, Study 1 enabled us to increase the external validity of our research. Most importantly, Study 2 and 3 also replicated the externally valid results of Study 1 and served as internal validation of the results in Study 1.

The manipulation of affective state differed between Study 2 (giving a certain health diagnosis), and Study 1 and 3 (recalling a current situation) and the corresponding control conditions differed as well between the studies (Study 2 = neutral condition; Study 1 and 3 = challenge condition). These differences might be regarded as a limitation. Yet health is one of the most important self-relevant domains individuals inform themselves about on the Internet and in which threat is experienced frequently (e.g., Fox, 2011; Fox & Duggan, 2013; Morahan-Martin, 2004). We wanted to address these issues in our research to increase the informative value. With the saliva test, we induced, next to the experimental condition, the only plausible neutral condition, that is, a condition containing no specific diagnosis. As such, it is comparable with other research (e.g., Ditto & Lopez, 1992; Ditto, Scepansky, Munro, Apanovitch, & Lockhart, 1998).

The manipulation of affective state applied in Studies 1 and 3 and the use of challenge as control condition might be criticized, because two different motivational states were compared in these studies and a neutral control condition is missing. However, taking a closer look at the manipulation and the definition of threat and challenge clearly indicates that this is not the case (Blascovich & Tomaka, 1996; Tomaka, Blascovich, Kibler, & Ernst, 1997). In line with the appraisals underlying threat and challenge, we implemented in both conditions appraisals of high situational demands. The difference between the conditions was implemented on the appraisal of personal resources. In the threat condition, participants thought about a situation in which they had insufficient resources, whereas in the challenge condition, they thought about a situation in which they had sufficient resources. Hence, the actual manipulation implemented two states on the resource appraisal dimension that were easily comparable and for which no third neutral condition exists. In contrast, a neutral control condition would have differed from the threat condition concerning the demands and the resources. Therefore, the challenge condition actually provides a more conservative comparison standard than a neutral control condition.

Compared with our experimental setup, actual human behavior and decision making are complex processes that are difficult to completely capture (e.g., Gigerenzer & Gaissmaier, 2011). Outside of the laboratory, individuals' Internet search behavior may be susceptible to various motivational and environmental factors, like the age-related differences in vigilance mentioned earlier in the general discussion. Moreover, searching the Internet for information requires complex, multistep behavior that also depends on certain cognitive skills and functions (Brand-Gruwel et al., 2009; Brand-Gruwel, Wopereis, & Vermetten,

2005; Walraven, Brand-Gruwel, & Boshuizen, 2010; Walraven et al., 2013). Finally, information in a domain may be inconsistent or may not allow for unequivocal conclusions (Bientzle, Cress, & Kimmerle, 2013; Kienhues, Stadtler, & Bromme, 2011). It was beyond the scope of the present studies to address this complexity. Future research should determine which individual variables contribute to the preferential processing of positive information and under which conditions the presented results hold. Nonetheless, the current studies provide important insights into how affective states may possibly influence certain Internet search behaviors that had not been investigated earlier.

The results of the present research have consequences for the practical use of the Internet as informational resource. The Internet has become the prime nonhuman source for information and is increasingly used in self-relevant domains, such as health (Fox, 2011; Fox & Duggan, 2013; Morahan-Martin, 2004). Importantly, Internet users actually use information from the Internet to make decisions in self-relevant domains. For example, in the health domain, health-threatened individuals increasingly base their decisions about whether to see a doctor or use certain medications on information from the Internet (Fox & Duggan, 2013; Fox & Jones, 2009). Our research hints to substantial caveats with regard to decision making by threatened individuals as they preferably process positive information from the Internet. Although this selectivity can help them feel better, it could considerably influence their decision making. For example, health-threatened individuals who often use the Internet for health-related information search can represent their health overly optimistically (Sassenberg & Greving, 2014), and may be at risk to make nonoptimal, inappropriate, or even wrong decisions (e.g., Lo & Parham, 2010). Such decisions could fatally harm rather than benefit them. In that sense, processing of particularly positive information from the Internet could profoundly influence threatened individuals' decisions.

