

The Captain of My Soul: Self-Determination and Need-Satisfaction Help Manage Death-Related Cognition, Anxiety, and Well-Being

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The present research tested the idea that a self-determined orientation may help people manage death-related thoughts and anxieties, and mitigate the effects of death awareness on well-being. Seven studies ($N = 3,331$), using a diversity of measures and manipulations, were consistent with that idea. First, mortality salience (vs. other topic primes) increased death-thought accessibility, but not if participants had high need-satisfaction (Study 1, $n = 160$; Study 2, $n = 216$) or were prompted to recall self-determined experiences (Study 3, $n = 188$). Second, need-satisfaction was associated with reduced death anxiety (Study 4a, $n = 301$; Study 4b, $n = 1,848$), and priming self-determined concepts eliminated the effect of mortality salience on death anxiety (Study 5, $n = 119$). Third, heightened death-thought accessibility was related to lower satisfaction with life (Study 6, $n = 271$) and happiness (Study 7, $n = 228$), but not among those with high need-satisfaction. Supplemental analyses suggested the effects of need-satisfaction were not due to associations with affect (Studies 1, 6, 7), epistemic certainty (ideological dogmatism, Study 4a), or mindfulness (Studies 5b and 6); need-satisfaction mitigated the effects of existential concern via self-esteem but not via growth orientation (Study 4b) nor due to its relationship with Openness (Studies 6 and 7). Together, these findings suggest a self-determined orientation can help buffer existential concern and buoy well-being and point to a potential existential protective function beyond its known growth-oriented functions.

Keywords: terror management, self-determination, mortality salience, autonomy, well-being

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In the fell clutch of circumstance,
I have not winced nor cried aloud.
Under the bludgeoning of chance
My head is bloodied, but unbowed.
Beyond this place of wrath and tears
Looms but the Horror of the shade,
And yet the menace of the years
Finds, and shall find, me unafraid.
It matters not how strait the gate,
How charged with punishments the scroll,
I am the master of my fate,
I am the captain of my soul.
—“Invictus,” from William Ernest Henley’s *Book of Verses* (1888)

At 16 years old, William Ernest Henley experienced complications from tuberculosis that led to the amputation of his left leg, followed by a lifetime of other surgical interventions. A constant worry for him, throughout his life, was gangrene and death; in a letter to a friend he confided, “I am afraid my marching days are over” (Cohen, 1974). Nevertheless, while in hospital recovering from one such surgery, he penned his famous *Invictus*. In the work, he alludes to his hazardous circumstances, poor health, and ultimate mortality, which would naturally be a cause for worry and a threat to his psychological well-being. But he found resilience and was unafraid in the face of such existential threat, not because of any external introjections about what to believe or how to behave (e.g., the “gait” and “scroll” are references to such pressures) but because of the vitalizing experience of his own sense of self-determination.

The present work seeks to better understand the connection between self-determination, existential concern, and well-being. Building on both self-determination theory (SDT; Ryan & Deci, 2000, 2017) and terror management theory (TMT; Greenberg et al., 2014; Routledge & Vess, 2019), a series of seven studies explored the role of self-determination in managing the cognitive (Studies 1–3) and affective (Studies 4–5) sides of existential concern and in attenuating the impact of existential concern on happiness and satisfaction with life (SWL; Studies 6–7).

Death-Awareness as a Threat to Well-Being

Like other animals, humans evolved a motivational orientation toward self-preservation. Because it is difficult for any animal to reproduce while dead, concrete existential threats are a cause for

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These studies were not preregistered, but the materials, supplemental analyses, anonymized datasets, and syntax files are available at the Open Science Framework (<https://osf.io/t37be>).

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anxiety and undermine psychological equanimity—and a motivator of evasive and remedial actions. But, in contrast to other animals, humans developed rather sophisticated cognitive capacities to grasp abstract concepts, including the concept of mortality. Thus, even when not in any immediate concrete danger, the awareness of mortality can be a cause for concern and a threat to psychological well-being.

