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The Interactive Effect of Mortality Reminders and Tobacco Craving on Smoking Topography

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Objective: Although fatal consequences of smoking are often highlighted in health communications, the question of how awareness of death affects actual smoking behavior has yet to be addressed. Two experiments informed by the terror management health model were conducted to examine this issue. Previous research suggests that the effects of mortality reminders on health-related decisions are often moderated by relevant individual difference or situational variables. Thus, a moderated effect was hypothesized here, and cigarette cravings were tentatively explored in this regard. ***Methods:*** In both studies, relatively light smokers completed a brief questionnaire about cigarette cravings, were reminded of their mortality or a control topic, and then smoked five puffs from a cigarette while the topography (i.e., volume, duration, and velocity) of their inhalations was recorded. ***Results:*** Significant craving × death reminder interactions emerged in both experiments. After reminders of mortality, stronger cravings predicted greater smoking intensity. Further, reminders of mortality increased smoking intensity for those with stronger cravings in both studies, and there was also some indication that mortality reminders decreased smoking intensity for those with weaker cravings. ***Conclusions:*** Although there are limitations in the present research's utilization of light smokers as opposed to heavy smokers, these findings indicate a nuanced effect of mortality reminders on smoking intensity and suggest that careful consideration needs to be given to when and how reminders of death are used in communications about smoking. The discussion also highlights the benefits of social psychologically informed theory for understanding health and smoking behavior.

Keywords: smoking, smoking cravings, puff topography, mortality salience, terror management theory

Whether through the Federal Drug Administration's recent efforts to regulate graphic cigarette warning labels, or through any number of cessation programs, the fatal consequences of smoking are often highlighted. Presumably this reflects the intuitive expectation that reminding people of their mortality will decrease smoking behavior, whether by curbing initiation, stopping the progression from casual to habitual use, or motivating cessation efforts. However, the fundamental question underlying this assumption has yet to be addressed: How do reminders of death actually affect smoking behavior?

Research derived from the social psychological theory of terror management (Greenberg, Pyszczynski, & Solomon, 1986) is increasingly revealing the importance of peoples' efforts to manage their awareness of inevitable mortality in understanding health-relevant decisions. The emergent terror management health model (TMHM; Goldenberg & Arndt, 2008) thus represents a bridge between traditional social and existential psychology and behavior in a health context. However, whereas TMHM has been applied to different health behaviors, it has yet to target peoples' actual tobacco consumption among either established or more novice smokers. The present research thus enlists the TMHM framework to offer preliminary insights into how death reminders influence smoking behavior.

The Terror Management Health Model

Terror management theory explains how humans' nonconscious awareness of mortality potentiates an ominous capacity for anxiety

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that is managed through investment in enduring cultural belief systems (e.g., one's nation, religion) that enable individuals to believe they are significant contributors to a purposeful, orderly, and meaningful world (see Becker, 1973). Accordingly, hundreds of studies demonstrate that accessible death-related thoughts (often manipulated via two-open ended questions that prompt reminders of mortality; i.e., mortality salience [MS]) increase identification with, and defense of, these cultural worldviews and bases of self-worth (Greenberg, Solomon, & Arndt, 2008 for review).

TMHM brings the theory into the health domain by articulating how health contexts can activate conscious or nonconscious death cognition. Building from Pyszczynski, Greenberg, and Solomon's (1999) dual defense analysis, TMHM posits that when mortality concerns are conscious, health decisions are guided partly by proximal motivational goals to remove death-related thought from focal attention by reducing perceived vulnerability to a health threat. Such decisions can facilitate health, as when conscious thoughts of death motivate people to increase exercise intentions (Arndt, Schimel, & Goldenberg, 2003). Yet because the underlying goal is to remove death thoughts from consciousness, people can also engage threat-avoidance responses (e.g., Greenberg et al., 2000). They can try to forget about it, distract themselves, or push the problem far into the future. The strategy used to remove death thoughts from focal awareness appears to depend on an individual's perceived ability to effectively manage the health situation and its implications for fatality (e.g., response efficacy, health optimism; Arndt, Routledge, & Goldenberg, 2006; Cooper, Goldenberg, & Arndt, 2010).

