A Threat-related Bias in Online Health Information Seeking: Examining the Relationship between Health Anxiety and Sensitivity for Threatening Online Health Information

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Abstract

The Internet is an important source of health information, specifically for those who worry about their health. Online health information seeking may, however, increase or maintain anxiety about health rather than reduce this anxiety. One explanation for this phenomenon pertains to a bias for threatening or illness confirming health information: Health anxious individuals may deliberately search for confirmation that something is wrong and at the same time may automatically focus on threatening information. The purpose of the current study was to relate prior evidence of a threat-related bias in health anxious individuals to online health information seeking. A cross-sectional survey including a forced-choice paradigm was fielded (N = 124) to examine to what extent health anxiety is associated with a preference for threatening search terms and search results. Results revealed that level of health anxiety was positively associated with searching for threatening information online as well as sensitivity for threatening search results. The present results may explain why anxiety in health anxious individuals does not decrease after online health information seeking, but rather remains stable.
Introduction

The Internet is an important source of health information and many people, specifically those who worry about their health, use it to find health information (Andreassen et al., 2007; Baumgartner & Hartmann, 2011; European Commission, 2013; European Union, 2014; Fox & Duggan, 2013; Siliquini et al., 2011; Singh & Brown, 2014). Although the main goals of online health information seeking may be to gain more information or reduce worries, previous research has shown that, particularly for people who are overly anxious about their health, online health information seeking may maintain rather than reduce existing worries (te Poel, Baumgartner, Hartmann, & Tanis, 2016).

Overly health anxious individuals are characterized by the often unwarranted fear that they have a serious illness or medical condition (Salkovskis, Rimes, Warwick, & Clark, 2002). Salkovskis & Warwick (1986), who were around the first to examine health anxiety from a cognitive-behavioural perspective, suggest that overly health anxious people are preoccupied with health and illness, because they maintain inaccurate beliefs about these issues (Salkovskis & Warwick, 1986). An important behavioural aspect of preoccupation with health is reassurance seeking with the goal of reducing health-related anxiety (Abramowitz, Schwartz, & Whiteside, 2002; Salkovskis & Warwick, 1986). Reassurance seeking, however, counter intuitively serves as a factor that maintains rather than diminishes levels of health anxiety (Abramowitz et al., 2002; Salkovskis & Warwick, 1986; Warwick, 1989). Examples of reassurance seeking include health care utilization, asking friends and family for reassurance, self-inspection, or reading about health
(Abramowitz & Moore, 2007; Abramowitz et al., 2002; Salkovskis & Warwick, 1986; Warwick & Salkovskis, 1990).

Online health information seeking may be considered a specific form of reassurance seeking. Previous studies indeed demonstrated that searching the Web for health information is positively correlated with health anxiety (Baumgartner & Hartmann, 2011; Muse, McManus, Leung, Meghreblian, & Williams, 2012; Singh & Brown, 2014; te Poel et al., 2016; te Poel, Hartmann, Baumgartner, & Tanis, 2017). It has furthermore been demonstrated that the higher the level of health anxiety, the more short-term distress one seems to experience following online health searches (Baumgartner & Hartmann, 2011; Muse et al., 2012; Singh & Brown, 2014; Singh & Brown, 2016).

One explanation as to why health anxious individuals feel more distressed after online health information seeking concerns a bias in the way they process health-related information (Abramowitz et al., 2002; Salkovskis & Warwick, 1986; Warwick, 1989): Health anxious individuals tend to be more sensitive for threatening or illness-confirming information (Abramowitz et al., 2002; Salkovskis, 1996). However, it has not yet been examined whether this sensitivity also pertains to online health information. The aim of the current study is to explore this bias in light of online health information seeking.

**Health Anxiety and a Threat-Related Bias**

People who experience some form of anxiety are known to be more sensitive to noticing stimuli that confirm their believes about a threat (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007; Salkovskis, 1996). For health anxious individuals, this sensitivity not only pertains to internal stimuli such as bodily sensations, but also external stimuli such as information about illness.
(Warwick, 1989). According to Salkovskis (1996), this sensitivity is manifested in two ways. Firstly, the bias is manifested in a deliberate search for confirmation of a threat (i.e., a confirmation bias), such as, for example, reading medical textbooks or information on medical websites. According to Abramowitz and colleagues (2002) this confirmation bias is further expressed by merely focusing on evidence of illness and overlooking information that does not confirm that one is ill. Secondly, the sensitivity manifests itself as an automatic attentional process that makes people more sensitive for stimuli or information suggesting that one is susceptible to threat (i.e., an attentional bias; Salkovskis, 1996). In other words, overly health anxious people may deliberately search for or focus on health information that confirms their worries about health threats, and subsequently may also automatically focus on threatening or illness-confirming health information. In the present study, this sensitivity in the form of a confirmation and attentional bias is referred to as a threat-related bias in health information seeking.

The assumption of a confirmation bias in overly health anxious individuals remains theoretical, based on the cognitive behavioural model of health anxiety (Abramowitz et al., 2002; Salkovskis & Warwick, 1986; Warwick, 1989) and is not substantiated with empirical data. The automatic and non-conscious attentional bias in health anxious individuals, however, has been studied repeatedly by means of experimental designs that applied paradigms that preclude conscious processing. Owens (2004), for example, applied a modified Stroop task and demonstrated that people with high levels of health anxiety reacted significantly slower than people with low levels of health anxiety when asked to name colours of health-related words (e.g., cancer, death), thus implying an attentional bias towards illness. Jasper and Witthöft (2011) used a dot probe task with pictorial
stimuli and showed that health anxiety is associated with faster orientation towards threatening stimuli at very short presentation times (175 ms), as well as slower disengagement of attention from threatening stimuli during longer presentation times (500 ms). Lee et al. (2013) also applied a dot probe task and their study revealed that health anxiety is associated with a difficulty in disengaging attention from threat-related words, but not orientation towards threat.

Kaur, Butow, and Thewes (2011) applied the modified Stroop task and a dot probe task, but their results revealed no evidence for an attentional bias toward threat-related words in health anxious individuals. Similarly, Lees, Mogg, and Bradley (2005) did not find an association between health anxiety and attentional bias for threat-related words and pictures using a visual probe task. However, their results revealed that people with higher levels of anxiety sensitivity, which is positively associated with health anxiety, demonstrated attentional bias towards pictures displaying health-related threats.

Although the results of these studies are partly inconsistent, they seem to point toward an attentional bias in health anxious individuals. Health anxious people may perceive more threatening illness-related information because they are more sensitive to it due to an attentional bias. This might explain why health anxious people experience more distress after their online health information searches and why health anxiety in the end does not decline but rather persists (Abramowitz et al., 2002; Salkovskis & Warwick, 1986; te Poel et al., 2016; Warwick, 1989). These assumptions are, however, speculative as previous studies did not examine the attentional bias in the context of online health information seeking.
Online Health Information Seeking and a Threat-related Bias

Singh & Brown (2016) provide some initial insight into the threat-related bias in health anxious individuals’ online health information seeking. In their study they instructed participants to search for health information online; their search behaviour was recorded and participants were interviewed about their feelings during and after searching. Results indicated that health anxious individuals were more sensitive for query escalation, i.e., their online searches resulted in queries for serious causes of an experienced symptom. Singh and Brown (2016) referred to this as a result of attentional bias, but merely explained this bias as a deliberate choice for specific information, indicating a confirmation bias. They further revealed that, immediately after query escalation, individuals with high levels of health anxiety felt more anxious compared to individuals with low levels of health anxiety. Although this increase in anxiety was only momentary, it does seem to support the proposition that health anxious people experience more distress after online health information seeking due to some sort of confirmation or attentional bias for threatening information. However, this is the first study that linked online health information seeking to a threat-related bias in health anxious individuals and more research is therefore warranted.

Previous studies revealed that people who go online to find health information most often start their search at a search engine (Fox & Duggan, 2013; Krijgsman et al., 2016). Searching for information through a search engine is therefore most likely the first moment that a threat-related bias will manifest itself. The current study responds to this by firstly hypothesizing that health anxiety is positively associated with starting a search for online health information with threatening but not neutral search terms (H1). Secondly, to test whether health anxiety is associated with a bias to
follow up threatening search results (i.e., search results that confirm that one might be ill), it was hypothesized that health anxiety is positively associated with the likelihood of opting for threatening health-related search results (H2).

**Method**

**Design and Participants**

An online survey design with forced-choice paradigm was used. Respondents were recruited by means of online convenience sampling in a non-clinical population, through the networks of the author and a research assistant. In total, 124 respondents completed the survey. Mean age was 31.89 years ($SD = 14.77$; ranging from 17-70) and 71% ($n = 88$) was female. More than half of the participants had obtained their highest degree in higher professional or university education (62.1%, $n = 77$). About one tenth of all respondents sought for health information online regularly, often, or every day. Respondents sought for health information online on average 1.75 times ($SD = 2.57$, range 0-20) in the last two months.

**Procedure**

Respondents were recruited online through Facebook, Twitter and e-mail, and could access the online survey via a link that was provided in the recruitment message. The survey started with information about the study, and respondents could only continue when they provided consent for use of their answers for scientific purposes. Firstly, demographics were assessed, followed by questions that measure health anxiety. Next, respondents were instructed to imagine they noticed a specific bodily symptom for several days, and decided to search online to find information about this symptom.
(See Appendix A). Singh and Brown (2016) suggested that studies examining online search behaviour related to health should account for the fact that some participants might be more familiar with the presented symptom than others. To rule out a possible effect of familiarity, in the present design an unfamiliar (thickened tongue) bodily symptom was used. A pre-test \( (N = 49) \) revealed that out of 13 existing bodily symptoms, thickened tongue was evaluated as most unfamiliar. Respondents in the pre-test had never sought for information about this symptom and 98\% had never experienced the symptom.

Following this, participants were exposed to five combinations of search terms (each including one threatening and one neutral search term). They were instructed to choose, for each combination separately, the search term they thought they would use to search for more information about the symptom. After this, a screen was presented identical to a search results page on Google, containing six search results that were either threatening or neutral (three threatening and three neutral search results). Respondents were asked to indicate which search result they would choose first.

**Measures**

**Health anxiety.** Health anxiety was measured with the 18-item Dutch Short Health Anxiety Inventory (DSHAI; te Poel et al., 2017). The DSHAI is based on the original Short Health Anxiety Inventory (Salkovskis, Rimes, Warwick, & Clark, 2002). The illness likelihood subscale of the DSHAI (14 items, \( \alpha = .83 \)) was used to indicate health anxiety (see Alberts, Hadjistavropoulos, Jones, & Sharpe, 2013; te Poel et al., 2017). This subscale assesses worry about health and awareness of bodily sensations or changes. Each item consisted of four statements, and respondents were asked to select the statement
that best described their feelings over the past two months. The statements were scored on an ordinal scale from 0 (which indicated low health anxiety) to 3 (high health anxiety; total sum scores ranging from 0 to 42; \( M = 9.29, SD = 4.69, \) range 1-26). A one-sample \( t \) test revealed that the average score on the 14-item D-SHAI in the sample was significantly higher than the mean found in the general Dutch population \( (M = 7.99; \) te Poel et al., 2017), \( t(124) = 3.09, p = .002, d = 0.28, 95\% CI [8.46, 10.12] \). The mean health anxiety score on the 18-item D-SHAI was 12.05 \( (SD = 5.70) \), which is comparable to the average health anxiety score in non-clinical samples \( (M = 12.41; \) Alberts, Sharpe, Kehler, \& Hadjistravopoulos, 2011), \( t(124) = -0.71, p = .481, d = 0.06, 95\% CI [11.04, 13.06] \). Prevalence of severe, or clinically significant, health anxiety was based on cut-off scores of 18 or higher \( (\) Muse et al., 2012; NHS: NHS-IAPT, 2011; Singh \& Brown, 2014, 2016) and 27 or higher \( (\) Alberts et al., 2013) on the complete 18-Item SHAI. Approximately 15\% of respondents scored 18 or higher \( (14.4\%) \) and 2.4\% of respondents scored 27 or higher on the 18-item D-SHAI. This roughly corresponds to the prevalence of severe health anxiety in the general population \( (\) American Psychiatric Association, 2013) and is comparable to the prevalence of health anxiety in the general Dutch population \( (\) te Poel et al., 2016; te Poel et al., 2017).  

**Online health information seeking.** At the start of the survey respondents were asked to indicate, with an open-ended question, how many times in the last two months they had searched the web for health information \( (M = 1.75, SD = 2.57, \) range 0-20). At the end of the survey they were asked to indicate on a seven-point answer scale, how many times they searched online for health information in the past two months \( (1 = never, 2 = almost never, 3 = now and then, 4 = regularly, 5 = often, 6 = a lot, 7 = every day; Mdn = 2.00, range = 6.00) \). Non-parametric correlation analysis revealed a strong ranked
correlation between both measures, \( r_s = .81, p < .001 \), indicating convergent validity.

**Sensitivity for threatening search terms.** The extent to which participants are sensitive towards searching for threatening health information was measured by means of five dichotomous items, each comprising two search terms related to the bodily symptom that was described to them. Each item consisted of a threatening search term (coded as 1) and a neutral search term (coded as 0). Threatening search terms were formulated based on the idea that health anxious people who misinterpret bodily symptoms fear illnesses that often show a chronic course, such as cancer (Marcus, 1999; Warwick, 1989). All search queries were tested in a pre-test by asking 20 participants to indicate for each combination of search terms which term they perceived as most threatening. Results revealed that for the five combinations of search terms, between 80% and 95% of participants flagged the threatening search terms as more threatening than the neutral search terms. An example of a combination is “tongue cancer (threatening) vs. cause thickened tongue (neutral)”. Participants were asked to indicate for each combination of search terms, which term they would use when searching for health information about the bodily symptom. See Appendix A for all search terms.

To account for the binary nature of the items, internal consistency was determined with ordinal alpha coefficient (based on polychoric correlations obtained through Mplus 7, Muthén & Muthén, 2012; \( \alpha = .82 \); Gadermann, Guhn, & Zumbo, 2012). Following, the scores on the items were combined in a composite sum score (\( M = .77, SD = 1.12; \) ranging from 0-5).

**Sensitivity towards selecting threatening search results.** In order to examine to what extent participants have a bias in selecting
threatening search results after a health-related search query, they were presented with a search results page consisting of six results related to the symptom thickened tongue. Three search results were threatening and the other three results were neutral (see Appendix A). Search results were again formulated based on the idea that health anxious people usually fear severe illness with a chronic course, such as cancer (Marcus, 1999; Warwick, 1989). Participants were asked with one question to indicate which search result they would click on first (neutral coded as 0, threatening coded as 1).

**Control Variables.** Health status was assessed by asking respondents to indicate whether they currently suffered from a temporary (0 = no, 1 = yes) or chronic illness (0 = no, 1 = yes). These two items were combined into one binary item indicating current health status (0 = healthy, 1 = ill; 74.2% of respondents indicated to be healthy). Respondents were furthermore asked to indicate whether they were familiar with the bodily symptom that was presented to them (0 = no, 1 = yes; 85.5% was not familiar with the presented symptom).

**Results**

**Descriptive Statistics**
Frequency analyses revealed that almost half of respondents chose at least one threatening search term (46%). For each combination of search terms individually, around 10-30% of respondents chose the threatening term over the neutral option (see Appendix A for percentages per combination of terms). Analysis furthermore showed that 4.8% of respondents opted for a threatening search result instead of a neutral result. The three threatening search results
were each chosen by 1.6% of respondents (see Appendix A for percentages per search result).

Correlational analysis revealed that respondents’ level of health anxiety was moderately positively associated with searching for online health information \(r = .31, p < .001\), when asked how many times one searched ranging from never to every day; \(r = .26, p = .004\), when asked to indicate how many times with an open-ended question).

**Hypothesis Testing**

To examine whether health anxiety is positively associated with searching online for threatening health-related information instead of neutral information (Hypothesis 1), hierarchical multiple regression analysis with sensitivity towards threatening search terms as dependent variable was conducted. In Step 1 health anxiety was included as independent variable. In Step 2, health status and familiarity with the presented bodily symptom were included as covariates (see Table 1). The multiple regression showed that the final model as a whole was significant, \(F(3, 120) = 10.94, p < .001\), and explained 22% of the variance in sensitivity for threatening search terms. Health anxiety significantly predicted sensitivity for threatening search terms, \(b^* = 0.46, t = 5.61, p < .001\). Per unit increase in health anxiety, the predicted level of sensitivity for threatening search queries increased by 0.11. The covariates were not significant predictors of the dependent variable.
Table 1

Coefficients of the models predicting whether health anxiety is associated with using threatening search terms when searching for online health information about a bodily symptom

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>95% CI</th>
<th>SE b</th>
<th>$b^{*}$</th>
<th>p</th>
<th>$R^2$</th>
<th>$\Delta R^2 (p)$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.24</td>
<td>-.64, .15</td>
<td>0.20</td>
<td></td>
<td>.223</td>
<td>.21</td>
<td></td>
</tr>
<tr>
<td>SHAI – Illness Likelihood</td>
<td>0.11</td>
<td>.07, .15</td>
<td>0.02</td>
<td>.46</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Model 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.22</td>
<td>.003 (.768)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.21</td>
<td>-.63, .20</td>
<td>0.21</td>
<td></td>
<td>.308</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHAI – Illness Likelihood</td>
<td>0.11</td>
<td>.07, .15</td>
<td>0.02</td>
<td>.46</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health status$^a$</td>
<td>-0.14</td>
<td>-.54, .27</td>
<td>0.21</td>
<td>-.05</td>
<td>.513</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiarity with$^b$ bodily symptom</td>
<td>-0.09</td>
<td>-.42, .60</td>
<td>0.26</td>
<td>.03</td>
<td>.720</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. SHAI = Short Health Anxiety Inventory; $^a$0 = healthy, 1 = ill; $^b$0 = not familiar, 1 = familiar.*
Hypothesis 2 predicted that health anxiety is associated with sensitivity toward threatening online health-related search results (H22). A hierarchical logistic regression analysis with sensitivity for threatening search results as dependent variable was performed. In Step 1 health anxiety was included and health status and familiarity with the symptom were added in Step 2 (see Table 2). The test of the full model against the constant only model was significant, $\chi^2(3) = 8.53$, $p = .036$. Health anxiety significantly predicted sensitivity for threatening search results, $b = .21$, Wald $= 6.71$, $p = .010$, $\text{Exp}(b) = 1.24$. For every unit change in health anxiety, the odds of choosing a threatening search result (versus a neutral search result) increased by a factor of 1.24. The covariates were not significant predictors of the dependent variable.

**Discussion**

The purpose of the current study was to test whether health anxiety is associated with a sensitivity for threatening health-related information in the form of search terms and search results. First, it was expected that the higher the level of health anxiety, the more one would be inclined to search for threatening health information online. Second, it was hypothesized that health anxiety is associated with sensitivity for threatening health-related search results. The present results confirm both hypotheses. The results furthermore demonstrated that the higher the level of health anxiety, the more often respondents searched for health information online (see also Baumgartner & Hartmann, 2011; Muse et al., 2012; te Poel et al., 2016; te Poel et al., 2017; Singh & Brown, 2014).
Table 2  
Coefficients of the models predicting whether health anxious individuals choose a threatening search result over a neutral search result

<table>
<thead>
<tr>
<th>Model 1&lt;sup&gt;a&lt;/sup&gt;</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
<td>SE $b$</td>
<td>Wald</td>
<td>$p$</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>Constant</td>
<td>-5.45</td>
<td>1.20</td>
<td>20.54</td>
<td>&lt;.001</td>
<td>0.00</td>
</tr>
<tr>
<td>SHAI – Illness Likelihood</td>
<td>0.21</td>
<td>0.08</td>
<td>6.97</td>
<td>.008</td>
<td>1.24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2&lt;sup&gt;b&lt;/sup&gt;</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$</td>
<td>SE $b$</td>
<td>Wald</td>
<td>$p$</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>Constant</td>
<td>-5.77</td>
<td>1.30</td>
<td>19.62</td>
<td>&lt;.001</td>
<td>0.00</td>
</tr>
<tr>
<td>SHAI – Illness Likelihood</td>
<td>0.21</td>
<td>0.08</td>
<td>6.71</td>
<td>.010</td>
<td>1.24</td>
</tr>
<tr>
<td>Health status&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.36</td>
<td>0.97</td>
<td>0.14</td>
<td>.706</td>
<td>1.44</td>
</tr>
<tr>
<td>Familiarity with bodily symptom&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.97</td>
<td>0.99</td>
<td>0.96</td>
<td>.326</td>
<td>2.63</td>
</tr>
</tbody>
</table>

Note. SHAI = Short Health Anxiety Inventory; <sup>a</sup>$R^2 = .05$ (Cox & Snell), .17 (Nagelkerke); Model $\chi^2(1) = 7.33$, $p = .007$; <sup>b</sup>$R^2 = .09$ (Cox & Snell), .16 (Nagelkerke); Model $\chi^2(3) = 8.53$, $p = .036$; <sup>c</sup>0 = healthy, 1 = ill; <sup>d</sup>0 = not familiar, 1 = familiar; * $p < .05$; **$p < .01$
Although the specific mechanism underlying the sensitivity for threatening health information as demonstrated in the current study is still unclear, the results do provide preliminary evidence for the idea that higher levels of health anxiety are associated with different search strategies in light of online health information seeking, and this biased strategy is likely to originate from an attentional or confirmation bias for threatening health information. Handling such a threat-related search strategy (either consciously or unconsciously) may over expose overly worried people to threatening but often irrelevant health information, which can result in heightened anxiety (see e.g., Singh & Brown, 2016). A threat-related bias may therefore also explain why health anxious individuals experience more distress after online health information seeking (Baumgartner & Hartmann, 2011; Muse et al., 2012; Singh & Brown, 2014). Moreover, in light of the cognitive behavioural model of health anxiety it can be expected that experiencing momentary distress or worries caused by the health information one searches for online (behavioural factor, i.e., reassurance seeking) due to a threat-related bias (cognitive factor) is likely to maintain rather than diminish already existing levels of health anxiety in the long term (Abramowitz et al., 2002; Salkovskis & Warwick, 1986; Warwick, 1989).

On the basis of the results from the current study one might argue that the proposed problem of a threat-related bias that leads to exposure to more threatening but often irrelevant health information, is merely problematic for a very small group of people. Almost half of respondents in the present study indicated to choose at least one threatening search term, but only five percent of respondents chose a threatening search result as option to find out more about the experienced bodily symptom. Nevertheless, the present results do reveal a small but positive relationship between health anxiety and
sensitivity for threatening search results. It must furthermore be highlighted that respondents in this study were asked to imagine that they experienced a specific bodily symptom while in fact they did not. Although speculative, one might expect the demonstrated relationship between health anxiety and a threat-related bias to be stronger in more personally relevant situations in which individuals search for health information about a symptom that they actually experience.

The current study extends the existing literature regarding health anxiety and online health information seeking by more specifically linking online search strategies to a bias for threatening information. The added value of the current study furthermore pertains to the operationalization of the dependent variables. In previous studies that examined an attentional bias, for example, health-threatening stimuli (words or pictures) were alternated with neutral stimuli that were unrelated to illness or health. This is, however, less applicable to real life situations, especially with regard to search results that individuals encounter online as a result of a search query. In the current study, participants were asked to choose between threatening and neutral search terms and results that were all directly linked to the bodily symptom that they were presented with. Despite the fact that all stimuli were directly related to the presented symptom, results still revealed a significant association between health anxiety and choosing threatening search terms and results. This design therefore strengthens the preliminary conclusion that health anxiety is related to a threat-related bias in searching for health information online.
Limitations and Recommendations for Future Research

Although promising, the results must be interpreted in light of the shortcomings of the current study. Firstly, data were gathered from a non-clinical convenience sample with a rather small sample size. In light of the exploratory character of the study the results may serve as input for future replication studies in more generalizable populations and also in clinical samples.

Secondly, it is possible that individuals apply different search strategies in real life. In the current study searching for health information was mimicked by asking participants to choose between predefined search terms and results. One might argue that individuals use different search terms when experiencing a bodily symptom in real life. Singh and Brown (2016), for example, showed that original search terms mostly pertained to the symptom itself. Future research could therefore further focus on the link between health anxiety and a ‘threatening’ start of a search for health-related information, for example by asking respondents to come up with their own search terms instead of forcing them to choose between options.

To better examine to what extent health anxious individuals automatically allocate attention to threatening search results, or whether they deliberately focus on threatening results that confirm something is wrong, traditional designs such as the modified Stroop task or the dot probe task are less suitable. These designs are less easily translated to real life settings. Online information seeking, however, lends itself well for eye-tracking designs (e.g., Pan, Hembrooke, Joachims, Lorigo, Gay, & Granka, 2007) which can provide a broader insight into where health anxious people allocate attention before making a decision on which search results they are interested in. Complementing such a design with tools that measure
how long it takes before individuals click on search results (i.e., dwell time) may further inform us about the nature of this decision, that is, whether it is deliberate or unconscious.

**Conclusion**

The present study provides lines for further research that may be promising. Health anxiety seems to be associated with a threat-related bias for online health information. This bias may explain why anxiety in health anxious individuals does not decrease after online health information seeking (Abramowitz et al., 2002; Salkovskis & Warwick, 1986; te Poel et al., 2016; Warwick, 1989). Despite the fact that the current study cannot clarify the underlying mechanism as to why health anxiety is associated with a bias toward threatening health-related information, it builds on previous studies and theory about an attentional and conformation bias in health anxiety, and applies these findings to the field of online health information seeking.

**Declaration of Transparency**

Data for the current study were collected as part of a survey study including a forced choice paradigm ($N = 234$), examining the moderating role of familiarity of bodily symptoms on the relationship between health anxiety and sensitivity towards threatening ‘search terms’ and ‘search results’. Participants were randomly instructed to imagine that they suffered from a familiar bodily symptom (stomach ache), or an unfamiliar bodily symptom (thickened tongue). Results revealed no moderating role of familiarity with the symptom. In the current study, I was merely
interested in the association between health anxiety and sensitivity towards threat. Because threatening ‘search terms’ and ‘search results’ were operationalized differently in the original study (i.e., related to stomach ache or thickened tongue, respectively), combining them in overall composite scores was not possible. Furthermore, the search results regarding stomach ache included a result referring to cervical cancer. The search results were therefore not all relevant for men. Therefore, in the current study, the associations between health anxiety and sensitivity towards threatening ‘search terms’ and ‘search results’ were examined independently in the sample of respondents who were asked to imagine that they noticed a thickened tongue ($n = 124$).

**Acknowledgements**

I would like to thank Willeke Dijkstra for her help with data collection for the present study and Susanne Baumgartner and Tilo Hartmann for their feedback on a draft version of this chapter.
Appendix A

Instruction thickened tongue

Imagine ... since several days you suffer from a bulge on your tongue. It feels uncomfortable and your tongue remains persistently thickened. You do not know where this thickening just comes from and you want to know more about the cause. You decide to search Google for the possible causes of the bulge on your tongue.
### Thickened tongue search queries

You are given five times two options of possible search queries that you might use when searching for the possible cause of your thickened tongue. Always select the search term that you think you would use when searching online. Don’t think too long about your choice, choose what first comes to mind or what appeals to you most.

<table>
<thead>
<tr>
<th>Neutral vs. Threatening (%)</th>
<th>Query</th>
<th>Neutral</th>
<th>Threatening</th>
<th>% of respondents who chose the query</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Aften tong</td>
<td>0</td>
<td>1</td>
<td>83.9</td>
</tr>
<tr>
<td>1</td>
<td>Mondkanker</td>
<td>1</td>
<td>0</td>
<td>16.1</td>
</tr>
<tr>
<td>1</td>
<td>Stikgevaar dikke tong</td>
<td>1</td>
<td>0</td>
<td>10.5</td>
</tr>
<tr>
<td>0</td>
<td>Allergie tong</td>
<td>0</td>
<td>1</td>
<td>89.5</td>
</tr>
<tr>
<td>0</td>
<td>Verdikking tong door voeding</td>
<td>0</td>
<td>1</td>
<td>88.7</td>
</tr>
<tr>
<td>Rank</td>
<td>Search Query</td>
<td>Neutral</td>
<td>Threatening</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tongkanker</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Oorzaak verdikking tong</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
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<td>3</td>
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<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Gezwel tong</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Last van tong</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Now you will see a section of a page of Google search results related to the symptom 'thickened tongue'. You will be asked some questions about this page. Imagine that you get to see these results after searching Google yourself. Please study the texts.
Thickened tongue search results

Now you will see a section of a page of Google search results related to the symptom 'thickened tongue'. You will be asked some questions about this page. Imagine that you get to see these results after searching Google yourself. Please study the texts.

1. Pijn in de tong: onschuldig maar pijnlijk
   30 jun. 2011 - In Amerika heeft ongeveer 7% van de inwoners last van pijn in de tong. Vrouwen van middelbare of hoge leeftijd hebben meer last van deze ...
   0 43.5

2. Kwaadaardige gezwellen
   Als syfis jarenlang onbehandeld blijft, kan dit tongkanker veroorzaken, de enige vorm van kanker die op de punt van de tong ontstaat. Beschadiging door ...
   1 1.6

3. St. Anna Ziekenhuis IC » Hevige allergische reactie
   Als iemand iets gegeten heeft waarvoor hij/zij allergisch is, dan zal dit zich meestal vertalen in zwelling van de slijmvliesen en tong. Door deze zwelling kan het ...
   0 16.1
4. Tongcarcinoom (zie ook Richtlijn Mondholte- en ... - NWHHT

6 aug. 2010 - Vanuit oncologisch gezichtspunt onderscheidt men aan de tong de ... slijmvliesveranderingen in de vorm van leucoplakie, verdikking, erosie of ontsteking. ... kunnen rijzen over de stadiumindeling en de verdere behandeling.

5. Kanker van de tong

Kanker van de tong is een kwaadaardige zwelling van de tong. De tong heeft in onze mondholte een belanonië functie bij het slikken, praten en proeven.

6. Mondaandoeningen: Tongaandoeningen ...

De tong is een orgaan in de mond dat voornamelijk uit spieren bestaat. ... niet-pijnlijke, gladde, ronde of ovale al dan niet gesteelde zwelling tot ongeveer..... genoemd - is een veelvoorkomende onschuldige afwijking van het tongoppervlak.