Building on the contributions of cultural anthropologist Becker (1971, 1973), TMT argues that because the awareness of death is an existential concern, people are motivated to manage the awareness of death by participating in sociocultural worldviews, maintaining close relationships, and obtaining self-esteem within those sociocultural systems (Greenberg et al., 2014; Routledge & Vess, 2019). Cultural worldviews involve identities, beliefs, and values that offer a sense of permanence through secular legacy (national identity, contributions to government, art, science, prosocial values, etc.) and/or supernatural means (e.g., souls, afterlife). Self-esteem then functions, in that context, as an indicator of how well one is living up to the standards and values of one's worldview. Close relationships also play a role in providing existential security, emotional comfort and support, self-esteem as partners hold each other in positive regard, and legacy (impacting friends, family, community; Mikulincer et al., 2003).

Death-Related Thoughts

Much research has examined the effects of both explicit and implicit death-related thoughts (Kosloff et al., 2019). When people are explicitly aware of death, it first triggers efforts to minimize or remove it from focal attention—either by suppressing it (Arndt, Greenberg, Solomon, et al., 1997), denying vulnerability (Greenberg et al., 2000), or engaging in pseudorational efforts to minimize the risk of death through improved physical health (Arndt & Goldenberg, 2017; Routledge et al., 2004). Such responses appear designed to move death out of conscious awareness, reducing the potential for anxiety. However, though now out of focal attention, the concept of mortality remains implicitly accessible for some time, motivating efforts to shore up a sense of permanence via culture, close relationships, and self-esteem (Routledge & Vess, 2019).

Death-Related Anxiety

Although death-related thoughts are a psychological threat and presumed to be a potential source of anxiety, relatively little work has studied the effects of cognitive death awareness on death-related *anxiety*. One early study found that viewing a video depicting death increased anxiety among those who did not receive an experimental boost to self-esteem (Greenberg et al., 1992). But in the decades since, most research has investigated the impact of death awareness on social processes and outcomes, rather than the presumed risk of anxiety, prompting some to criticize the lack of research on the “terror” that would supposedly arise in the absence of effective terror management processes (Martin & van den Bos, 2014).¹ However, in recent years, research (such as the present work) has begun studying the implications of death-related anxiety and the possible psychological processes that might help to

mitigate that anxiety (Juhl & Routledge, 2016; Yetzer & Pyszczynski, 2019).

Indeed, studies have found that mortality salience (MS) primes can increase death anxiety but that such anxiety is mitigated among people with effective buffers in place, such as those who feel life is meaningful (Routledge & Juhl, 2010); who prefer to rely on existing meaning systems (high need for structure; Routledge et al., 2013); who are prone to indulging in nostalgic reflections (Juhl et al., 2010); who report broad social self-construals (Juhl & Routledge, 2014); and who have a heightened sense of self-esteem (Abeyta et al., 2014; Routledge et al., 2010). Thus, a few studies suggest that MS may indeed have an impact on death-related anxiety and that certain psychological buffers can help manage that anxiety.

Broader Expressions of Well-Being

Importantly, TMT holds that effectively buffering death awareness is key for healthy psychological functioning, more generally, and that without an effective buffer in place, death awareness can potentially undermine well-being more broadly (Juhl, 2019; Juhl & Routledge, 2016). A small but growing body of research has begun to investigate this idea. Early work found that defending one's worldview after MS boosts perceived meaning in life among the mildly depressed (Simon et al., 1998). More recently, several studies using an MS manipulation and several using measures of death-thought accessibility (DTA) found that elevated death-thought was associated with reduced meaning in life among those with weaker self-esteem (Routledge et al., 2010), those without religious faith (Vail & Soenke, 2018), those with weaker connection to sociocultural structure (Vess et al., 2009), and those on the verge of being without a long-term sociocultural goal (Vess et al., 2017). Other work has found that MS undermined SWL among those with extrinsic goal aspirations (wealth, fame, attractiveness; Vail et al., 2019) and those with low self-esteem (Routledge et al., 2010); MS exacerbated withdrawal from life among those who contemplated goal failure (J. Hayes et al., 2016); and MS reduced subjective vitality among those with low social self-construals (Juhl & Routledge, 2015) or low self-esteem (Routledge et al., 2010). Other work has investigated the effects of death awareness on measures of ill-being. For example, one study found MS exacerbated symptoms of generalized anxiety among those reporting weaker broad social self-construals (Juhl & Routledge, 2014), and another study found that DTA was associated with negative affect among those with low but not heightened self-esteem (Routledge et al., 2010). Thus, absence of

¹ Some (e.g., Lambert et al., 2014) have pointed out that hundreds of prior studies actually have measured affect but that the instruments used (most often the PANAS) were perhaps not sensitive enough and using supposedly more refined instruments were able to detect increased fear/anxiety immediately after MS (during conscious death awareness). However, those affective responses were assessed only during that immediate conscious/explicit death awareness phase and were not associated with the more “distal” (nonconscious/implicit) phase of sociocultural defenses. Thus, others (e.g., Juhl, 2019) have suggested that proximal fear/anxiety is related to proximal emotion regulation strategies (e.g., suppression, pseudorational problem solving) and that given the lack of available research on the topic, it remains to be seen whether *distal* changes in death-related affect neatly correspond to distal changes in death-related thoughts and defensiveness.

an effective buffer, death awareness might similarly undermine SWL and happiness.