In contrast, when mortality concerns are active but outside of focal attention, health relevant decisions are guided in part by bolstering self-esteem and maintaining one's symbolic conception of self. This idea has been examined in a number of health domains, including smoking intentions. Hansen and colleagues (2010) showed that graphic warning labels that conjure up thoughts of death increase smoking intentions among students who base their self-worth on smoking, demonstrating the response profile to nonconscious cognitions about death is oriented to esteem enhancement (see also Arndt et al., 2009; Martin & Kamins, 2010).

Although a few studies have applied terror management theory to understanding facets of smoking, these studies have focused on how death-related thought presumed to be outside of conscious awareness influences the esteem-relevant smoking intentions of young adults. No studies have explored actual smoking behavior, and no studies have explored the effect of conscious death cognition on such behavior. This represents a critical issue given the ubiquity with which information about smoking explicitly highlights its fatal consequences. The current studies therefore use the TMHM to generatively elucidate the more proximal effect of death-related thought on tobacco self-administration.

The Present Research

Whereas a conventional, rational health decision-making analysis might predict a straightforward effect of death reminders on smoking intensity—that reminding people they will die would attenuate smoking—there are reasons to consider a more nuanced prediction. As noted earlier, explicit reminders of mortality have generally not produced main effects on health-relevant judgments. Rather, research often reveals moderation by dispositional or situational variables relevant to health generally, or to the particular health situation. For example, among individuals who believed that applying sun protection effectively reduces vulnerability to skin cancer, or when such perceptions were bolstered, conscious thoughts of death led to increased sun protection intentions (e.g., Cooper et al., 2010). However, when perceived efficacy was low, conscious death thoughts instead motivated people to deny their vulnerability or avoid the relevant health scenario.

But what might moderate the effects of conscious mortality reminders on smoking behavior? Acknowledging a number of candidates, we sought to extend TMHM research with an exploratory study considering a well-established situational predictor of smoking behavior: smoking urge or craving (Cox, Tiffany, & Christen, 2001; Cronk & Piasecki, 2010; Shiffman et al., 2002). Our initial hypotheses with regard to craving were somewhat tentative but were grounded in the documented associates of tobacco craving levels.[1] Whereas active smokers are prone to discount future health risks (e.g., Baker, Johnson, & Bickel, 2003), the intensity of cravings affects the strength and direction of this bias. Weak craving is associated with greater perceived quitting efficacy (Niaura, Shadel, Brit & Abrams, 2002), and stronger craving leads smokers to perceive more positive aspects and consequences of continuing to smoke (Sayette & Hufford, 1997; Sayette, Loewenstein, Kirchner, & Travis, 2005). Thus, individuals with stronger cravings may discount risks and focus more on positive consequences of smoking, whereas those with weak cravings may be more attuned to associated risks.

Integrating this work with the TMHM suggests that craving may moderate the intensity of smoking behavior after conscious reminders of mortality. To the extent that individuals with a strong craving to smoke discount future health problems and focus on positive aspects of smoking, reminders of mortality might motivate defensive efforts (cf., Brehm & Brehm, 1981) and increase smoking intensity. In contrast, when cravings are low, and concerns about risks and associated health problems are perhaps more central, reminders of death might reduce smoking intensity.

Given the speculative nature of these predictions, an initial study explored the potential manifestation of this interactive effect, and a second study sought to replicate the patterns uncovered. Both studies assessed smokers' craving levels, followed the traditional terror management approach of manipulating reminders of death, and then measured the topography of participants' actual smoking response. Smoking topography refers to how a person actually smokes (i.e., inhales) a cigarette and was selected as the dependent measure so as to move beyond self-report intentions. Although there are a variety of indices of smoking motivation in the literature, topography has been validated as a reliable indicator of smoking behavior (Lee, Malson, Waters, Moolchan, & Pickworth, 2003). Not only does research indicate that topography varies with presumed desire to smoke (e.g., when regular smokers are given low nicotine yield cigarettes, Hammond, Fong, Cummings, &

[1] As noted in the Method and Results sections, both studies also explored smoking dependence as a potential moderator. However, as the research unfolded, although craving and dependence are generally correlated (and were in this research), craving emerged as the more reliable moderator and thus we focus our presentation on this variable, commenting on the potential role of dependence and other influences in the Discussion.

Hyland, 2005), but topography also varies as a function of experimental manipulations, such as those that increase negative mood or anxiety, which are hypothesized and found to increase smoking desire (e.g., Fucito & Juliano, 2009; McClernon et al., 2005; Palfai, Colby, Monti, & Rohsenow, 1997). We thus reasoned that topography was a suitable outcome with which to explore the potential effects of conscious mortality reminders on smoking behavior.

Study 1

Method

Participants

One hundred seventy psychology undergraduates (106 male; M_{age} = 18.94, SD = 1.38; 154 Caucasian, eight Asian American, six African American, and one Latino/Hispanic) participated in a study described as examining "basic personality and smoking behaviors." Participants were informed they would be asked to smoke during the study.

Procedure

Before their session, participants provided the name of their usual cigarette brand so the appropriate cigarettes would be on hand. At the lab session, the experimenter explained the procedure, obtained informed consent, and then escorted the participant into a private room where they reported their cravings and recorded a baseline puff topography session that also served to familiarize them with the equipment. They later completed filler questionnaires, were reminded of death (or the control topic), and then recorded a second puff topography session, followed by additional questionnaires.

Materials

Craving. The 10-item brief Questionnaire on Smoking Urges (QSUB; Cox et al., 2001), and all subsequent materials, were administered via the Clinical Research Support System (CReSS; Plowshare Technologies, Baltimore, MD) computer interface. Responses were recorded using click-and-drag slider scales ranging from 0 (*strongly disagree*) to 100 (*strongly agree*). The QSUB is composed of two highly related factors, desire to smoke and anticipation of pleasure (e.g., "I have a desire for a cigarette right now") and expected relief from negative symptomatology (e.g., "I could control things better right now if I could smoke"). A global composite measure[2] (M = 36.83, SD = 19.64, range = .2–84.8) showed acceptable reliability (α = .92).

Baseline smoking intensity. Smoking topography was assessed with a table-top CReSS device, calibrated 30 min before each session using both the internal voltage meter (M = .0020, SD = .0026), as well as a "practice puff" drawing approximately 30 mL through a syringe, recording the volume difference registered by CReSS (M = 2.39, SD = 1.18).

Participants were guided to light a cigarette (the light-up puff was not recorded) and asked to take five recorded puffs at their leisure. This established their baseline topography and equalized all participants on time since their last nicotine consumption. Baseline smoking intensity was computed from the average of CReSS measurements of volume (how much was inhaled), duration (how long the puff lasted), and maximum flow rate (velocity or speed of puff) for these five puffs, standardizing the averages and forming a composite intensity value (α = .87).[3]

MS. Participants were randomly assigned to complete one of two versions of a "Projective Life Attitudes Assessment" (see Greenberg et al., 2008). In the MS condition, participants responded to the prompts, "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 happens to you as you physically die and once you are physically dead." In the control condition participants contemplated failing an upcoming exam.

Anxiety. After this manipulation, a single item asked how anxious participants felt at the moment.

Smoking intensity. Next, participants were again guided to light a cigarette (light-up puff not recorded) and asked to take five recorded puffs at their leisure. The five-puff procedure was used to match the baseline period and thus allay suspicion that this period may have been of particular interest. The same method used for computing baseline intensity was used to compute target smoking intensity (α = .87).

Nicotine dependence and demographics. Participants then completed questionnaires containing the Fagerstrom Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991; α = .69; M = 1.90, SD = 2.03, range = 0–8), assessing dispositional level of tobacco dependence so the role of nicotine dependence could be examined, followed by a demographic questionnaire. The mean (.41) and modal (0) response to the FTND item assessing number of cigarettes per day (0 = 10 or fewer, 1 = 11 to 20, 2 = 21 to 30, 3 = 31 or more) indicated participants typically smoked 10 or fewer per day.

Upon completion (for both studies), the experimenter probed for suspicions, debriefed, and thanked each participant.

Results and Discussion

Smoking intensity. The MS × craving interaction was assessed using multiple regression methods prescribed by Aiken and West (1991).[4] Accordingly, QSUB scores were centered about the sample mean and the interaction term was computed by multiplying the centered variable with dummy codes representing the MS manipulation (0 = *exam*, 1 = *death*). Covariates were entered first (i.e., CReSS calibration values and baseline smoking intensity), followed by the main effects and then the interaction term.

[2] For both Studies 1 and 2, the expected factor structure of the QSUB was replicated. However, Cox et al. (2001) found very strong inter-factor correlations (e.g., .80) and a similarly high overall reliability (e.g., .89). As the present studies also found a high inter-factor correlation (.64), and that the results were the same using either of the two QSUB factors (αs > .81), we report analyses using the global composite.

[3] The assessment of reliability indicated that, both during baseline and the postmanipulation smoking period, intensity, flow, and duration cohered together. As we had no specific hypotheses about unique effects on distinct smoking dimensions, we formed the overall composite index of intensity. We note that when analyzed separately, the effects are largely driven by inhalation flow. While none of the other dimensions reveal significant effects, as one might expect given the high reliability of the composite, the patterns were similar.

[4] Five outliers (all zs > 2.5) were removed from the dataset.

There was no main effect of craving, and only a marginal effect of MS such that reminders of mortality increased smoking intensity, β = .08, $t(169) = 1.72$, $d = .26$, $p = .09$. However, this was qualified by a MS × Craving interaction, $F(1, 163) = 5.49$, $\Delta R^2 = .01$, $p = .02$ (see Figure 1). When reminded of mortality, greater craving was positively associated with smoking intensity, β = .19, $t(169) = 2.75$, $d = .42$, $p = .007$; in the exam condition, craving was unrelated to intensity, β = −.03, $t(169) = -.52$, $d = -.08$, $p = .60$. Looked at differently, compared with the exam condition, mortality reminders increased smoking intensity among those with greater (+1 *SD*) craving, (β = .20, $t(169) = 2.89$, $d = .44$, $p = .004$) but not among those with lower (−1 *SD*) craving, (β = −.03, $t(169) = -.41$, $d = -.06$, $p = .68$).

Anxiety. As commonly found in TMT research (Greenberg et al., 2008), the analysis on anxiety revealed no main effect of MS (β = −.12, $t(169) = -1.52$, $d = -.02$, $p = .13$), or an interaction with urge, $F(1, 163) = .05$, $\Delta R^2 < .001$, $p = .82$. A main effect of craving indicated that cravings were positively related with anxiety (β = .25, $t(169) = 3.26$, $d = .50$, $p = .001$). Importantly, controlling for anxiety did not alter the MS × Craving interaction on smoking intensity.

Nicotine dependence. Given nicotine dependence was assessed at the end of the study, we checked whether it was affected by the MS manipulation. Regressing nicotine dependence on MS, craving, and their interaction revealed no main effect of MS (β = .05, $t(169) = .65$, $d = .10$, $p = .52$) or interaction, $F(1, 163) = .08$, $\Delta R^2 = .00$, $p = .78$, though cravings positively related to nicotine dependence (β = .37, $t(169) = 3.76$, $d = .58$, $p < .001$). Controlling for dependence did not alter the MS × Craving interaction on smoking intensity, and the dependence × MS interaction on intensity was not significant by itself or when controlling for craving.

Study 1 indicates that craving moderates the effect of mortality reminders on smoking intensity. Given the novelty and speculative nature of this effect, however, replication is needed. Moreover, although we observed the significant association between craving and intensity after MS, much of this relationship stemmed from those with relatively high smoking urges. Those with low smoking urges, while directionally consistent with predictions, did not show a significant effect. This may reflect a more opportunistic approach to smoking among students (Cronk & Piasecki, 2010) or perhaps a more tenuous influence of craving when it is especially low. The thought of failing an exam may also influence smoking (Brandon, Wetter, & Baker, 1996) and thus cloud how reminders of mortality instigate different responses than that observed in response to a more neutral prime. Finally, Study 1 administered the FTND at the end of the study, which introduces potential ambiguity as to whether craving is indeed the operative individual difference. Study 2 was conducted with these issues in mind.

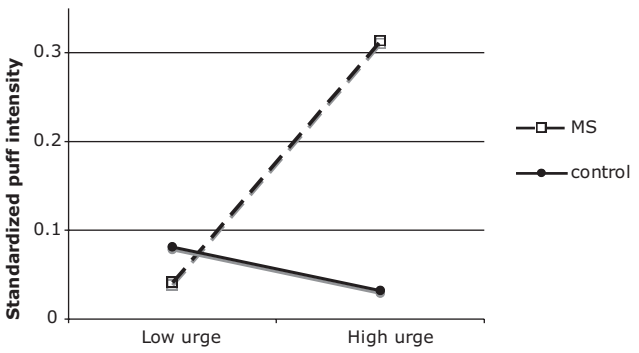

Figure 1. Death reminder × Craving interaction on smoking intensity (Study 1).

Study 2

Method

Participants

Forty-five community residents (23 male) were recruited via a university E-mail advertisement ($M_{age} = 22.94$, $SD = 6.52$, range 19–51) offering $20.00 in exchange for participation. Forty additional undergraduate psychology students (28 male) were recruited as in Study 1 ($M_{age} = 18.97$, $SD = 1.70$, range 18 – 27).[5] The final sample consisted of 85 smokers.

Procedure

Participants first completed an online survey querying smoking patterns and their usual brand, and then at least 7 days later, completed a lab session with procedures similar to Study 1.

Materials

Nicotine dependence. The FTND (α = .70, $M = 1.52$, $SD = 1.90$) was administered in the preliminary survey. The mean (.22) and modal (0) response to the question of how many cigarettes, on average, participants smoked per day indicated they typically smoked 10 or fewer per day.

Baseline smoking intensity. Calibration and baseline assessments followed the same procedure as in Study 1 (calibration: voltage $M = .00017$, $SD = .00013$; syringe mL – CReSS mL $M = .83$, $SD = 1.12$). Standardized averages of puff volume, duration, and maximum flow were again combined to form a measure of baseline smoking intensity (α = .91).

Craving. The 10-item QSUB (Cox et al., 2001) and all subsequent questionnaire materials were administered via MediaLab (Jarvis, 2002) research software. Responses were recorded on rating scales ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Craving levels were similar to Study 1 despite the different response format used ($M = 2.67$, $SD = .84$, range = 1.1–4.8).

MS. Participants completed the same MS manipulation as in Study 1, but here the control condition was a more neutral prompt to contemplate moving furniture.

Anxiety. This was followed by a single-item assessment of anxiety as in Study 1 (1 = *Not at all,* 6 = *Very anxious*).

Smoking intensity. The same method used for Study 1 was again used to compute target smoking intensity (α = .93).

[5] The student and community samples did not differ on FTND scores, $F(1, 83) = 2.35$, $\Delta R^2 = .03$, $p = .13$. Also, the MS × Craving interaction on intensity did not differ between community and student samples [i.e., the 2 (community member vs. student) × 2 (MS vs. exam) × Craving interaction was not significant, $F(1, 74) = .62$, $\Delta R^2 < .01$, $p = .43$].

Results and Discussion

Smoking intensity. The MS × Craving interaction was assessed using the same approach and covariates as in Study 1.[6] There were no main effects of craving or MS ($t(169)$s < 1.07, ps $> .29$), but analyses revealed the predicted MS × Craving interaction, $F(1, 78) = 9.36$, $\Delta R^2 = .03$, $p = .003$ (see Figure 2). When reminded of mortality, craving was positively associated with smoking intensity ($\beta = .26$, $t(84) = 3.05$, $d = .67$, $p = .003$) yet was unrelated to puff intensity in the furniture condition ($\beta = -.09$, $t(84) = -1.20$, $d = -.26$, $p = .24$). This relationship stemmed from influences at both ends of the craving spectrum. Compared with the furniture condition, MS increased smoking intensity among those with greater (+1 *SD*) craving ($\beta = .19$, $t(84) = 2.36$, $d = .51$, $p = .02$) and reduced intensity among those with lower (−1 *SD*) craving ($\beta = -.16$, $t(84) = -2.04$, $d = -.45$, $p = .045$).

Anxiety. No main effects of urge or MS ($t(84)$s < 1.44, ps $> .16$) or an interaction emerged on anxiety, $F(1, 78) = .45$. Controlling for anxiety did not alter the MS × Craving interaction on smoking intensity.

Nicotine dependence. Cravings were again positively related to nicotine dependence ($\beta = .21$, $t(84) = 2.04$, $d = .45$, $p = .045$). However, controlling for dependence did not alter the MS × Craving interaction on smoking intensity, nor was there a FTND × MS interaction on intensity while controlling for craving.

Study 2 replicated the finding that craving moderates the influence of mortality reminders on smoking intensity. However, not only did MS increase smoking intensity for those with relatively high cravings, those with low cravings smoked with reduced intensity after being reminded of mortality. This latter effect may have emerged here but not in Study 1 because low craving MS participants in Study 2 appeared to smoke with a bit less intensity than their Study 1 counterparts. To inform this possibility, we combined the samples from each study and examined the difference between MS and control participants at 2 *SD* below the mean craving level. Among those with low cravings, MS reduced smoking intensity, $\beta = -.19$, $t(254) = -2.36$, $d = .30$, $p = .019$. Finally, Study 2 measured nicotine dependence before study participation but still converged with Study 1 to suggest that effects attributed to situational craving cannot be accounted for by overall nicotine dependence.

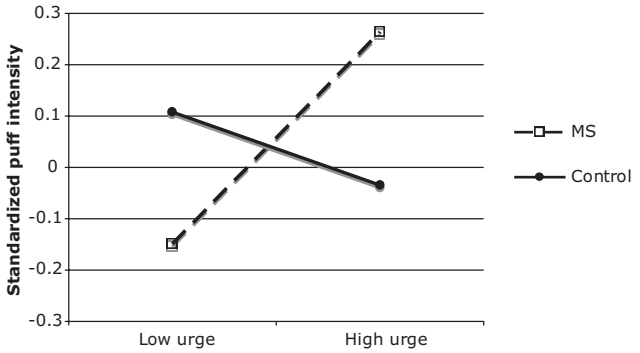

Figure 2. Death reminder × Craving interaction on smoking intensity (Study 2).

General Discussion

The present studies are the first to explore how reminders of death influence actual smoking intensity as measured by the topography of inhalations. Across both studies, MS interacted with individuals' preexisting level of smoking urge. Among those experiencing relatively greater cigarette cravings, reminders of mortality increased smoking intensity. Study 2 further suggested that MS reduced smoking intensity among those with especially weak cravings.

As noted at the outset, the research was initiated with tentative predictions about the potential for mortality reminders to interact with craving and impact smoking behavior. The progression of the present studies thus highlights an important strength of social psychology lab research to facilitate relatively rapid testing, replication, and development of theory and application. In the present context, this work uses a social psychologically grounded theory to offer a novel perspective on a seemingly ubiquitous tendency to pair mortality-related information with smoking cessation campaigns. Contrary to assumptions that seem to be involved, death-related cognition may not always have the intended effect of increasing responsiveness to risk information. The present rationale instead suggests that when smokers experience cravings, conscious thoughts of death may lead them to increase risky behavior. This tentative hypothesis was explored in Study 1 and then replicated in Study 2. When combined with previous research showing that individuals who smoke for extrinsic or esteem relevant reasons respond to nonconscious death-related thought with decreased quitting intentions (e.g., Hansen et al., 2010), this suggests careful consideration needs to be given to when and how reminders of death are used as part of cessation efforts. It is important for future research to explore the possibility of combining mortality information (e.g., as may be presented on graphic warning labels or as part of cessation programs) with information that aims to attenuate smoking urges and increase attention to risk, perhaps by enhancing efficacy perceptions (Niaura et al., 2002).

When considering these results, it is important to note that craving levels were low and may not reflect the relatively intense emotional state with which craving is often studied in the literature. A critical task for future research is to thus explore the effect of mortality reminders when craving levels are intense, perhaps among more advanced or highly dependent smokers than those sampled here, or when paired with a cue or deprivation instructions known to heighten smoking craving. Yet the present findings can also be considered in light of a burgeoning interest in understanding influences on smoking behavior among relatively novice or light smokers. Although craving was associated with dependence in the present research as is typical, the overall craving levels seem to be more indicative of "chippers" or light and intermittent smokers (LITS; e.g., King & Epstein, 2005). Yet this is an important group to study. With research traditionally restricted to those with more ingrained habits, there is growing recognition of the need for psychological research to provide more information about what is becoming a substantial portion of the smoking population (e.g., Shiffman, 2009). Further, insight about factors affecting nicotine self-administration among relatively novice smokers is

[6] One outlier ($z > 2.5$) was removed from the dataset.

also important because these are the individuals who may transition to more habitual use (Colder et al., 2006; National Cancer Institute, 2008).

The present research is of a preliminary nature but, we believe, indicative of the generativity of bringing social psychological theory generally, and the terror management perspective specifically, to bear on understanding health, and in this case, smoking behavior. We note a number of possibilities that can be integrated with the present approach below.

One might be tempted to suggest that reminders of death increased arousal and this arousal in turn influenced smoking intensity. Indeed, some studies have shown that situational inducements of anxiety can increase smoking intensity as measured by topography (e.g., Rose, Amanda, & Jarvik, 1983). However, there is not always a clear relationship between anxiety and smoking (Kassel, Stroud, & Paronis, 2003). Further, considerable research indicates that the MS treatment used in these studies typically does not directly increase anxiety, affect, or arousal (Greenberg et al., 2008). The current results converge with this prior work in showing no effect of mortality reminders on anxiety. Although we used a single item measure of anxiety, hundreds of studies have used more nuanced measures of mood and similarly found no effects, making it difficult to explain the present effects on this basis.

Perhaps more provocative is that conscious reminders of death influence smoking in part through their elicitation of the *potential* for anxiety. Indeed, death reminders have been found to elicit a potential for anxiety (Greenberg et al., 2003) that can be misattributed and influence health behavior (Goldenberg, Arndt, Hart, & Routledge, 2008). This becomes especially interesting when one considers that smoking self-administration may be triggered by "interoceptive inklings of affect" and serve to forestall mood decrements before they become sufficient to color more conscious self-reports (Baker et al., 2004). Thus, not only might TMT help to elucidate motivational features of smoking behavior, but in vivo smoking paradigms may present a useful way to examine the management of potential existential anxieties. Thus, both sides of the social psychology/health coin can be polished.

Another possibility is mortality reminders representing an associative cue for smoking, at least for some smokers. Smoking cues can increase desire to smoke (Carter & Tiffany, 1999), and although not especially common, some smokers link smoking to possibilities of death (Hendricks & Brandon, 2005). Might the link also run the other way? That is, might reminding those with strong smoking urges of death increase the desire to smoke as a result of the associates inherent in their bioinformational network? We know that reminders of death activate dominant worldview-relevant constructs (e.g., nationalistic or relational cognitions) for use in managing existential concerns (Arndt, Greenberg, & Cook, 2002). The possibility that smoking-related schemas might be similarly activated is intriguing for its potential to significantly expand the levels of analysis at which death reminders impact smoking.

Finally, the present findings can inform interfaces between existential defense, health, and self-regulatory resources. For example, self-regulatory depletion increases susceptibility to urge-based influences generally (Muraven & Baumeister, 2000) and to smoking among smokers (Shmueli & Prochaska, 2009; but see also O'Connell, Schwartz, & Shiffman, 2008). Given that the management of conscious death thought is an effortful activity that depletes self-regulatory resources (e.g., Galliott, Schmeichel, & Baumeister, 2006), reminders of mortality could interact with preexisting elevated smoking urges to increase smoking intensity because managing such reminders, especially in conjunction with the cognitive resource demand of dealing with cravings (see Sayette, 2004), depletes the self-regulatory resources typically used to control urge based behavior. Although it is not clear how such a perspective would account for those with low urges smoking less intensely in Study 2, this remains a potentially interesting intersection for future research.

Conclusion

Though there is certainly more to be learned, the present studies illustrate the potential insights that can be gained by integrating the terror management analysis of existential motivation with inquiry into smoking behavior. The findings open the door to a better understanding of the differential effects of death reminders on smoking and their implications for warning labels and cessation programs, as well as expanding what we know about situational factors affecting tobacco self-administration. Yet the potential contributions are most certainly a two-way street. This work also offers the potential to expand our understanding of the management of death-related cognition by studying the everyday behaviors, such as puffing away on cigarettes, people (ironically) use to cope with the awareness of their finitude.

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