In conclusion, this research provides substantial evidence that counter-regulation effects are involved when individuals in a negative affective state (i.e., experiencing threat) search for information on the Internet in a self-relevant domain. Threatened individuals prefer positive information from the Internet, that is, they selectively direct their attention to positive links and positive web pages, and thereby recall more positive information after the Internet search. Thus, threatened individuals show preferential processing of positive information for the steps of the Internet search process. This selective tendency, in turn, has a palliative effect on their current affect.

References

Andrewes, D. (2001). *Neuropsychology: From theory to practice*. New York, NY: Psychology Press.

Bientzle, M., Cress, U., & Kimmerle, J. (2013). How students deal with inconsistencies in health knowledge. *Medical Education, 47,* 683–690. http://dx.doi.org/10.1111/medu.12198

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology, 28,* 1–51.

Brand-Gruwel, S., Wopereis, I., & Walraven, A. (2009). A descriptive model of information problem solving while using internet. *Computers & Education, 53,* 1207–1217. http://dx.doi.org/10.1016/j.compedu.2009.06.004

Brandtstädter, J., & Rothermund, K. (2002). The life-course dynamics of goal pursuit and goal adjustment: A two-process framework. *Developmental Review, 22,* 117–150. http://dx.doi.org/10.1006/drev.2001.0539

Chun, M. M., & Turk-Browne, N. B. (2007). Interactions between attention and memory. *Current Opinion in Neurobiology, 17,* 177–184. http://dx.doi.org/10.1016/j.conb.2007.03.005

Craik, F. I. M., Govoni, R., Naveh-Benjamin, M., & Anderson, N. D. (1996). The effects of divided attention on encoding and retrieval processes in human memory. *Journal of Experimental Psychology: General, 125,* 159–180. http://dx.doi.org/10.1037/0096-3445.125.2.159

Croyle, R. T., & Ditto, P. H. (1990). Illness cognition and behavior: An experimental approach. *Journal of Behavioral Medicine, 13,* 31–52. http://dx.doi.org/10.1007/BF00844898

Ditto, P. H., & Lopez, D. F. (1992). Motivated skepticism: Use of differential decision criteria for preferred and nonpreferred conclusions. *Journal of Personality and Social Psychology, 63,* 568–584. http://dx.doi.org/10.1037/0022-3514.63.4.568

Ditto, P. H., Scepansky, J. A., Munro, G. D., Apanovitch, A. M., & Lockhart, L. K. (1998). Motivated sensitivity to preference-inconsistent information. *Journal of Personality and Social Psychology, 75,* 53–69. http://dx.doi.org/10.1037/0022-3514.75.1.53

Duckworth, K. L., Bargh, J. A., Garcia, M., & Chaiken, S. (2002). The automatic evaluation of novel stimuli. *Psychological Science, 13,* 513–519. http://dx.doi.org/10.1111/1467-9280.00490

Ebner, N. C., Freund, A. M., & Baltes, P. B. (2006). Developmental changes in personal goal orientation from young to late adulthood: From striving for gains to maintenance and prevention of losses. *Psychology and Aging, 21,* 664–678. http://dx.doi.org/10.1037/0882-7974.21.4.664

Elliot, A. J., & Covington, M. V. (2001). Approach and avoidance motivation. *Educational Psychology Review, 13,* 73–92. http://dx.doi.org/10.1023/A:1009009018235

Elliot, A. J., Eder, A. B., & Harmon-Jones, E. (2013). Approach-avoidance motivation and emotion: Convergence and divergence. *Emotion Review, 5,* 308–311. http://dx.doi.org/10.1177/1754073913477517

Elliot, A. J., & Thrash, T. M. (2002). Approach-avoidance motivation in personality: Approach and avoidance temperaments and goals. *Journal of Personality and Social Psychology, 82,* 804–818. http://dx.doi.org/10.1037/0022-3514.82.5.804

Fallows, D. (2008). Search engine use. *Pew Internet & American Life Project*. Washington, DC. Retrieved from http://www.pewinternet.org/files/old-media//Files/Reports/2008/PIP_Search_Aug08.pdf.pdf

Fox, S. (2011). Health topics. *Pew Internet & American Life Project*. Washington, DC. Retrieved from http://www.pewinternet.org/files/old-media//Files/Reports/2011/PIP_Health_Topics.pdf

Fox, S., & Duggan, M. (2013). Health online 2013. *Pew Internet & American Life Project*. Washington, DC. Retrieved from http://www.pewinternet.org/files/old-media//Files/Reports/PIP_HealthOnline.pdf

Fox, S., & Jones, S. (2009). The social life of health information. *Pew Internet & American Life Project. Washington, DC. Retrieved from* http://www.pewinternet.org/files/old-media//Files/Reports/2009/PIP_Health_2009.pdf

Fu, W.-T., & Pirolli, P. (2007). SNIF-ACT: A cognitive model of user navigation on the World Wide Web. *Human-Computer Interaction, 22,* 355–412.

Gerjets, P., Kammerer, Y., & Werner, B. (2011). Measuring spontaneous and instructed evaluation processes during web search: Integrating concurrent thinking-aloud protocols and eye-tracking data. *Learning and Instruction, 21,* 220–231. http://dx.doi.org/10.1016/j.learninstruc.2010.02.005

Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic decision making. *Annual Review of Psychology, 62,* 451–482. http://dx.doi.org/10.1146/annurev-psych-120709-145346

Greving, H., & Sassenberg, K. (2014). *The influence of threat on Internet search behavior*. Unpublished manuscript, Leibniz-Institut für Wissensmedien, Tübingen, Germany.

Greving, H., & Sassenberg, K. (2015). Counter-regulation online: Threat biases retrieval of information during Internet search. *Computers in Human Behavior, 50,* 291–298. http://dx.doi.org/10.1016/j.chb.2015.03.077

Johnson, A., & Proctor, R. W. (2004). *Attention: Theory and practice*. Thousand Oaks, CA: Sage. http://dx.doi.org/10.4135/9781483328768

Jonas, E., McGregor, I., Klackl, J., Agroskin, D., Fritsche, I., Holbrook, C., . . . Quirin, M. (2014). Threat and defense: From anxiety to approach. *Advances in Experimental Social Psychology, 49,* 219–286.

Kammerer, Y., & Gerjets, P. (2012). Effects of search interface and internet-specific epistemic beliefs on source evaluations during web search for medical information: An eye-tracking study. *Behaviour & Information Technology, 31,* 83–97. http://dx.doi.org/10.1080/0144929X.2011.599040

Kammerer, Y., & Gerjets, P. (2014). The role of search result position and source trustworthiness in the selection of web search results when using a list or a grid interface. *International Journal of Human-Computer Interaction, 30,* 177–191. http://dx.doi.org/10.1080/10447318.2013.846790

Kienhues, D., Stadtler, M., & Bromme, R. (2011). Dealing with conflicting or consistent medical information on the web: When expert information breeds laypersons' doubts about experts. *Learning and Instruction, 21,* 193–204. http://dx.doi.org/10.1016/j.learninstruc.2010.02.004

Koranyi, N., & Rothermund, K. (2012). Automatic coping mechanisms in committed relationships: Increased interpersonal trust as a response to stress. *Journal of Experimental Social Psychology, 48,* 180–185. http://dx.doi.org/10.1016/j.jesp.2011.06.009

Krohne, H. W., Egloff, B., Kohlmann, C.-W., & Tausch, A. (1996). Untersuchung mit einer deutschen Form der Positive and Negative Affect Schedule (PANAS) [Research with a German version of the Positive and Negative Affect Schedule (PANAS)]. *Diagnostica, 42,* 139–156.

Lind, E. A., & Van den Bos, K. (2002). When fairness works: Toward a general theory of uncertainty management. *Research in Organizational Behavior, 24,* 181–223. http://dx.doi.org/10.1016/S0191-3085(02)24006-X

Lo, B., & Parham, L. (2010). The impact of web 2.0 on the doctor-patient relationship. *The Journal of Law, Medicine & Ethics, 38,* 17–26. http://dx.doi.org/10.1111/j.1748-720X.2010.00462.x

Matschke, C., & Sassenberg, K. (2010). Does rejection lead to disidentification? The role of internal motivation and avoidance strategies. *European Journal of Social Psychology, 40,* 891–900. http://dx.doi.org/10.1002/ejsp.756

Matschke, C., & Sassenberg, K. (2012). I want to be like you: Self-regulation in the development of the social self. *Social Psychology, 43,* 115–126. http://dx.doi.org/10.1027/1864-9335/a000090

Morahan-Martin, J. M. (2004). How internet users find, evaluate, and use online health information: A cross-cultural review. *CyberPsychology & Behavior, 7,* 497–510. http://dx.doi.org/10.1089/cpb.2004.7.497

Peacock, E. J., & Wong, P. T. P. (1990). The stress appraisal measure (SAM): A multidimensional approach to cognitive appraisal. *Stress Medicine, 6,* 227–236. http://dx.doi.org/10.1002/smi.2460060308

Petty, R. E., Wegener, D. T., & Fabrigar, L. R. (1997). Attitudes and attitude change. *Annual Review of Psychology, 48,* 609–647. http://dx.doi.org/10.1146/annurev.psych.48.1.609

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40,* 879–891. http://dx.doi.org/10.3758/BRM.40.3.879

Purcell, K. (2011). Search and email still top the list of most popular online activities. *Pew Internet & American Life Project*. Washington, DC. Retrieved from http://www.pewinternet.org/files/old-media//Files/Reports/2011/PIP_Search-and-Email.pdf

Purcell, K., Brenner, J., & Rainie, L. (2012). Search engine use 2012. *Pew Internet & American Life Project*. Washington, DC. Retrieved from http://www.pewinternet.org/files/old-media//Files/Reports/2012/PIP_Search_Engine_Use_2012.pdf

Roesch, S. C., & Rowley, A. A. (2005). Evaluating and developing a multidimensional, dispositional measure of appraisal. *Journal of Personality Assessment, 85,* 188–196. http://dx.doi.org/10.1207/s15327752jpa8502_11

Rothermund, K. (2011). Counter-regulation and control-dependency. *Social Psychology, 42,* 56–66. http://dx.doi.org/10.1027/1864-9335/a000043

Rothermund, K., Bak, P. M., & Brandtstädter, J. (2005). Biases in self-evaluation: Moderating effects of attribute controllability. *European Journal of Social Psychology, 35,* 281–290. http://dx.doi.org/10.1002/ejsp.250

Rothermund, K., Brandtstädter, J., Meiniger, C., & Anton, F. (2002). Nociceptive sensitivity and control: Hypo- and hyperalgesia under two different modes of coping. *Experimental Psychology, 49,* 57–66. http://dx.doi.org/10.1027//1618-3169.49.1.57

Rothermund, K., Gast, A., & Wentura, D. (2011). Incongruency effects in affective processing: Automatic motivational counter-regulation or mismatch-induced salience? *Cognition and Emotion, 25,* 413–425. http://dx.doi.org/10.1080/02699931.2010.537075

Rothermund, K., Voss, A., & Wentura, D. (2008). Counter-regulation in affective attentional biases: A basic mechanism that warrants flexibility in emotion and motivation. *Emotion, 8,* 34–46. http://dx.doi.org/10.1037/1528-3542.8.1.34

Rouet, J.-F., Ros, C., Goumi, A., Macedo-Rouet, M., & Dinet, J. (2011). The influence of surface and deep cues on primary and secondary school students' assessment of relevance in web menus. *Learning and Instruction, 21,* 205–219. http://dx.doi.org/10.1016/j.learninstruc.2010.02.007

Sassenberg, K., & Greving, H. (2014). *Health threat prompts self-serving bias: When information search on the Internet leads to a positive view of own health*. Unpublished manuscript, Leibniz-Institut für Wissensmedien, Tübingen, Germany.

Sassenberg, K., & Hansen, N. (2007). The impact of regulatory focus on affective responses to social discrimination. *European Journal of Social Psychology, 37,* 421–444. http://dx.doi.org/10.1002/ejsp.358

Sassenberg, K., Sassenrath, C., & Fetterman, A. K. (2015). Threat ≠ prevention, challenge ≠ promotion: The impact of threat, challenge and regulatory focus on attention to negative stimuli. *Cognition and Emotion, 29,* 188–195. http://dx.doi.org/10.1080/02699931.2014.898612

Schwager, S., & Rothermund, K. (2013a). Counter-regulation triggered by emotions: Positive/negative affective states elicit opposite valence biases in affective processing. *Cognition and Emotion, 27,* 839–855. http://dx.doi.org/10.1080/02699931.2012.750599

Schwager, S., & Rothermund, K. (2013b). Motivation and affective processing biases in risky decision making: A counter-regulation account. *Journal of Economic Psychology, 38,* 111–126. http://dx.doi.org/10.1016/j.joep.2012.08.005

Schwager, S., & Rothermund, K. (2014). On the dynamics of implicit emotion regulation: Counter-regulation after remembering events of high but not of low emotional intensity. *Cognition and Emotion, 28,* 971–992. http://dx.doi.org/10.1080/02699931.2013.866074

Sparrow, B., & Chatman, L. (2013). Social cognition in the internet age: Same as it ever was? *Psychological Inquiry, 24,* 273–292. http://dx.doi.org/10.1080/1047840X.2013.827079

Strachman, A., & Gable, S. L. (2006). What you want (and do not want) affects what you see (and do not see): Avoidance social goals and social events. *Personality and Social Psychology Bulletin, 32,* 1446–1458. http://dx.doi.org/10.1177/0146167206291007

Tomaka, J., Blascovich, J., Kibler, J., & Ernst, J. M. (1997). Cognitive and physiological antecedents of threat and challenge appraisal. *Journal of Personality and Social Psychology, 73,* 63–72. http://dx.doi.org/10.1037/0022-3514.73.1.63

Van den Bos, K., & Lind, E. A. (2002). Uncertainty management by means of fairness judgments. *Advances in Experimental Social Psychology, 34,* 1–60.

Walraven, A., Brand-Gruwel, S., & Boshuizen, H. P. A. (2010). Fostering transfer of websearchers' evaluation skills: A field test of two transfer theories. *Computers in Human Behavior, 26,* 716–728. http://dx.doi.org/10.1016/j.chb.2010.01.008

Walraven, A., Brand-Gruwel, S., & Boshuizen, H. P. A. (2013). Fostering students' evaluation behaviour while searching the internet. *Instructional Science, 41,* 125–146. http://dx.doi.org/10.1007/s11251-012-9221-x

Ward, A. F. (2013). *One with the Cloud: Why people mistake the Internet's knowledge for their own* (Unpublished doctoral dissertation). Harvard University, Cambridge, MA.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063–1070. http://dx.doi.org/10.1037/0022-3514.54.6.1063

Wood, W. (2000). Attitude change: Persuasion and social influence. *Annual Review of Psychology, 51,* 539–570. http://dx.doi.org/10.1146/annurev.psych.51.1.539

Appendix

Presented Links in Study 2

Positive Links

Uncomplaining course of disease

Positive side effect: Healthier diet

NAET – a promising medical treatment

Early diagnosis – beneficial prognosis

Frequency of incidence overestimated

Individuality – symptoms oftentimes weakly pronounced

Right to get numerous benefits – health insurance funds take over the costs

Intolerance against 150i – protection against diabetes

Negative Links

Intolerance against e 150i – derogation of the gastrointestinal tract

Risk – chronic complaints

Café and restaurant visits – goodbye?!

Abstinence – black list of forbidden food

Displeasing, allergy-like symptomatology

Weakened immune defense – increased sensitivity

Financial and temporal pressures

Hardly any therapy chances

Received October 3, 2014
Revision received April 30, 2015
Accepted May 17, 2015 ■