Self-Determination and Well-Being

Together, the above findings suggest death-related thought is a potential source of anxiety and threat to well-being, but also that certain conditions might mitigate that effect. As suggested in Henley's *Invictus*, one such condition might be self-determination—feeling able to competently behave in freely chosen ways while maintaining positive sociocultural functioning.

One prominent theory focused on that experience is SDT (Ryan & Deci, 2000, 2017). Based on earlier work (Bowlby, 1977; DeCharms, 1968; Deci, 1975; White, 1959), SDT argues that people are fundamentally oriented toward personal growth and well-being. Research has found that this self-determined orientation is facilitated by the experience of what SDT calls “basic psychological needs”: autonomy, competence, and relatedness—with autonomy being the critical component of a self-determined orientation (Ryan & Deci, 2017).

People experience *autonomy*, the central component of self-determination, when they feel their attitudes and behaviors are based on their internalized beliefs and values. Low autonomy occurs when one's behavior is regulated by external pressure, rather than one's own motives, such as when social norms create pressure to conform (e.g., guilt, shame, contingent self-worth) or when an authority figure compels a behavior. In contrast, autonomous behavior is perceived as the self-determined expression and endorsement of one's internalized standards and values, enacted with a sense of psychological freedom and volition.² Additionally, people experience *competence* by capably engaging and effectively navigating one's daily environment, and they experience *relatedness* through intimacy, friendship, and belongingness with others.

Decades of research demonstrate that such need-satisfaction promotes optimal functioning and well-being (Vansteenkiste et al., 2020). Indeed, need-satisfaction is associated with SWL, meaning in life, and positive affect (Ferrand et al., 2014; Martela et al., 2018; Sheldon & Niemiec, 2006). In contrast, low need-satisfaction is associated with stress (Campbell et al., 2017; Weinstein & Ryan, 2011), depressive symptoms (Cordeiro et al., 2016), and anxiety (Ng et al., 2012). Further, SDT argues that need-satisfied self-determination drives growth-oriented well-being because those with self-determined orientations are better able to cope with stress and thus are more open and less defensive (Vansteenkiste & Ryan, 2013). In helping people cope with stress, for example, a self-determination prime bolstered performance and attenuated physiological threat responses during a stressful interview and speech (Hodgins et al., 2010) and a solo dance performance (Quested et al., 2011). A self-determined (vs. controlled) orientation prime also reduced avoidance of negative experiences (Hodgins et al., 2006) and suppression of emotionally distressing information (Weinstein et al., 2011; Weinstein & Hodgins, 2009).

Little previous research has examined whether self-determination might mitigate the effect of death awareness on existential concerns and well-being, but we think there are compelling reasons to suspect it might.

Existential Concern and Theoretical Overlap Between SDT and TMT

Although they may have some important differences, TMT and SDT might also have more in common with each other than appears at first blush. If autonomy activates and orients people toward their internalized beliefs and values, then individuals with a stronger autonomy orientation should feel more confidently affirmed of the internalized aspects of their cultural worldview—the beliefs and values they hold nearest and dearest. Becker (1973) argued that as people develop from infants to adults, they encounter various cultural beliefs and values, integrate some of them into their sense of self, and are thus able to autonomously pursue and express them. In this way, a person might develop a passion for basketball, internalize a religious faith, or value studying hard in school—rather than simply feeling externally pressured by society to do such things.

Self-determined orientations may, therefore, naturally affirm core aspects of one's internalized death-denying systems of meaning and self-worth, thus attenuating existential concerns and reducing the need for other worldview defenses. Indirect evidence for that idea comes from studies testing TMT's buffer hypothesis, finding that MS typically increases DTA and worldview defenses—but not if participants first engaged in a self-affirmation task that asked them to spontaneously (presumably autonomously) express and affirm their nearest and dearest values (Schmeichel & Martens, 2005; Vail et al., 2018). More direct evidence comes from recent studies finding that MS motivated worldview defenses, but not after an autonomy prime (Vail et al., 2020). Correlational work also finds autonomy is associated with a sense of symbolic immortality and meaning in life, resources helpful in buffering existential concerns (Horner et al., 2021). Therefore, although not previously explored, autonomy orientations may also buffer against existential concern and its impact on well-being.

Likewise, SDT and TMT have something in common regarding competence. TMT is focused on the defensive function of self-esteem, whether maintained via self-deceptive biases, extrinsic contingencies of self-worth, or genuine competence in valued domains. SDT, however, rejects self-esteem, per se, because it identifies the self-deceptive biases and extrinsic contingencies often involved in self-esteem as potentially growth inhibiting, and so SDT focuses instead on the growth-oriented benefits of competence. Notably, however, SDT holds that competence can bolster self-esteem among other more growth-oriented outcomes (Ilardi et al., 1993; Patrick et al., 2007). Thus, we find some common ground: TMT recognizes that self-esteem can be had via competence, and SDT recognizes that competence can bolster self-esteem.

With that in mind, it is notable that although prior TMT research on the role of self-esteem has perhaps often focused on ways that MS can motivate self-deceptive biases (e.g., self-serving attributions, Mikulincer & Florian, 2002) and efforts to live up to extrinsic

² It is important to note that any behavior can be experienced as controlled or autonomous. For example, Jane might go to soccer practice every day because she genuinely believes soccer offers something of value and finds it interesting, making her participation autonomous and self-determined; in contrast, Sally might also go to soccer practice every day not because of any genuine appreciation or interest, but because her doctor ordered her to get some exercise or because her wife and friends play and she now feels pressure to go along with the group, making it a more introjected and externally controlled behavior.

contingencies of self-worth (e.g., physical appearance, Arndt et al., 2009), at least some TMT work shows it can also motivate self-esteem striving through genuine attempts at competence. For example, among those who based their self-esteem partly on their physical strength, MS motivated a genuine increase in strength output on a hand dynamometer (Peters et al., 2005); and among those who valued their basketball skills, MS motivated better performance in a one-on-one game as well as increased number of points scored in a shooting task (Zestcott et al., 2016). Additionally, feelings of competence reduced self-esteem striving following MS inductions (Ben-Ari et al., 1999; Miller & Ben-Ari, 2004). Such findings suggest that MS can motivate efforts to achieve genuine competence in valued worldview-relevant domains and that—in addition to its known growth-oriented functions—competence can function as an existential buffer.

Similarly, the SDT concept of relatedness functions, at least in part and in addition to its known growth-oriented functions, as a source of existential security and thus a buffer against existential threat (Mikulincer et al., 2003). For example, MS motivates the increased desire for intimacy (Mikulincer & Florian, 2000) and motivation to form close relationships (Hirschberger et al., 2002), and activating thoughts about such relationship partners reduced DTA following an MS induction (Cox & Arndt, 2012). From a reverse angle, threats to close relationships can increase DTA and distress (Hirschberger et al., 2002; Mikulincer et al., 2002).

Together, the abovementioned work is consistent with the idea that need-satisfaction and self-determination represent a point of theoretical overlap: SDT and TMT may share some common ground in that need-satisfaction may, in addition to its known growth-oriented function, also serve a protective function against existential concerns and thus buoy well-being.

The Present Research

Together, the present analysis leads to the previously untested hypothesis that although death awareness can be an existential stressor, self-determined orientations and need-satisfaction should be associated with reduced death-related concern and greater well-being. The present research tested the hypothesis across a series of seven studies, using a diversity of measures and manipulations. Studies 1–3 focused on the cognitive side of existential concern; in each study, we primed MS (vs. other topics), measured need-satisfaction or manipulated self-determined orientation, and measured DTA. The present hypothesis was that although MS would increase DTA, that effect would be attenuated among those high in need-satisfaction or primed self-determined orientation. Studies 4 and 5 focused on the affective side of existential concern. In Study 4, we measured need-satisfaction and death anxiety. In Study 5, we primed MS (vs. other topic), primed self-determined (vs. controlled) orientation concepts, and then measured death anxiety. The hypotheses were that need-satisfaction would be associated with reduced death anxiety (Study 4) and that priming self-determined concepts would attenuate the effect of MS on death anxiety (Study 5). Studies 6 and 7 focused on broader expressions of well-being: each measured DTA, need-satisfaction, and either SWL (Study 6) or happiness (Study 7). The hypothesis was that greater DTA would be associated with reduced SWL and happiness but that this effect would be attenuated among those high in need-satisfaction. Thus, across all seven studies, it was expected that

self-determined orientations and need-satisfaction should buffer existential concern and buoy well-being.

All studies were collected with institutional review board approval, and all participants gave informed consent; protocol materials, anonymized data, and analysis syntax for each study are available at <https://osf.io/r37be>.

Study 1

A large body of previous work has demonstrated that MS can increase DTA, but that the effect can be mitigated when protective psychological buffers are in place (J. Hayes et al., 2010; Kosloff et al., 2019). For example, some studies have found that the effect of MS on DTA is attenuated among those who affirmed internalized values (Schmeichel & Martens, 2005; Vail et al., 2018), self-esteem (Harmon-Jones et al., 1997; Schmeichel et al., 2009), or relational attachments (Cox & Arndt, 2012). But no prior work has directly intersected self-determined orientations with DTA. Thus, Study 1 first measured participants' need-satisfaction³—the experiences of autonomy, competence, and relatedness—which SDT research finds the key for optimal functioning, personal growth, and well-being. Then, we administered a between-subjects experimental manipulation, such that participants were randomly assigned to one of two conditions that either primed the concept of mortality or the concept of sadness (control condition). Then, we measured DTA using the word-stem completion task (J. Hayes et al., 2010).

Based on the present analysis, we made three hypotheses: First, MS (vs. control condition) will increase DTA (more death-related word-stem completions); second, need-satisfaction will be associated with lower DTA; third, an interaction such that the effect of MS on DTA will be attenuated among those with relatively high need-satisfaction.

Method

Sample Size Planning

A meta-analysis (Steinman & Updegraff, 2015) found that manipulations of explicitly death-related (vs. unrelated) stimuli, such as that used in this study, produce a medium-large effect ($g = .60$; $f = .30$) on DTA. An a priori power analysis (G*Power; Faul et al., 2009) for F family tests⁴ involving a continuous variable

³ Importantly, SDT research has found autonomy, competence, and relatedness have additive effects, rather than interactive effects, such that increased levels of satisfaction of any and all of the three needs bolster intrinsic motivation, improve performance, and promote well-being (Ryan & Deci, 2000, 2017). Thus, even though the need-satisfaction measure includes subscales for autonomy, competence, and relatedness, SDT researchers often score and interpret self-determined “need-satisfaction” as a single composite dimension because increased levels of any of the subscales contribute in additive ways to the overall state of self-determination (Gagné, 2003; Thøgersen-Ntoumani et al., 2011). We followed the conceptual approach and analytic strategy here. However, the measure does, of course, include separate subscales for autonomy, competence, and relatedness, allowing researchers to check the functions of each component need. Thus, for the curious reader, we also provide brief summaries of the unique role of each need in-text along with the full statistical details in the online Supplemental Material.

⁴ The G*Power ANCOVA model was selected for sample size planning because the present work involves a Need-Satisfaction (continuous) \times 2 (between-subjects: MS vs. neutral) design, and the G*Power ANCOVA model is able to calculate sample sizes needed to detect interactions between a continuous “covariate” (need-satisfaction) and a categorical variable (songs: death-related vs. sad).

(need-satisfaction), a categorical variable (MS vs. control), and their interactions, indicated that a minimum of 90 participants would be needed to detect a medium effect size of $f = .30$ at $p = .05$ with at least .80 power.

Participants

A total of 160 participants were recruited via a psychology department research exposure program and compensated with partial course credit. All participants completed all the target materials; no data were excluded.

Materials

Need-Satisfaction. Following much prior SDT research, a 21-item measure (Gagné, 2003; Kasser et al., 2014) used a 10-point Likert-type scale (1 = *strongly disagree*, 10 = *strongly agree*) to assess need-satisfaction. All items were scored/recoded such that higher scores indicated greater satisfaction; example items are “I feel like I am free to decide for myself how to live my life,” “I often do not feel very capable” (reverse-coded), and “People in my life care about me.” An overall composite mean score was computed for the 21 items ($\alpha = .90$), as were subscale means for the six items assessing autonomy ($\alpha = .76$), six items assessing competence ($\alpha = .77$), and nine items assessing relatedness ($\alpha = .87$).

Mortality Salience. Similar to previous research (Das et al., 2009; Fransen et al., 2008), participants were randomly assigned to complete one of two versions of a manipulation, disguised as a measure of familiarity with songs across the folk, pop, rock, and hip-hop genres. In each condition, participants were shown a list of 25 song titles and asked to indicate whether they were familiar with the song (1 = *not at all familiar*, 10 = *very familiar*). However, the list of songs was deliberately manipulated to either be explicitly death related or sadness related. In the MS condition, the song list was called “Top 25 Songs About Death” and included songs such as Ready to Die by Notorious B.I.G. (1994); Somebody Got Murdered by The Clash (1980); and Knockin’ on Heaven’s Door by Bob Dylan (1973). In the sadness condition, the song list was called “Top 25 Saddest Songs of All Time” and included songs such as Song Cry by Jay-Z (2001); Hurt by Johnny Cash (2002); and The Sounds of Silence by Simon and Garfunkel (1964). The sadness comparison condition was chosen to test whether MS exerts effects beyond the salience of other affectively negative topics.

Delay and Distraction. Next, participants completed the Positive and Negative Affect Schedule (PANAS-X, Watson & Clark, 1992), as well as a brief reading task and word-search task. This procedure is based on research (Pyszczynski et al., 1999; Routledge & Vess, 2018) finding that conscious awareness of death first motivates efforts to remove death thoughts from consciousness by suppressing them or reducing the direct threat of death (e.g., health and safety checks); but, when moved outside focal awareness (e.g., subliminal primes, or an explicit MS prime followed by delay/distracter tasks), death awareness exerts a nonconscious influence.

DTA Measure. Following prior research (Greenberg et al., 1994; Schmeichel & Martens, 2005; Vail et al., 2018), DTA was assessed using a word-stem completion task. Thirty-six partially completed words were presented; 12 could be completed in either neutral or death-related ways depending on participants’ levels of active death-related cognition. For example, the partial

word COFF_ _ could be completed as either COFFEE or COFFIN. The 12 target words were *killed, murder, skull, death, corpse, dead, coffin, grave, buried, lethal, fatal, and mortal*; death-related completions were scored as 1, and non-death-related completions were scored as 0. DTA was computed by summing the number of death-related word completions ($M = 3.51$, $SD = 1.35$).

Demographics. In all the present studies, participants completed a questionnaire recording demographic factors such as age, sex, and race (see Supplemental Table S1).

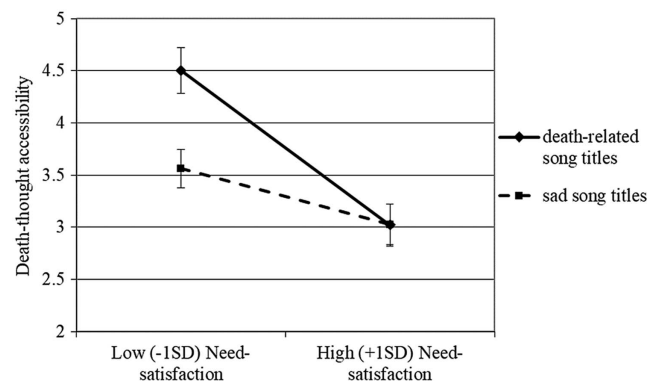
Results

Target Analyses: Need-Satisfaction \times MS Interaction on DTA

Multiple regression methods were used to examine the Need-Satisfaction \times MS interaction on DTA. Need-satisfaction scores were centered on the mean, MS was dummy-coded, and the interaction term was computed by multiplying them. Need-satisfaction and MS were entered in the first step and the interaction term in the second step. There was a marginal main effect of MS, $t(158) = 1.88$, $d = .30$, 95% CI $[-.01, .82]$, $p = .061$, such that DTA was higher in the MS ($M = 3.71$, $SD = 1.53$) than the sad condition ($M = 3.31$, $SD = 1.12$). Additionally, greater need-satisfaction was associated with lower DTA, $\beta = -.33$, $t(158) = -4.34$, $p < .001$. However, there was a significant Need-Satisfaction \times MS interaction, $\Delta F(1, 156) = 5.41$, $\Delta R^2 = .03$, $p = .021$ (Figure 1).

The interaction was explored by examining the MS effect when adjusting the need-satisfaction scores ± 1 SD and examining the need-satisfaction slope in the MS and sad conditions (see Table 1). Among those with lower (-1 SD) need-satisfaction scores, MS (vs. sad) increased DTA, $\beta = .35$, $t(158) = 3.30$, $p = .001$. In contrast, among those with higher ($+1$ SD) need-satisfaction scores, MS did not increase DTA, $\beta = -.001$, $t(158) = -.009$, $p = .99$. From another perspective: In the sad prime condition, need-satisfaction was related to lower DTA, $\beta = -.20$, $t(158) = -2.11$, $p = .036$; and in the MS condition, need-satisfaction was also associated with lower DTA, $\beta = -.55$, $t(158) = -4.71$, $p < .001$.

Figure 1
Interaction Pattern Observed in Study 1



Note. In Study 1, MS was associated with greater DTA at low (-1 SD), but not high ($+1$ SD), levels of need-satisfaction. Error bars depict standard error. DTA = death-thought accessibility; MS = mortality salience.

Table 1
Estimated Mean Death-Related Word Completions in Study 1

Variable	<i>n</i>	Low (−1 <i>SD</i>) need-satisfaction		High (+1 <i>SD</i>) need-satisfaction	
		<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
Death prime	80	4.50	.22	3.02	.20
Sad prime	80	3.56	.18	3.03	.20

Note. Unstandardized coefficients. *SE* = standard error.

Supplemental Analyses: Examining the Unique Role of Each Need

Multiple regression techniques examined the uniqueness of each need in moderating the effect of MS on DTA (details in online Supplemental Material). Neither the MS × Autonomy, MS × Competence, nor MS × Relatedness coefficients were significant, indicating each accounted for overlapping variance in DTA and consistent with the idea that need-satisfaction is often appropriately analyzed as a composite.

Supplemental Analyses: PANAS

MS had no effect on any PANAS subscales nor were there any Need-Satisfaction × MS interactions on the subscales. Because need-satisfaction was correlated with all the subscales (positively with positive mood, happiness, self-assuredness, attentiveness, serenity, and surprise, and negatively with negative mood, fear, hostility, guilt, sadness, fatigue, and shyness), we regressed DTA on the Need-Satisfaction × MS interaction while controlling for all the PANAS subscales as competing moderators. Guilt and happiness emerged as uniquely significant moderators, while need-satisfaction did not, but PROCESS model (A. F. Hayes, 2022) analysis found they did not mediate the role of need-satisfaction in the Need-Satisfaction × MS interaction (see online Supplemental Material for details).

Discussion

First, the data validated the present MS manipulation, finding it had a medium effect on DTA, which was consistent with the first hypothesis: DTA was higher in the MS condition (death-related song prime) compared to the control condition (sad song prime). Second, data were also consistent with the second hypothesis: Greater need-satisfaction was associated with lower DTA. Third, the data were also consistent with the third hypothesis. Indeed, the interaction pattern revealed greater DTA in the MS (vs. sad) condition among those with low need-satisfaction, but not among those with high need-satisfaction. We also note that although need-satisfaction is often associated with affect, as it was again here, the effects of need-satisfaction were unique and could not be explained by its association with affect.

Study 2

Whereas Study 1 found need-satisfaction moderated the effect of explicit MS on DTA, Study 2 sought to further investigate the robustness of that effect by testing whether it might similarly

moderate the effect of subliminal MS on DTA. Thus, in Study 2, we again first measured participants' need-satisfaction. But then, instead of an explicit MS prime manipulation, we randomly assigned participants to one of two conditions in a subliminal prime task: a "death" word prime or a neutral word prime. Last, instead of measuring DTA using a word-stem completion task, we used a computerized lexical decision task (J. Hayes et al., 2010).

The hypotheses were the same as in Study 1: First, MS (vs. control condition) will increase DTA (faster death-word reaction times [RTs] on the lexical decision task); second, need-satisfaction will be associated with lower DTA (slower death-word RTs); third, the effect of MS on DTA will be attenuated among those with high need-satisfaction.

Method

Sample Size Planning

A meta-analysis of prior research (Steinman & Updegraff, 2015) found that subliminal MS manipulations produce a medium effect ($g = .57$; $f = .29$) on DTA. An a priori power analysis (G*Power; