Cancer and the Threat of Death: The Cognitive Dynamics of Death-Thought Suppression and Its Impact on Behavioral Health Intentions

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Abstract

Five studies examined the cognitive association between thoughts of cancer and thoughts of death and their implication for screening intentions. Study 1 found that explicit contemplation of cancer did not increase death-thought accessibility. In support of the hypothesis that this reflects suppression of death-related thoughts, Study 2 found that individuals who thought about cancer exhibited elevated death-thought accessibility under high cognitive load, and Study 3 demonstrated that subliminal primes of the word cancer led to increased death-thought accessibility. Study 4 revealed lower levels of death-thought accessibility when perceived vulnerability to cancer was high, once again suggesting suppression of death-related thoughts in response to conscious threats associated with cancer. Study 5 extended the analysis by finding that after cancer salience, high cognitive load, which presumably disrupts suppression of the association between cancer and death, decreased cancer-related self-exam intentions. Theoretical and practical implications for understanding terror management, priming and suppression, and responses to cancer are discussed.

Medical advances have afforded people the ability to take preventative measures against a variety of forms of cancer and other diseases. Early detection of cancer is the best way to survive it, which is of course why doctors recommend routine checkups and screenings (American Cancer Society, 2003). Still, individuals often fail to participate in cancer screening, including those who are at risk (e.g., Mayo, Ureda, & Parker, 2001). One possible explanation for this failure to perform recommended health behaviors is borne from the paradox created between knowledge and fear of that knowledge. Although early detection is the surest way to survive cancer, the prospect of learning that one has cancer is terrifying (e.g., Cameron, 1997). Indeed, even thoughts of disease-detection practices elicit negative affect (Millar & Millar, 1995), and cancer itself is typically associated with negative thoughts such as pain, suffering, and intense fears of death (e.g., Ferrell, Grant, Funk, Otis-Green, & Garcia, 1998; also see Baum & Andersen, 2001). It is the potential connection between thoughts of cancer and thoughts of death that is the focus of the present research.

To the extent that thoughts of cancer are associated with concerns about death, decades of priming research (see, e.g., Higgins, 1996) would suggest that having people think about cancer should increase the accessibility of death-related thoughts. However, there are converging reasons to expect that this relationship might be more complex than a typical priming effect. As a number of studies conducted from the perspective of terror management...
theory (Greenberg, Pyszczynski, & Solomon, 1986; Greenberg, Solomon, & Pyszczynski, 1997) have indicated, conscious thoughts of death are threatening and thus are often suppressed so as to remove such cognitions from focal awareness (e.g., Arndt, Greenberg, Solomon, Pyszczynski, & Simon, 1997). Further, thinking about contracting cancer may be particularly threatening because it represents a tangible example of how the abstract specter of death may be experienced. To better understand the effects of cognitions pertaining to cancer, the present studies explore patterns of death-thought accessibility when concerns about cancer are rendered salient or are otherwise activated. We further apply this analysis to provide initial insights into the behavioral health implications of this hypothesized suppression process. The present studies are thus positioned to provide insights into the dynamics of mental suppression and construct activation as they pertain to potent fears in peoples’ lives.

**Priming and Cognition Pertaining to Cancer**

Basic priming effects are of course among the more widely documented findings, not just in social psychology but in psychological research more broadly (see e.g., Higgins, 1996). Traditional spreading-activation models suggest that knowledge is organized within a network of semantically and associatively linked concepts (Collins & Loftus, 1975; Klinger & Greenwald, 1995), and thus one concept (e.g., “nurse”) can be activated by priming an associated construct (e.g., doctor). In the last decade, research has demonstrated less intuitive associations that are thought to operate through similar mechanisms. For example, priming power among certain men increased sexual perceptions of female targets, presumably because of learned associations between the two (Bargh, Raymond, Pryor, & Strack, 1995), and, more recently, research has shown that priming means activates the goals to which they lead (Shah & Kruglanski, 2003). In this light, decades of research on the ubiquity of priming effects suggests that if cancer is associated with thoughts of death, priming the former should increase the accessibility of the latter. However, the story may not be that straightforward. For example, conceptualizations of associative networks have developed to include multiple cues that may be present within a particular situation (e.g., Ratcliff & McCoon, 1994). From our perspective, these multiple cues may also encompass motivational elements that are brought to bear by either the construct being primed or the target construct with which it may be associated (Arndt, Greenberg, & Cook, 2002). Further, recent research demonstrates the important role that motivation can play in associative priming and automatic activation effects (e.g., in terms of goal-action links; Aarts & Dijksterhuis, 2000; Ferguson & Bargh, 2004; Shah, Freidman, & Kruglanski, 2002). In the present context, thoughts of cancer may provoke such motivational elements.

Specifically, the threatening nature of cancer may influence the link between priming cancer and the subsequent accessibility of death-related thoughts. Because thinking about cancer can be distressing and can arouse feelings of vulnerability (Bowen, Helmes, Powers, & Andersen, 2003; Shapiro et al., 2001), contemplating the disease may motivate a number of different
coping behaviors (Bowen et al., 2003; Cameron, 1997) that may in turn affect the accessibility of associated constructs. Indeed, a substantial literature attests to the multifarious ways in which individuals defensively bias their processing of and reactions to personally relevant negative health information, including minimizing estimates of personal risk and evaluating diagnostic tests as inaccurate (see e.g., Croyle, Sun, & Hart, 1997; Ditto, Jemmott, & Darley, 1988).

Historically there has not been a great deal of health-oriented research that has used cognitive and semantic processing paradigms, but in recent years that has started to change. One of the leading paradigms for examining cognitive processing of illness perceptions has been the emotional Stroop (1935) task and variants of this methodology. The emotional Stroop task has been implemented in the context of psychopathology research to show that people with certain chronic or acute anxieties (or symptoms) show impaired processing of stimuli related to that particular anxiety (see J. M. G. Williams, Mathews, & MacLeod, 1996). The rationale here is that heightened sensitivity to a threat word impairs cognitive processing associated with that word (e.g., naming the color in which the word is presented in a Stroop task). In the context of health research, P. G. Williams, Wasserman, and Lotto (2003) found that individuals who had poorer self-assessed health evidenced greater cognitive interference when making judgments about self-relevant illness words. In addition, G. E. Smith, Eggleston, Gerrard, and Gibbons (1996) examined cognitive associations between valenced and sexual words to elucidate the characteristics of sexual risk perceptions for erotophilics and erotophobics. Jessop, Rutter, Sharma, and Albery (2004) recently used a variant of the emotional Stroop task to show that asthmatic individuals displayed heightened interference when trying to name asthma-related words, and that such performance was related to treatment adherence levels. MacLeod and Hagan (1992) have also found that the processing of threat-related information (as measured by a modified Stroop task) predicted distress from a cancer diagnosis. Thus, there is an emerging sense of the usefulness of cognitive processing paradigms for examining the impact of psychologically threatening information in the domains of health and illness perceptions.

Recent research is also consistent with the notion that the threatening nature of cancer can interfere with the cognitive processing of cancer information. Erblich, Montgomery, Valdimarsdottir, Cloitre, and Bovbjerg (2003) exposed women with or without a family history of breast cancer to a color naming Stroop test that included words related to cancer as well as other disease and affective words. The results indicated that women with a history of breast cancer exhibited longer response latencies and more errors on the cancer list compared with the other word lists. The authors argued that this reveals impaired cognitive processing of cancer stimuli. However, general anxiety, cancer-specific anxiety, and depression did not mediate these results, suggesting that biased cognitive processing is not a direct function of distress. Following Erblich et al., we suggest that more subtle cognitive processes may be at work; one such process may be a tendency to suppress the death-related cognitions with which cancer is associated. This account seems promising when one considers that previous research, albeit from a rather different tradition of experimental social psychology, has indicated that people are apt to suppress conscious thoughts of death.

**Terror Management Research on Death-Thought Accessibility**

Terror management theory (see Greenberg et al., 1997, for a complete presentation) is based on the premise that humans are in a precarious position due to the conflict between biological motives to survive and the cognitive capacity to realize life will ultimately end. This generally unconscious awareness that death is inevitable, coupled with proclivities for survival, creates potentially paralyzing anxiety that people manage by investing in a meaningful conception of the world (cultural worldview) that provides prescriptions for valued behavior and thus a way to also maintain self-esteem. For example, support for the theory has been provided by numerous findings that reminding people of their own eventual death (mortality salience) results in an attitudinal and behavioral defense of their cultural worldview (worldview defense, e.g., Greenberg et al., 1990) and a striving to attain self-esteem (e.g., Routledge, Arndt, & Goldenberg, 2004; see Pyszczynski, Greenberg, Solomon, Arndt, & Schimel, 2004, for a review). Although terror management theory has traditionally focused on the effects of unconscious concerns with mortality on these symbolic or indirect distal defenses, recent research has led to the conceptualization of a dual defense model that also explicates responses provoked by conscious death-related thoughts (Arndt, Cook, & Routledge, 2004; Pyszczynski, Greenberg, & Solomon, 1999).
From this perspective, when thoughts of death are conscious, the individual endeavors to remove those cognitions from focal attention. The initial evidence for these ideas came from Greenberg, Pyszczynski, Solomon, Simon, and Breus (1994), who conducted a series of experiments to explore patterns of worldview defense and death-thought accessibility after participants were reminded of mortality. These studies indicated that immediately following an explicit reminder of death (mortality salience), death-thought accessibility was low; however, when the mortality prime was followed by a delay, death-thought accessibility increased and worldview defense emerged. Arndt and colleagues (Arndt, Greenberg, Solomon, et al., 1997) hypothesized that the initially low level of death accessibility after mortality salience may be due to thought suppression. Drawing from Wegner's (e.g., 1992) research indicating that suppression, as an effortful mental process, can be undermined when cognitive resources are limited, Arndt and colleagues found that individuals under high cognitive load exhibited an immediate increase in the accessibility of death-related thoughts. This suggests that when death thoughts are in focal attention, individuals suppress such thoughts and concomitantly exhibit low levels of accessibility; but once proximal defenses are relaxed (e.g., via delay and distraction) or undermined (e.g., via cognitive load), death-thought accessibility increases and indirect defenses (e.g., worldview defense) take over.

The Present Research

The literatures pertaining to basic priming effects and construct activation, the ways in which people process illness information, and the cognitive reverberation of mortality salience have all yielded critical insights in their respective areas. However, each leaves certain issues unaddressed. In recent years, there has been burgeoning interest in how goal states influence priming and activation effects, but a specific focus on illness representations has not been examined from this perspective. In addition, though health research has examined the cognitive link between a risk category (e.g., asthma) and an outcome category (e.g., accessibility of asthma words), this link has generally been direct (e.g., asthma risk affecting processing of asthma words). Research has yet to explicate the relationship between a health threat and its comparatively indirect association with death-related cognition. Further, terror management research has explicated the death-related activation that follows mortality salience but has yet to consider how other health stimuli may implicate death-related cognition. In light of these issues, the following studies were conducted to illuminate the cognitive processing of cancer stimuli by investigating patterns of death-thought accessibility after participants were led to think about cancer.

Study 1

In Study 1, participants were induced to think about their own mortality, about contracting cancer, or about an aversive control topic (i.e., dental pain). An aversive topic rather than a neutral topic was selected for the control condition because it controls for the general elicitations of negative affect that may be evoked by the death or cancer salience treatment. Participants subsequently completed a word search puzzle and then a measure of death-thought accessibility. A basic priming effect would predict that the salience of cancer should increase death-thought accessibility, much like the salience of mortality has been found to do in previous research (e.g., Greenberg et al., 1994).

Method

Participants

Fifty women from the University of Missouri—Columbia participated in the experiment in exchange for partial credit for their introductory psychology class.
Procedure

Participants were tested in sessions of 4 to 6 students. Upon the participants’ arrival, the experimenter described the experiment as a study of personality characteristics. To provide a cover story for the word search (delay device) and the word completion exercise (thought accessibility measure), participants were informed that because the personality questionnaires would not take the full hour, they would be completing some additional measures that were being pretested for future studies. The experimenter asked participants to complete the questionnaires with their first, natural responses and also assured participants that their answers would not be associated with their names. After reading and signing a consent form, participants were provided with a packet of questionnaires and a blank manila envelope. Participants were asked to place the completed questionnaires in the envelope and then to place the envelope in a box to indicate that they were finished. All materials were completed at divided workstations to further ensure the participants’ privacy.

Materials

Salience manipulation

The prime was induced through a questionnaire, titled The Projective Life Attitude Assessment, which presented two open-ended questions under the guise of a new, innovative measure of personality. The open-ended instructions for the mortality salience condition (Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989) were as follows: Please briefly describe the emotions that the thought of your own death arouses in you, and Jot down, as specifically as you can, what you think will happen to you as you physically die and once you are physically dead. Parallel questions were presented in the cancer and dental pain (control) salience conditions: Please briefly describe the emotions that the thought of [cancer, dental pain] arouses in you, and Jot down, as specifically as you can, what you think will happen to you as you physically [get cancer, experience dental pain] and once you have physically [gotten cancer, experienced dental pain].

Puzzle delay

Previous research suggests that a mortality salience induction will only increase death-thought accessibility after a delay that allows death thoughts to drift outside focal attention (Greenberg et al., 1994). Therefore, after the salience manipulation, participants were presented with two letter matrices (each on a separate page) which served as a distraction task between the salience induction and the accessibility measure (Greenberg, Arndt, Simon, Pyszczynski, & Solomon, 2000). Participants were asked to imagine that they were a new television executive at a conference and their task was to tune into “any discussions about television” by locating as many of the television-related words as possible in 3 min. Each of the two word matrices represented a different room of the conference, and the words presented could be found in either matrix. Participants were also told that “no one is expected to find all of the words in this time period, we are simply looking at word patterns.” The list of television-related words consisted of direct, drama, station, commercial, program, dial, comedy, soap opera, sitcom, satellite, actor, cable, and channel.

Death accessibility

Participants were next presented with a word completion task that was ostensibly being tested for future studies. The task was actually an accessibility measure similar to those used by other researchers (e.g., Bassili & Smith, 1986; Gilbert & Hixon, 1991; Steele & Aronson, 1995; Tulving, Schacter, & Stark, 1982) and was designed to assess the accessibility of death-related thoughts. The measure presented participants with 26 word fragments, 8 of which could be completed with a neutral or death-related word. This measure has been used successfully in a number of terror management studies (e.g., Greenberg et al., 1994; Mikulincer & Florian, 2000; Mikulincer, Florian, Birnbaum, & Malishkevich, 2002). For example, the fragment COFF_ _ could be completed as COFFEE (a neutral word) or COFFIN (a death-related word). The possible death-related words were buried, dead, killed, skull, murder, stiff, coffin, and grave.

Results and Discussion

Death Accessibility

To assess the effects of the different salience manipulations on death-thought accessibility, we conducted a one-way analysis of variance (ANOVA). This analysis revealed a significant effect for the manipulation, $F(2, 47) = 4.42, p < .02,$ [eta]$^2$
Pairwise comparisons showed that, as in previous research, priming mortality increased death-thought accessibility compared with that found in the control condition, \( t(47) = 2.45, p < .02, [\eta]^2 = .11 \) (Ms = 3.82 and 2.63, SD s = 1.07 and 1.54, respectively). However, participants primed with cancer also revealed lower levels of death-thought accessibility (\( M = 2.65, SD = 1.37 \)) compared with that in the mortality salience condition, \( t(47) = 2.54, p < .02, [\eta]^2 = .12 \), and there was no difference between the cancer prime and the control condition, \( t(47) < 1 \). A one-versus-two contrast analysis confirmed that the mortality salience condition showed higher levels of death-thought accessibility than did the (combined) cancer and dental pain salience conditions, \( t(47) = 2.97, p = .005, [\eta]^2 = .16 \).

Study 1 was designed to explore the effect of priming cancer on death accessibility compared with that of priming death and a control topic. Although we replicated previous terror management research by showing that priming mortality increases the accessibility of death-related thoughts when a delay is introduced between the death prime and the accessibility measure (e.g., Greenberg et al., 1994), priming cancer did not produce elevated death accessibility. This null effect lends itself to at least two potential interpretations. On the one hand, cancer may not be associated with thoughts of death and thus priming cancer would do little to increase death-thought accessibility. This seems unlikely however, given that cancer is known to be one of the leading causes of death in the United States. In addition, previous research is quite clear as to how threatening people tend to view the topic of cancer (Bowen et al., 2003; Cameron, 1997); a diagnosis of cancer may elicit more distress than any other disease (Shapiro et al., 2001), and, in fact, people report greater concerns about cancer than about being dead (Thorson & Powell, 1990). Because thinking about contracting cancer may be especially threatening, this may lead to particularly robust efforts toward suppressing death-related thoughts. If this is the case, then increased suppression would explain why death accessibility remained low for individuals primed with thoughts of cancer.

To provide some exploratory insight into peoples’ cognitions about cancer, we pursued two strategies. First, we conducted a series of content analyses on the open-ended responses generated from the salience primes. We hoped this content analysis might provide some tentative insight into how participants write about cancer in ways that are similar to or different from the mortality and dental pain topics. Second, we collected some supplemental data on the associates of the words cancer and death, and the frequency with which students contemplate these topics.

**Content Analyses**

Two coders rated the open-ended responses on the following six dimensions by using 5-point scales (0 = not at all to 5 = very much): number of death-related words, a focus on death or survival themes ([alpha] = .99), negativity expressed ([alpha] = .84), degree of threat expressed ([alpha] = .67), shallow or deep writing ([alpha] = .96), and a count of total words used. For the number of death-related words and focus on death themes, ANOVAs revealed main effects of priming condition, both \( F(2, 48) \geq 17.70, p < .001, [\eta]^2 \geq .44 \). Death primes elicited the most death-related words (\( M = 3.00, SD = 2.52 \)) and death focus (\( M = 1.69, SD = 1.31 \)), though cancer prime participants used more death words (\( M = .56, SD = .73 \)) and had higher death focus (\( M = 1.69, SD = 1.31 \)) than did dental pain participants (death word: \( M = 0.00, SD = 0.00 \); death focus: \( M = 0.03, SD = 0.13 \)), all \( t(48) > 4.51, p < .01, [\eta]^2 = .30 \).

Because the negativity and threat dimensions were so highly correlated (\( r = .77 \)), they were averaged to form a threat–negativity dimension. An ANOVA on these ratings revealed a main effect of prime condition, \( F(2, 48) = 4.09, p = .02, [\eta]^2 = .15 \). Consistent with Thorson and Powell (1990), the cancer prime responses (\( M = 3.30, SD = .74 \)) conveyed more threat–negativity than did the mortality salience responses (\( M = 2.44, SD = .85 \), \( t(48) = 2.77, p < .01, [\eta]^2 = .14 \), but did not differ from the dental pain responses (\( M = 2.81, SD = .96 \)), \( t < 1.64, p > .10 \).

For the shallow versus deep process writing, there was also a main effect for prime, \( F(2, 48) = 4.98, p < .02, [\eta]^2 = .13 \). The means indicated that both death (\( M = 2.32, SD = 1.22 \)) and cancer primes (\( M = 2.31, SD = .95 \)) elicited deeper writing compared with the dental pain control (\( M = 1.31, SD = .93 \)), \( t s > 2.70, p s < .05, [\eta]^2 > .13 \), but they did not
differ from each other. The total number of words did not differ by prime condition, $F(2, 49) = 1.69, p > .19$.

**Supplemental Data on Word Associates**

We asked a sample of undergraduates ($N = 35$) to do a free association task (i.e., list the first [up to] 10 words that come to mind) in response to the words “cancer” and “death.” Participants were first informed of and given the prompt for one target, and, after listing their responses, they were informed of and given the prompt for the other target (counterbalanced for order). These associates were then separated from the primes and rated on a 7-point scale for how threatening they were by two raters unaffiliated with our research and thus blind to hypotheses ($\alpha = .79$). An order (death first or cancer first) $\times 2$ (word associates: death and cancer) mixed model ANOVA showed only a main effect of cue such that the words associated with cancer were rated as significantly more threatening than those associated with death, $F(2, 33) = 4.30, p < .05, \eta^2 = .12$ ($M_s = 5.47$ and $4.98, SD_s = 0.98$ and 0.96, respectively).

There are, of course, a number of reasons why these supplemental data should be regarded tentatively and interpreted with caution. For example, hypothesized suppression processes may be at work with what participants write down, and participants’ judgments were not relative. That is, the experience of dental pain may be regarded as extremely negative, but had participants known that we were comparing it with the perceived negativity of death or cancer, they may have responded differently. Despite these limitations, these supplemental data are suggestive. In Study 1, even though cancer prime participants referenced death and survival more than did dental pain participants, they did not show higher death accessibility. Although the present cancer prime responses do not elicit the same level of focus on death as did the mortality salience treatment (at least in terms of what participants are willing to write down), data from both content analyses and word associates are consistent with a greater level of threat and negativity in response to the topic of cancer. This suggests that high death-related threat may be critical in instigating an enduring suppression.

However, this still leaves the question of why exactly cancer may be more threatening and might elicit a greater suppression of death-related thought than the topic of death itself. We can only speculate at this point, but part of the reason may stem from the regularity with which individuals, in this case college students, are accustomed to contemplating death and cancer. Indeed, college students would seem to have occasion to contemplate death (e.g., experiencing a particularly turbulent airplane ride; knowing classmates who were victims of drunk-driving accidents, drug-overdoses, suicide; philosophical pondering), and thus may have more effectively integrated it within a defensive network. In contrast, at least for the typical college student, cancer presents a more novel thought that, lacking such exposure, may be less well integrated into a defensive network. Thus, if undergraduate students think more about death generally (compared with cancer-related thoughts), this may explain why cancer is seen as more threatening and arouses a more robust suppression.

**Supplemental Data on Frequency of Contemplation**

To provide some data on this issue, we conducted another supplemental study ($N = 35$). Students were first asked how often they think about getting cancer and, upon answering, were asked how often they think about dying (counterbalanced for order). A 2 (order) $\times 2$ (topic) mixed model ANOVA revealed only a main effect of topic, $F(2, 33) = 6.32, p < .02, \eta^2 = .16$, such that students thought more about dying than about getting cancer ($M = 5.43, SD = 2.09$ and $M = 4.46, SD = 2.21$, respectively).

We want to strongly emphasize the tentativeness of any conclusions that can be reached from these supplemental data and that more carefully designed studies are certainly needed to examine the apparent dissociation between reminding participants of cancer and mortality. However, taken together, both the content analyses and the supplemental data are consistent with the possibility that the topic of cancer may be seen as particularly threatening and is one in which participants are less versed. This in turn suggests that, given cancer’s apparent level of threat, its association with death-related thoughts may be vigorously suppressed. In Study 2, we sought to examine this possibility more directly.

**Study 2**
Wegner’s (1992, 1994) theory of ironic processes of mental control provides important insight into the nature of effortful suppression. According to this theory, the suppression of unwanted thoughts involves two related processes: a conscious operating system that distracts attention from the unwanted thoughts and an unconscious monitor that assesses the effectiveness of the thought suppression. Although individuals are often able to suppress unwanted thoughts, the conscious operating system requires mental resources whereas the unconscious monitor does not. Therefore, if cognitive resources are limited, the operating system may falter, whereas the unconscious monitor continues to search for a breakdown in suppression. Thus the irony of mental suppression is manifest under conditions of high cognitive load: The process meant to guard against unwanted thoughts actually increases their accessibility.

As noted earlier, previous research has found that after being reminded of mortality, death accessibility increases when a delay is present between the induction and the accessibility measure or immediately following the mortality salience induction when individuals are under high cognitive load (e.g., mentally rehearsing a long number; Arndt, Greenberg, Solomon, et al., 1997). This suggests that individuals spontaneously suppress thoughts of death immediately after being reminded of mortality. Therefore, if thinking about cancer increases the suppression of death-related thoughts even after a delay, this suppression should be less effective if cognitive resources are taxed by additional cognitive demands. Thus after thinking about cancer under high cognitive load, increased death-thought accessibility should be observed.

Method

Participants

Forty-four women from the University of Missouri—Columbia participated in this experiment and received partial credit for their introductory psychology class. Participants were randomly assigned to conditions in a 2 (salience: cancer vs. dental pain) × 2 (cognitive load: high vs. low) between-subjects factorial design.

Procedure

The procedure was similar to that of Study 1. However, here participants were given a cover story that described the study as examining the relationship between personality and whether people can perform two tasks simultaneously. Participants were told that while completing some personality measures they would be asked to mentally rehearse a 10-digit number for later recall. After the initial briefing, the experimenter handed out the packets and asked participants not to start until the number had been given. The experimenter wrote the 10-digit number on a whiteboard and fully erased it after 30 s. Participants were reminded to silently rehearse the number in their heads until they were prompted to write it down in the packet. When they finished their packet, they were instructed to put it in an envelope that was provided and then to place the envelope in a designated box.

Materials

The packet of materials included filler personality questionnaires that supported the cover story, followed by the cancer or dental pain salience induction, a puzzle delay task, and the death-accessibility measure. The materials were identical to Study 1 with the addition of the cognitive load manipulation.

The cognitive load was introduced as an additional task to rehearse while completing the personality questionnaires. Having participants mentally rehearse a number has been used as a cognitive load by a number of researchers (e.g., Gilbert & Hixon, 1991; Wegner, Erber, & Zanakos, 1993). Participants were given 30 s to look at the number and then it was up to them to mentally rehearse it until it was prompted for recall. Participants in the low-load condition were prompted for the number directly before the salience manipulation; participants in the high-load condition were not prompted for the number until the end of the packet after the accessibility measure.

Results and Discussion

Participants’ overall success at recalling the number suggests that they were in fact mentally rehearsing it. Only 3 of the 44 participants did not recall at least four correct digits. The results do not change if these participants are excluded.
Death Accessibility

To assess whether cancer salience interacted with cognitive load to affect death-thought accessibility, we conducted a 2 (salience: cancer vs. dental pain) × 2 (load: high vs. low) between subjects ANOVA. The results revealed that neither of the main effects were significant (F's < 1); however, the predicted interaction emerged, F(3, 40) = 5.69, p < .05, [eta]² = .16. The means and standard deviations are presented in Table 1. Pairwise comparisons indicated that cancer salient participants showed higher accessibility in the high-load condition compared with that in the low-load condition, t(40) = 2.44, p < .02, [eta]² = .13. This is consistent with the notion that death accessibility was higher after thinking about cancer when participants' abilities to suppress thoughts were undermined by the cognitive load. Also as predicted, for the high-load participants death accessibility was higher among cancer salient participants compared with that of control participants, t(40) = 2.32, p < .05, [eta]² = .12. Finally, consistent with the results of Study 1, there was no significant difference between the low-load-dental salience and the low-load-cancer salience conditions (t < 1), and there was no significant difference between the dental salience conditions under low and high cognitive load, t(40) = 1.09.

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<th>Cancer Salient</th>
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<td>Low Load</td>
<td>M = 0.38, SD = 0.45</td>
<td>M = 0.24, SD = 0.37</td>
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<tr>
<td>High Load</td>
<td>M = 0.45, SD = 0.50</td>
<td>M = 0.28, SD = 0.40</td>
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Table 1 Cell Means, Standard Deviations, and Cell Sizes as a Function of Cognitive Load and Salience Conditions on Death-Thought Accessibility in Study 2

Content Analyses

Once again, two coders rated the open-ended responses on number of death words, focus on death and survival ([alpha] = .98), threat-negativity ([alpha] = .71 & .76), shallow versus deep processing ([alpha] = .89), and total words used. Given the high correlation between threat and negativity codings (r = .74), they were again combined. A 2 (load) × 2 (prime) ANOVA on number of death words revealed no effect involving load (F's < 2.08, p's > .15), but there was a main effect of prime, F(1, 40) = 5.76, p = .02, [eta]² = .12. Cancer prime participants (M = 0.82, SD = 1.00) used more death words than dental pain prime participants (M = 0.23, SD = 0.69). A 2 (load) × 2 (prime) ANOVA on attention to death-survival issues showed no effects involving load (both F's < 1.38, p's > .24), but it similarly showed more focus on death and survival when participants were asked to write about cancer compared with dental pain, F(1, 40) = 8.57, p < .01, [eta]² = .12 (M's = .80, SD = .95 and .14, SD = .47, respectively). This is consistent with the coding analysis of Study 1 and suggests that cancer is indeed more linked to death than is the topic of dental pain. There were no significant effects on threat-negativity, shallow versus deep processing, or total words used (all F's < 1.22).

Study 2 supported the hypothesis that thinking about cancer leads to increased death-thought suppression. The results showed that under low cognitive load, cancer salient participants exhibited low death accessibility as in Study 1, which supports the idea that priming cancer creates a conscious threat that leads to sustained suppression efforts even when a delay is present between the cancer induction and the accessibility measure. However, under high cognitive load, death accessibility was elevated, supporting the hypothesis that priming cancer can lead to increased death-thought accessibility if suppression is hindered by taxing cognitive resources.

The content analyses are again informative for a number of reasons. First, they show that the topic of cancer elicited greater thoughts of death than did dental pain in participants' open-ended responses but did not elicit differences in...
negativity. This attests to the suitability of the dental pain topic as a control condition. Second, the lack of any effects involving load help to address some potential alternative explanations for these findings. Specifically, one possibility is that the high cognitive load may have led participants in the cancer condition to simply think about cancer in a more shallow manner, which in turn might lead to a greater focus on death. However, the fact that there was no difference on number of death words, degree of focus on death-survival, level of threat expressed, shallow versus deep writing, or total words used as a function of load does not support this possibility. Further, it is interesting to note that although the addition of cognitive load led to increased death-related word accessibility (as measured by word stem completions) after cancer salience, it did not affect references to death in the open-ended responses that participants generated. This may be because the need for suppression was not apparent until after participants finished writing their responses. Alternatively, it may also be that what participants write down in their responses reflects more deliberative cognition than that tapped by the word stem accessibility measure.

**Study 3**

Study 3 was designed to extend the previous findings in a number of different ways. First, in Study 2, unlike in Study 1, we did not include a mortality salience condition. Although our intent was to examine the effects of cancer salience (vs. a control topic) under conditions of cognitive load on death-related word accessibility, our failure to include the mortality salience condition leaves us unable to compare mortality and cancer primes in a scenario in which both might be expected to increase death-related word accessibility. We thus conducted Study 3 to offer such a comparison. However, rather than again examining the effects of explicit thoughts of mortality or cancer, we considered an additional situation in which both primes might be expected to increase death accessibility. Specifically, if the conscious threat of cancer engenders the need to suppress its connection to death-related thought, then suppression should be unnecessary if cancer thoughts are activated outside of conscious attention. To this end, we used subliminal priming procedures to expose participants to presentations of the word death, cancer, or fail and hypothesized that given its activation outside of conscious attention, both the cancer and the death primes would increase death-related word accessibility relative to the control condition. Note that we used the control prime of fail to extend our findings beyond usage of dental pain as a control topic. Fail was chosen because it is a potentially self-relevant threat and has been used in previous terror management studies (e.g., Arndt et al., 2002).

In addition, in the first two studies, a word fragment completion measure was used to index levels of death accessibility. Although such measures generally (e.g., Bassili & Smith, 1986; Gilbert & Hixon, 1991; Steele & Aronson, 1995; Tulving et al., 1982), and this measure specifically (e.g., Arndt, Greenberg, Solomon, et al., 1997; Greenberg et al., 1994; Mikulincer & Florian, 2000), have been found to be quite effective in assessing activated constructs, convergent findings with an alternative measure would offer further support for the present analysis. Study 3 thus used a lexical decision task (i.e., judgments about whether a string of letters is a word or a nonword) to examine participants’ reaction time (RT) to death-related words. The reasoning behind such measures is that judgments about stimuli relevant to accessible constructs are more quickly rendered when that construct, or constructs that prime those stimuli, have been activated (see e.g., Bargh & Chartrand, 2000; Fazio, 1990).

A further issue that Study 3 was designed to address concerned the specificity of the effect of the primes to the accessibility of death-related constructs. In each of the two previous studies, we measured the accessibility of death-related thought but did not measure whether the primes affected the accessibility of negative thoughts more generally. Previous research has suggested that priming negative emotions may lead to affect regulation, increasing the reaction time for subjects to endorse negative primes (e.g., Power, Stuessy, Mahony, & Brewin, 1991). Thus, in this study, participants made lexical decisions not only about death-related words but also about more general negative words as well. Note that this finding by Power et al. (1991) also suggests an alternative way to interpret RT scores; that is, high RTs reflect greater regulation toward the construct. However, the present predictions follow previous RT work (e.g., Bargh & Chartrand, 2000) to postulate that when primed subliminally, the cancer stimuli would increase sensitivity to death-related words and would thus lead to faster RTs.
Method

Participants

Fifty-five introductory psychology students (43 men, 11 women, and 1 who declined to report gender but was included in the final analysis) from the University of Missouri–Columbia participated in the experiment in return for partial course credit.

Procedure

Up to 4 participants completed the experiment at one time. An experimenter described the study as two computer tasks designed to investigate perceptions of word relationships and the ability to discern words from nonwords. The experimenter stressed that participants’ responses would remain anonymous and provided each participant with a consent form to read and sign. Then the instructions for each task were verbally explained and these instructions were repeated on the computer before each task. Participants were ushered into individual cubicles where they completed two word perception tasks. All measures were completed on the computer. For both tasks, stimuli were presented on a 15-in. color monitor controlled by an IBM-compatible computer equipped with MediaLab (Empirisoft Corporation, 2002) display software. Within the MediaLab interface, DirectRT software synchronized the timing of the stimuli. Once all of the participants were finished, the experimenter thoroughly debriefed them and thanked them for their time.

Participants first completed a word relationship task. The first few frames presented the instructions which explained that the word relation program would present two words on the computer screen and participants are to indicate whether they think the words are related by pressing the right or left shift key. For example, if they saw the words rose and flower, they were to press the right shift key to indicate that they are related, but if they saw the words sneaker and fajita, they were to press the left shift key to indicate they were not related. Four practice trials allowed participants to familiarize themselves with the procedure. All stimuli were presented in Times New Roman 14-point font in the center of the computer screen. The first and the third stimuli were the words for which participants were to judge the presence or absence of a relationship. These words also provided a forward and backward mask, respectively, and were each displayed for 356 ms. The critical subliminal primes were presented between the two mask words for 28 ms as in previous research (e.g., Arndt, Greenberg, Pyszczynski, & Solomon, 1997; Arndt et al., 2002). In the subliminal death prime condition, participants were exposed to 10 such trials with the word death presented between the two masks. Likewise, the cancer and fail prime conditions presented the word cancer and fail, respectively, between the two masks. The randomization was prepared by another assistant, and conditions were coded as numbers, so that the experimenter was able to remain blind to conditions.

The second task, which served as our dependent measure, began with instructions informing participants they were to determine whether the string of letters presented formed either a word (which they were to indicate by pressing the right shift key) or a nonword (indicated by pressing the left shift key). They were told that they could respond as soon as they saw the letter string and that their objective was to answer as quickly and as accurately as possible. Participants were presented with three practice trials to familiarize them with the procedure. The target letter string was presented for 1,000 ms between a forward and a backward mask (xxxxx). Participants completed 60 trials that consisted of four word types. Half of the trials were nonwords that were created by changing one letter of actual words to form pronounceable nonwords (e.g., fraw, quert). The rest of the trials contained 10 of each category: negative words (torture, danger, cruel, evil, betray, gloomy, anxious, pain, hate, monster), neutral words (doormat, baseball, picture, tree, magnet, cloak, chair, express, radio, desk), and death words (dead, coffin, killed, stiff, skull, tomb, buried, murder, grave, mourn). A separate sample of 31 undergraduates rated the 100 words on negative emotionality, positive emotionality, and connection to death, which confirmed their intended classification. Negative words were rated as more emotionally negative than death or neutral words (both $t(31) > 2.12$, $p < .05$, [eta]$^2 > .12$). However, there was no difference in positive emotionality for death and negative words ($t < 1$). Death-related words were also rated as more death-related than negative or neutral words, both $t(31) > 8.18$, $p < .001$, [eta]$^2 > .67$. In addition, for the death words, ratings were higher on death-relatedness than on negativity, $t(31) = 4.85$, $p < .001$, [eta]$^2 = .44$; and for negative words, ratings were higher on negativity than death-relatedness, $t(31) = 5.49$, $p < .001$, [eta]$^2 = .49$. Notably, the death and negative target words do not differ on estimates of word frequency (on the basis of the Kuera & Francis, 1967, norms [$t < 1$, $p > .70$]). A set of the 60 trials was generated in random order and each
participant saw the stimuli in the same order. The program recorded the response latencies for each trial.

After the second task was completed, participants were presented with a series of questions to check their awareness (if any) of the prime in the first task. The questions began broadly and then became more specific. The questions included the following: How many words did you see in each display (each trial for which you were to make relational judgments)? (open-ended response); Did you ever see more than two words flashed at a time? (1 = yes, 2 = no, 3 = I don’t know); If yes, was it the same word or a different word from the others you saw? (1 = same, 2 = different, 3 = I don’t know); If you think it was a different word, list what you think it may have been (open-ended response); Assuming that there was a word flashed in between the two target words, which of the following do you think it may have been? (1 = sex, 2 = death, 3 = pain, 4 = fail, 5 = cancer).

Results and Discussion

Checks on Awareness of Subliminal Stimuli

The questions about how many words participants saw in each display, whether they ever saw more than two words, if so whether the words were the same or different, and the question asking them to guess which word was flashed were all subject to Pearson chi-square tests to determine whether any responses differed by condition. These analyses revealed no such differences (all p s > .44). In addition, all but 1 participant did not list any guesses when asked what word may have been flashed or wrote such phrases as I don’t know. The one exception was a participant who wrote the word apple. Thus, as in previous studies, it seems clear that there was at least no retrospective awareness of the masked prime.

Reaction Times to the Lexical Decision Task

In lexical decision task studies, there are generally two strategies for dealing with latencies that are less than 200 ms or greater than 2,000 ms (Bargh & Chartrand, 2000; Fazio, 1990). Given that they most likely reflect errors, such responses may be either dropped or recoded to 200 and 2,000 ms, respectively. Although the results are the same with either approach, we report the former strategy and dropped any response to the lexical decision task that was less than 200 ms or greater than 2,000 ms (11% of the responses). Mean RTs were then computed for the neutral words, death words, and negative words, excluding incorrect responses (1.3%).

To control for general RT speed, neutral word RTs were regressed on both death word RTs and negative word RTs and then a 3 (prime: death, cancer, fail) × 2 (death words vs. negative words) mixed model ANOVA was performed on the residual RT scores. This analysis revealed only the predicted two-way interaction, F(2,48) = 5.47, p < .01, [eta]² = .10 (all other F s < 1, p s > .78). Cell means are presented in Table 2. In order to examine the nature of this interaction, we conducted a series of pairwise comparisons within both death and negative words. As hypothesized, both death prime and cancer prime participants manifested faster RTs to death words than fail prime participants (both t s = 2.24, p s < .05, [eta]²s > .09) but did not differ from each other (t < 1). In contrast, for the negative words, there were no significant differences between conditions (all t s < 1.56, p s > .12). Two-versus-one planned contrasts confirmed that cancer and death primes led to lower RTs to death-related words than did the fail prime condition, t(48) = 3.37, p = .002, [eta]² = .19, but did not differ from fail prime participants for negative word RTs (t < 1).

Table 2 Cell Means and Standard Deviations for the Subliminal Prime by Word Type Interaction on Reaction Time (RT) in Study 3

http://ovidsp.tx.ovid.com/spa/ovidweb.cgi?S=CIKGFPJMLDDNCCGNCGLIHMLOEJ0AA00&Link=Set=S.sh.15.16.18%7c2%7csl_10
The present findings indicate that, in contrast to the explicit cancer salience manipulation used in Study 1, when cancer and death are primed outside of conscious awareness, death-thought accessibility increases with cancer just as it does with a death prime. This is consistent with the notion that when cancer is activated but is not conscious, participants do not need to suppress its connection to death-related ideation. Further, the present findings appear to be unique to the activation of death ideation as they do not generalize to other negative words and are obtained with an alternative RT measure of construct accessibility.

The use of an alternative RT measure of accessibility in the present study could, however, be seen as introducing some ambiguity into the interpretation of these results. That is, one might wonder whether the different pattern of findings between Study 1 and Study 3 occurred because of the explicit versus subliminal priming procedure or because of the different means of assessing accessibility. However, it is important to note that both word fragment measures and RT measures have been well established as techniques to assess construct accessibility. Perhaps more important, the alternative explanation that cancer prime participants showed higher death accessibility in Study 3 but not in Study 1 because of differences in accessibility assessment techniques between the studies cannot explain the effects of the load manipulation in Study 2, whereas the notion that participants suppress the conscious connection between cancer and death can explain findings across all three studies.

**Study 4**

But do thoughts of cancer always engender efforts to suppress death-related thought, and if not, what are the conditions under which this effect is more or less likely? When hearing that a close friend who smokes two packs of cigarettes a day has contracted lung cancer, nonsmokers may experience sympathy and sadness, but it seems unlikely that their thoughts turn to their own potential risk of sharing this fate. However, if a close friend is diagnosed with breast cancer, the other friend may think about her own vulnerability, experience the news as more threatening, and thus be more likely to engage suppression of the connection between cancer and death. Indeed, Erblich et al. (2003) found that it was primarily those participants with a family history of breast cancer who showed impaired cognitive processing on a cancer variant of the Stroop task.

What we are suggesting, then, is that perceived vulnerability to cancer can function as an important moderator of the extent to which cancer information will arouse suppression of death-related cognition. A number of studies are consistent with the notion that perceived vulnerability can elicit psychological defenses and inferences that ameliorate (at least subjectively) the perception of personal susceptibility to the threat (e.g., Boney-McCoy, Gibbons, & Gerrard, 1999; Gerrard, Gibbons, & Warner, 1991; Weinstein, 1984). In the present context, when perceived vulnerability is high, the information should be more threatening, suppression should be engaged, and death-thought accessibility should be low. However, when perceived vulnerability is low, suppression should be comparatively unnecessary and thus death-thought accessibility should increase as a result of the connection between the constructs. The purpose of Study 4 is to assess the merits of this analysis. An additional purpose of Study 4 is to assess a potential mediator of this hypothesized effect. Specifically, this analysis implies that how threatening participants view the cancer information should mediate the effects of perceived vulnerability to cancer on levels of death-thought accessibility.

In this study, rather than have participants think about the prospect of contracting cancer generally, we opted to focus on a specific form of cancer and to present participants with (bogus) information that connoted either high or low vulnerability. Specifically, we had female participants read a bogus research article that suggested that a growth hormone linked to a person's height was related to breast cancer risk. Vulnerability was based on the combination of the article that was read and the height of the participant.

**Method**

http://ovidsp.tx.ovid.com/spa/ovidweb.cgi?S=CKGFPJMLDDNCCGNCGLHMLOEJ0A00&Link=Set=S.sh.15.16.18%7c2%7cs1_10 Page 14 of 30
Participants

Forty women from the University of Missouri–Columbia participated in the experiment in exchange for partial course credit. Two participants were excluded because they indicated that they were suspicious because they had recently participated in a similar study involving death-thought accessibility.

Procedure

Participants were told that the study was investigating “personality and reading comprehension” and that they would be completing a packet of personality questionnaires and would then be reading a couple of short articles about which they would be asked to recall information. The number of participants per session ranged from 4 to 6. The experimenter assured participants that their responses would not be associated with their names in any way, and all materials were completed at divided workstations to further ensure their privacy. They were given each packet with a blank manila envelope and were instructed to place completed materials in the envelope and then to place the envelope in a designated box. Once everyone was finished, the experimenter probed for suspicion and thoroughly debriefed the participants. Special care was taken to ensure that participants realized the article about cancer was fictitious. The experimenter spent an extended period of time explaining to participants exactly why this study was being done, that it was not being undertaken lightly, and the nature of previous findings. The experimenter also gave participants Web site addresses for information pages from the National Cancer Institute and the American Cancer Society where they could learn more about cancer risk factors and preventative measures. No participant reported any negative feelings from their participation and most expressed interest in and appreciation of the research.

Materials

After completing filler personality questionnaires, participants were given the reading comprehension passages. These included the following two passages: first a filler passage about radio transmission modes, then the cancer passage that contained the vulnerability induction. Each passage was followed by a set of open-ended comprehension questions to bolster our cover story that the study was investigating reading comprehension. The second passage was a 1-page “article” ostensibly from the Seattle Times and was titled “Research Finds New Hormone Linked to Breast Cancer.” The article described research that has found a link between breast cancer and a fictitious growth hormone called AD3, which is described as being a predictor of breast cancer. Half of the participants read that women with low levels of AD3 (evidenced by a height of 5 ft. 4 in. or shorter) have an increased chance of contracting breast cancer, and the other half of the participants read that high levels of AD3 (evidenced by a height above 5 ft. 4 in.) were at increased risk for contracting breast cancer. This split at 5 ft. 4 in. was based on the median height for women between 18 and 25 years of age (e.g., Centers for Disease Control, 2000; Hall, 2003).

Immediately following the article, participants were asked to complete three questions regarding whether they had heard of these findings before, the name of the hormone, and what height was predictive of greater breast cancer risk. In addition, participants were asked to rate how threatening the article was on a 9-point scale that ranged from 1 (not at all) to 9 (very threatening). Participants then completed the same death-accessibility measure as in Studies 1 and 2. At the end of the packet, participants completed a series of demographic questions that included a question asking them their height and a question asking them if they had any family history of breast cancer. Of the participants, 4 women indicated a family history of breast cancer, but the results do not change if they are excluded. The analyses below therefore include these 4 participants.

Results and Discussion

All of the participants answered the comprehension questions related to the article correctly, with the exception of 1 participant who indicated that she had heard of the cancer findings before. Because her exclusion did not change the results, the analyses presented below include this participant.
We first classified participants into high \( (n = 16) \) versus low \( (n = 22) \) vulnerability groups on the basis of which article they received and their self-reported height. In order to assess whether high-vulnerability participants showed lower levels of death-thought accessibility than did low-vulnerability participants, we conducted a one-way ANOVA on the accessibility of death-related words. This analysis revealed a significant effect, \( F(1, 36) = 6.44, p < .02, [\eta]^2 = .15 \). The direction of the means supported our hypothesis: Participants in the high-vulnerability condition showed lower death-thought accessibility \( (M = 1.19, SD = .98) \) compared with those in the low-vulnerability condition \( (M = 2.09, SD = 1.15) \).

**Perceived Threat as a Mediator**

To assess whether how threatening participants found the cancer article mediated this effect, we followed the guidelines for assessing mediation as outlined by Baron and Kenny (1986). First, as described above, there was a significant effect of vulnerability (the independent variable) on death accessibility (the dependent variable). Second, there was an effect of vulnerability on how threatening participants viewed the article (the mediator), \( F(1, 35) = 6.86, p < .02, [\eta]^2 = .16 \). Third, there was a significant relationship between threat perceptions and death accessibility \( (r = -.42, p < .01) \), which is consistent with the idea that increased threat is associated with more suppression and thus lower death accessibility. Finally, when threat perceptions were entered into the model as a covariate, the effect of vulnerability on accessibility was no longer significant, \( F(2, 34) = 1.86, p > .18 \). As an alternative illustrative approach to conducting mediational analyses, a series of separate regression analyses were also performed. A mediation model with standardized betas, standard errors, and significance tests is depicted in Figure 1. Note that the sample size for these regression analyses is somewhat small (Cohen, 1988), and thus this model should be interpreted with caution.

![Figure 1 Standardized betas (standard errors) as a function of the mediational analysis between perceived vulnerability, level of threat, and death-thought accessibility scores in Study 4. As depicted, when perceived threat was included in the model, the previously significant relationship between vulnerability and death-accessibility scores was substantially reduced, suggesting a partially mediated effect. * \( p < .02 \). ** \( p = .01 \)](http://ovidsp.tx.ovid.com/spa/ovidweb.cgi?&S=CIKGFPIJMLDDNCNCGCLHIHMOEOJAA00&Link+Set=S.sh.15.16.18%7c2%7csl_10)
thought. This work suggests that the salience of the threat of cancer promotes a suppression of death-related cognition. This raises the question of whether there is any health-related functional significance of this hypothesized suppression reaction. Research in the domain of more generalized goal states suggests that both construct activation (e.g., of means of accomplishing the goal) and construct inhibition (e.g., of competing goals or obstacles) may facilitate goal attainment (e.g., Fishbach, Friedman & Kruglanski, 2003; Shah et al., 2002; Shah & Kruglanski, 2002). In the context of cancer screening, perhaps the salience of death is such an obstacle. Confrontation with the prospect of cancer can arouse a number of defensive reactions that can interfere with productive health steps, such as cancer screening behaviors (e.g., Bowen et al., 2003; Cameron, 1997; Olson & Morse, 1996; Race & Silverberg, 1996). Indeed, an estimated 70% of women do not regularly conduct breast self-exams (BSEs) (Lindberg & Wellisch, 2001). According to the present analysis, if people are prone to respond defensively to the threat of cancer, then the suppression of death-related thought may in fact represent a productive means of reducing inhibitions against engaging in screening behaviors. Put simply, if the specter of death is less accessible, then people may be better psychologically equipped to conduct a screening.

This suggests that being able to suppress the activation of death-related cognition after thinking about cancer would facilitate a more proactive interest in performing screening behaviors. In contrast, if people are unable to suppress the activation of death-related thought, they may be pressed to respond defensively through some other means. In this context, then, such persons should be more avoidant of pursuing diagnostic information and thus less inclined to engage in screening behaviors. We therefore conducted a fifth study to investigate these attitudinal implications of the cognitive processes examined in Studies 1-4. Specifically, we investigated the influence of cancer salience (and subsequent suppression) on individuals’ willingness to conduct future self-exams.

To do so, we used a parallel procedure to that used for Study 2. Specifically, participants wrote about cancer or asthma under conditions of high or low cognitive load. We then assessed intentions to conduct future self-exams (BSEs for female participants and testicular self-exams [TSEs] for male participants). This study thus extends the previous designs in three ways. First, whereas the prior studies asking participants to write about cancer (Studies 1 and 2) used only female participants, in this study both males and females were recruited. Second, this study used an additional control topic of asthma salience, which is important to address the possibility that the predicted effects are due to the salience of any unfortunate health outcome. Asthma was chosen because it is a health threat, but should not have the same linkage with death as cancer. Third, this study extends the analysis from cognitive representations of death to behavioral screening intentions.

We reasoned that when cancer is primed under low cognitive load, individuals should have the resources to successfully suppress the connection between death and cancer and thus may be more inclined to report increased intentions to perform self-exams. However, under high cognitive load, individuals may be deprived of the necessary resources to suppress the death-cancer connection, which may in turn lead to lower intentions to perform self-exams. Thus we predicted that when individuals are able to suppress the death-related thoughts associated with cancer they do so, but when their cognitive resources are taxed they avoid threat through alternative means, in this case by avoiding behaviors that can have important health benefits.

Method

Participants

Eighty-three undergraduate students (39 women and 44 men) from the University of Missouri–Columbia participated in this experiment and received partial credit for their courses. Participants (both male and female) were randomly assigned to groups in a 2 (cognitive load: high vs. low) × 2 (salience: cancer vs. asthma) between-subjects design.

Procedure

The procedure was identical to that of Study 2 with the three exceptions previously noted. Specifically, both male and female participants were used and were given gender appropriate packets. In completing the packet, participants were
randomly assigned to high or low cognitive load conditions and prompted to think about the prospect of cancer or asthma. Instead of death-thought accessibility, our dependent measure assessed participants’ intentions to conduct breast or testicular self-exams. The breast self-exam intention questionnaire consisted of the following six items:

At this moment, I feel particularly motivated to conduct BSEs.
At this moment, the thought of conducting a BSE is particularly unappealing.
At this moment, the thought of conducting a BSE makes me feel uncomfortable.
How likely is it that you will do a BSE in the future?
How likely is it that you will do a BSE this week?
How likely is it that you will do a BSE this month?.

All items were rated on a 9-point Likert-type scale that ranged from 1 (not at all true/not at all likely) to 9 (very true/extremely likely). These items were modified to specify TSEs for men by substituting TSE for BSE.

Results and Discussion

As in Study 2, participants’ overall success at recalling the number suggests that they were in fact mentally rehearsing it. Only 3 of the 83 participants did not recall at least four correct digits. The results do not change if these participants are excluded.

Self-Exam Intentions

After reverse scoring the appropriate items, the six items ([alpha] = .76) were averaged to calculate a self-exam intentions score. A 2 (load: low or high) × 2 (salience: cancer or asthma) between-subjects ANOVA revealed no main effects but did show the predicted two-way interaction, \( F(1, 79) = 8.86, p < .01, \eta^2 = .10 \) (see Table 3 for means and standard deviations). Pairwise comparisons showed that under low-load conditions, there was a tendency for the cancer prime to increase self-exam intentions compared with the asthma prime, \( t(79) = 1.82, p = .07, \eta^2 = .04 \), suggesting that given the cognitive resources to suppress thoughts of death, individuals may take a more proactive approach to screening. Consistent with our predictions, however, among the high-load conditions, those primed with cancer showed lower self-exam intentions compared with those primed with asthma, \( t(79) = 2.41, p < .02, \eta^2 = .07 \). This is consistent with the notion that when cognitive resources are taxed and suppression is impaired, participants are more likely to avoid health screening. Looked at differently, among those primed with cancer, the high-load condition showed lower intentions to perform self-exams compared with the low-load condition, \( t(79) = 2.68, p < .01, \eta^2 = .08 \), but there was no such difference within the asthma conditions (\( t < 1.56, p > .13 \)). Notably, initial analyses included gender as a factor and found no significant effects involving this variable (all \( F_s < 1.67, p_s > .20 \)).
that presumably support suppression efforts. Because death-thought accessibility was only high when cognitive resources were taxed by the same general method, explored the role of suppression in response to cancer salience by taxing the cognitive resources cancer elicited low levels of death-thought accessibility comparable to that of the control condition. Study 2, through the use of a word stem completion task to reveal that in contrast to mortality salience, explicitly thinking about cancer compared to asthma, F(1, 79) = 19.27, p < .001, [eta]^2 = .19 (M = 1.01 and 0.09, SD = 1.14 and 0.55, respectively). This is consistent with the coding analysis of Studies 1 and 2. A 2 (load) \times 2 (prime) ANOVA on attention to cancer survival issues showed no effects involving load (both F < 1) but similarly found more focus on death and survival when asked to write about cancer compared to asthma, F(1, 79) = 3.02, p = .09, [eta]^2 = .04. Cancer prime participants (M = 0.55, SD = 0.86) tended to use more death words than did asthma participants (M = 0.15, SD = 0.95). A 2 (load) \times 2 (prime) ANOVA on attention to death-survival issues showed no effects involving load (both F < 1, p > .33) but similarly found more focus on death and survival when asked to write about cancer compared to asthma, F(1, 79) = 19.27, p < .001, [eta]^2 = .19 (M = 1.01 and 0.09, SD = 1.14 and 0.55, respectively). This is consistent with the coding analysis of Studies 1 and 2. A 2 (load) \times 2 (prime) ANOVA on threat–negativity revealed no effects involving load (both F < 1) but did reveal a significant main effect of prime condition, F(1, 79) = 6.86, p = .01, [eta]^2 = .08. Cancer prime participants (M = 2.18, SD = 0.62) expressed more threat–negativity than asthma prime participants (M = 1.80, SD = 0.66). There were no significant effects on shallow versus deep processing or total words used (all Fs < 1).

Recall that Study 2 found, after writing about cancer, death-thought accessibility was lower when participants were under low cognitive load relative to high cognitive load. Via the same design, Study 5 found, after writing about cancer, self-exam intentions were higher when participants were under low cognitive load relative to high cognitive load. Given the convergence in procedures, this suggests that suppressing death-related cognition after thinking about cancer may allow people to take greater interest in diagnostic cancer information. These findings may also be viewed as compatible with the attentional myopia model of behavioral control (e.g., Mann & Ward, 2004) as well as recent findings from the theory of goal systems (e.g., see Kruglanski et al., 2002). From the perspective of the attention myopia model, cognitive taxation disrupts self-regulation toward health outcomes by rendering an individual's behavior more susceptible to situationally salient cues. And from the perspective of goal systems theory, goal activation can inhibit the accessibility of constructs that might be detrimental to the goal. In the present context, because participants are unable to suppress death-related thoughts, such cognitions may make participants reluctant to perform screening behaviors. However, with death-related cognition pushed out of awareness, an individual may be swayed by the productive cues associated with screening behavior and thus better positioned toward the goal of maintaining physical health.

In this way, the present study offers a number of potentially important contributions. First, most generally, it extends the current analysis to a different outcome, one that is of vital importance for understanding propensities to engage in behavior that can facilitate early detection of cancer and thus reduce mortality rates from the disease. Second, the study also unveils a potentially beneficial consequence of suppression, a process that is typically construed as having negative effects on physical and psychological well-being. Third, given the theoretical link between the suppression of death-related thought and attention to health information, the study provides converging support for the suppression analysis. This analysis can thus explain findings from five different studies. Fourth, this study includes an important control condition (i.e., the salience of asthma) that was absent in the previous four studies and helps to address alternatives that these general effects are due to any aversive cognition about a medical condition. Fifth, whereas the previous studies that used explicit cancer primes included only female participants, here both males and females showed the predicted effects.

**General Discussion**

On the basis of previous research suggesting that cancer is often construed as a death sentence (e.g., Cameron, 1997; Ferrell et al., 1998), the present Studies 1-4 investigated the extent to which cancer primes increase the accessibility of death-related thoughts, and in Study 5, this analysis was applied to self-exam intentions. Unlike previous work discussing the link between cancer and death, this research provides insight into the differential cognitive processing of explicit and implicit cancer stimuli, their link to the accessibility of death-related thought, and the implications for facilitating less avoidant responses to cancer self-exams.

Study 1 used a word stem completion task to reveal that in contrast to mortality salience, explicitly thinking about cancer elicited low levels of death-thought accessibility comparable to that of the control condition. Study 2, through the use of the same general method, explored the role of suppression in response to cancer salience by taxing the cognitive resources...
that presumably support suppression efforts. Because death-thought accessibility was only high when cognitive resources were diminished, Study 2 suggests that conscious thoughts of cancer may be likely to arouse suppression efforts. Consistent with this idea, Study 3 shows that when cancer was primed outside of conscious awareness, death accessibility, as indexed by an RT measure (but not accessibility of negative words in general), increased just as it did for those participants who were primed with the word death. In Study 4, we found when participants are confronted with information conveying high vulnerability to cancer, death-thought accessibility (measured via word stems) is lower than when participants are presented with information conveying low vulnerability. Furthermore, the effect was mediated by participants' perceived level of threat. Finally, Study 5 implicates the role of suppression after the explicit salience of cancer (via the same prime as Studies 1 and 2) by finding increased self-exam intentions under low load but decreased self-exam intentions under high load.

One potential issue with this series of studies is that across studies we used different priming techniques and different dependent variables. This could introduce some ambiguity when the results are tied together. Of course, the use of varying methods can also be seen as an important strength. That is, despite these differences, all studies can be explained by a common theoretical position that provides what we believe is strong support for the suppression explanation. In addition, the variability of methods does not appear to open an alternative explanation that can explain the findings from all five studies. The present research thus begins to lay a foundation for understanding how concerns about cancer are connected to thoughts of death and the implications this has for health-oriented responses. Although more work is clearly needed, the present findings suggest a number of interesting implications.

Implications for Terror Management Theory

Recent terror management work has begun to elucidate a process model of how concerns about mortality affect cognitive and social processes by examining the cognitive architecture by which people defensively respond to the conscious and unconscious awareness of death (see Arndt et al., 2004). From this perspective, by virtue of its motivational significance, the awareness of death occupies a central position within a semantic network and can be activated by associated events or dispositional and situational breakdowns in the protective mechanisms that keep conscious concerns with death at bay (e.g., Goldenberg, Cox, Pyszczynski, Greenberg, & Solomon, 2002; Landau et al., 2004; Mikulincer et al., 2002). When death-related thoughts are conscious, this initiates proximal defenses, such as suppression, that pseudorationally ameliorate the need for further attention to conscious death-related concerns. Such proximal responses to heightened death-related cognition can be conducive to physical health (e.g., increased sun-block intentions; Routledge et al., 2004) but can also implicate risky health responses (e.g., decreased BSE intentions as in Study 5 or increased vulnerability denial as in Greenberg et al., 2000). Recent research suggests that individual differences in such variables as health optimism may be able to predict when an individual will respond in a more health productive or unproductive manner (Arndt, Routledge, & Goldenberg, 2006). With death-related cognition now accessible but outside of current focal attention or when the nonconscious accessibility of mortality is directly increased via subliminal priming methods, this activation spreads to constructs that are associated with the individuals' culturally prescribed investments in meaning and esteem. When such investments become activated by thoughts of death, they are then defended in the face of stimuli that impinge on those beliefs; an action that serves to reduce the heightened accessibility of death-related thoughts that led to the reaction.

The present findings add an important facet to this emerging model by showing that death-thought accessibility can be increased by the associated topic of cancer but, importantly, that this linkage is attenuated by the propensity for conscious thoughts of cancer to be sufficiently threatening to engage particularly robust suppression efforts.8 Terror management theorists have often maintained that the construct of death engenders unique psychological effects (e.g., Greenberg et al., 1997), but it also appears that other threats (in this case, cancer) may implicate motivated cognitive processing of their connection with death-related ideation. A topic for future research may be how associated constructs such as cancer impact some of the variety of death-related terror management defenses that have been identified in previous research. Indeed, Landau et al. (2004) found that priming the terrorist attacks of 9/11 increased death-thought accessibility and political manifestations of worldview defense. The Landau et al. studies did not explore suppression processes, and thus another direction for future research may be to examine how death-related stimuli differ in their cognitive byproducts when they
implicate physical health versus when they do not. The present research provides an invitation to such efforts by beginning to map out how the topic of cancer reverberates to activate death-related thought.

Understanding Priming Effects and Suppression Processes Involving Cancer and Death

The relationship between priming cancer and death-thought accessibility is not merely a function of free association but appears to have a motivational element that is engaged when thoughts of cancer are consciously activated. First, whereas having people explicitly think about cancer did not increase death-thought accessibility (under low cognitive load; Studies 1 and 2), subliminal cancer primes did produce such an effect (Study 3). Second, although cancer and death may have a semantic connection, Study 4 illustrates that the activation of death-related constructs was mediated by perceived threat to the self. That is, individuals who did not feel threatened by the cancer information were apparently less motivated to suppress thoughts of death and thus exhibited elevated accessibility. However, threatened individuals appeared to insulate themselves from this information through thought suppression, which was illustrated by low death-related word accessibility.

This is consistent with, and represents an applied application of, the idea that personal relevance can play an important moderating role in the motivated cognitive linkage between constructs (e.g., Ferguson & Bargh, 2004; Shah & Kruglanski, 2002). Therefore, the present research extends previous priming research by elucidating in a content-relevant context how motivational elements can influence the linkage between two cognitions, and how priming certain constructs outside of conscious attention can elicit different cognitive effects than priming those constructs within conscious attention.

Moreover, this work also raises the possibility that two constructs, despite sharing associations, can differentially affect cognitive and motivated processing as a function of their implicit or explicit activation. Specifically, in Study 3, subliminal primes of the word cancer and death both increased death-thought accessibility. In Study 1, content analyses indicated they both increased reference to death (relative to the control topic) when they were initially contemplated. However, after explicit contemplation in Study 1, mortality salience increased death-thought accessibility but cancer salience did not. In light of the load findings of Studies 2 and 5 and the vulnerability findings of Study 4, this suggests a dissociation between explicit activation of the cancer and death constructs in terms of their propensity to provoke a robust suppression.

But why would the salience of cancer lead to a greater suppression of death-related thought than the salience of mortality? The present studies were not specifically designed to address this question, and thus we can only tentatively speculate. However, some possibilities may merit further attention. As Thorson and Powell (1990) argue, the topic of cancer may be seen as more threatening than the topic of death. Consistent with this conclusion are data from the present content analyses and the supplemental study on word associates. Part of this negativity may stem from a second difference between cancer and death—participants' comparative unfamiliarity with thinking about cancer, leading it to be less well integrated into an established system of cognitive and motivational defense. Consistent with this possibility are the supplemental data on frequency of contemplation in which participants reported having thought about death more than they did about cancer. Finally, cancer (at least as participants thought about it in these studies) may be a more concrete manifestation of abstract concerns about death, and this comparative lack of abstraction may render it more threatening. Although future research is clearly needed to further understand this potential dissociation, the present data introduce a novel area of inquiry in suggesting that two associatively linked constructs can have dissociative consequences.

The present findings also contribute to an understanding of suppression of unwanted thoughts, particularly as such processes naturally unfold. Previous suppression research usually manipulated mental control by instructing participants to suppress or express specific thoughts (see e.g., Wenzlaff & Wegner, 2000). However, initially suggested by Greenberg et al. (1994) and confirmed by Arndt, Greenberg, Solomon, et al. (1997), reminders of mortality elicit a self-motivated suppression of death-related thought. The present research documents a similar spontaneous effect with respect to confrontation with the topic of cancer. In addition, there are other noteworthy instances in which suppression appears to be self-motivated. When making causal attributions for others' behavior, people tend to engage in a self-motivated suppression of dispositional explanations, which then later resurface to more strongly color subsequent social judgments (Geeraert, Yzerbyt, Corneille, & Wigboldus, 2004; Yzerbyt, Corneille, Dumont, & Hahn, 2001). The fact that these spontaneous suppression effects occur in
such very different domains (i.e., confrontation with death and confrontation with causal attributions) suggests that researchers may be just scratching the surface of uncovering domains of self-motivated suppression.

Geeraert et al. (2004; see also Yzerbyt et al., 2001) have pointed out that cases of self-motivated suppression pose an interpretive problem for the perspective advanced by Foerster and Liberman (2001; see also Liberman & Foerster, 2000), who argued that suppression rebound effects are due to participants' motivational interpretations of experimenters' instructions to avoid thinking about a certain topic. However, to the extent that participants are suppressing death-related cognition in response to conscious thoughts of death as a form of defensive avoidance of threatening ideation, a broader view of Liberman and Foerster's work suggests an interesting way to mitigate this effect. That is, Liberman and Foerster suggest that encouraging emotional expression of the to-be-suppressed concept and acknowledging the difficulties of confronting the topic can eliminate some consequences of suppression. In the present context, future research may thus benefit from exploring how acknowledging people's trepidations about cancer can reduce defensive responses to this most unfortunate disease.

It is important to recognize however that there may be an important temporal consideration in the palliative effects of reducing suppression. Study 5 suggests that allowing people to suppress the activation of death-related thought in response to contemplation of cancer may better prepare them to take recommended screening action. Thus, in the short term, such suppression may have some beneficial consequences and it may be that only over time can people relax suppression and concurrently inhibit the defensive response tendencies that threaten to thwart recommended health behavior. Findings from the emotional suppression literature are consistent with this idea. After initially disclosing a suppressed trauma, people show higher levels of negative affect. However, over time, such disclosure predicts greater physical and psychological well-being (e.g., Pennebaker, 1989). Given the importance of screening behaviors for early detection of cancer, this could be a vital direction of research.

Implications for Health Threats

In this light, the present research also suggests a number of implications for understanding issues relating to health. Examining the influence of thinking about cancer and perceived vulnerability on the activation of death-related thoughts can help to elucidate how cancer-related information is cognitively processed. In some of the first research to examine cognitive processing of cancer information, Erblich and colleagues (2003) found that individuals with a family history of breast cancer showed increased response latencies to cancer-related concepts, supporting their hypothesis that distress increases impairment of processing cancer stimuli. The present research adds to these findings in showing that, just as a large number of people respond to cancer illnesses with denial and repression strategies (McKenna, Zevon, Corn, & Rounds, 1999), when participants are led to think about cancer they tend to suppress its connection to thoughts of death. In this way the present studies also add suppression to the other defensive reactions elicited by threatening health information (e.g., minimize importance or relevance, overestimate prevalence; compensatory self-enhancement; see, e.g., Boney-McCoy et al., 1999; Croyle et al., 1997).

Although there are steps that individuals can take in order to stay healthy, it is often easier to deny one's vulnerability or ignore the issue altogether because cancer thoughts can elicit such anxiety (e.g., Cameron, 1997; Cameron & Leventhal, 1995). Investigating the patterns of death-thought accessibility may reveal the ways in which individuals react to cancer information and perhaps explicate why so many people do not participate in cancer prevention and screening behaviors. As we saw with Study 5, removing the accessibility of a potential source of anxiety (i.e., death) may help to facilitate a more productive response. In this way, the present research follows recent empirical efforts that attest to the utility of studying cognitive information processing in the context of health topics (e.g., P. G. Williams et al., 2003). The present findings, for example, are consistent with research suggesting that threat may lead to avoidance motivations (Cameron, 1997). But certain avoidance motivations may have beneficial effects for reducing other avoidance reactions. In this case, such suppression may be an effective response to the extent that it facilitates the fortitude needed to confront the disease without being paralyzed with fears about its often lethal course. Armed with an understanding of the cognitive link between cancer thoughts and death accessibility, future research may thus be in a better position to understand how behavioral reactions to cancer

http://ovidsp.tx.ovid.com/spa/ovidweb.cgi?S=CIKGFPIJMLDDNCCGNCGLIHMLOEJOAA00&Link+Set=S.sh.15.16.18%7c2%7cs1_10
may depend on the defense routes available as well as the resources a person brings with them.

References


In comparing the results of Study 1 and Study 2, there appears to be a difference in the overall level of accessibility of death-related thoughts. However, given that the studies were conducted during different semesters and at different times within a semester, we caution against comparing levels across studies and prefer to look at the patterns within each study. Notably, the effect size estimates are similar across studies.
One may wonder why if participants are suppressing death-related thought (in the cancer condition in Study 1 and the low-load cancer condition in Study 2), death-thought accessibility is not lower than that observed in the control condition. Following previous terror management theory research, we suggest that the suppression of death-related thought is reflected in the absence of elevated death-thought accessibility; that is, at equivalent levels to what is observed in a baseline or control condition. Consistent with this explanation, in every previous terror management theory study examining death-thought accessibility, those death prime conditions hypothesized to have lower death-thought accessibility (e.g., because of suppression) have not been found to differ from dental pain or from other aversive topics (e.g., worries about the future, taking an important exam; Arndt, Greenberg, Simon, Pyszczynski, & Solomon, 1998, Study 2; Arndt, Greenberg, Solomon, et al., 1997, Studies 1 and 3; Greenberg, Arndt, Schimel, Pyszczynski, & Solomon, 2001), as well as from more neutral topic controls (e.g., watching TV, thinking about leisure activities; Greenberg et al., 1994, Study 4; Harmon-Jones et al., 1997, Study 3; Mikulincer & Florian, 2000, Studies 2 and 3; Mikulincer & Florian, 2002, Study 3; Simon et al., 1997, Study 4). Thus, our finding of no differences with control conditions is entirely consistent with the previous literature. [Context Link]

This rate is higher than what is typically found in lexical decision task studies. However, most of this can be attributed to long RTs for nonwords. Less than 1% of responses fell under the 200-ms mark. In addition, only 5.4% of the word trails exceeded 2,000 ms. The fact that many of the nonwords resembled words as opposed to nonsense letters (e.g., blort) may in part explain this pattern. [Context Link]

Separate analyses were performed on neutral and nonwords. The results revealed that there was no significant effect of prime (subliminal exposure to the word cancer, death, or fail) on neutral or nonwords (both Fs < 1). [Context Link]

Note that the only remote trend within the RTs to the negative words was for fail prime participants to be a bit faster. It may be important to point out that we did not conduct comparisons between death and negative words because, as Fazio (1990) and others suggest in a discussion of latency measures of accessibility, a judgment may be made for a number of reasons in addition to the semantics of the word target. Although with the present stimuli there were no differences in word frequency between the death words and the negative words, it is unclear whether differences, or lack thereof, between (in this case) death word and negative word RTs reflect attention to the content of the word or occur because of other word characteristics. For this reason, we believe the between-condition comparisons within a word type are the most important for assessment of the effects of the subliminal primes. [Context Link]

The degrees of freedom are reduced for this analysis because 1 participant did not complete the threat question. [Context Link]

Because of insufficient evidence that BSEs reduce mortality rates associated with breast cancer, the American Cancer Society has recently changed their guidelines so that monthly BSEs are now considered optional for at risk women. However, as new guidelines reflect, women should be familiar with how their breasts feel and be able to recognize changes in their breasts (e.g., www.cancer.org). Further, breast exams may be especially useful for younger women for whom regular mammography is not recommended (R. A. Smith et al., 2003). [Context Link]

One interesting methodological issue not well explicated by the present studies concerns the role of a delay in observing the explicit cancer salience-death-thought accessibility effects. Because previous terror management research finds that a delay following an explicit mortality salience manipulation is typically needed to observe increased death-thought accessibility (Pyszczynski et al., 1999), we followed a similar practice in the present studies in which we explicitly manipulated the salience of cancer. However, we did not systematically explore the role of a delay (e.g., would a longer delay allow for the surfacing of increased death-thought accessibility in the absence of cognitive load?), and thus future research is needed to
clarify this issue. [Context Link]

Keywords: terror management; health threats; construct accessibility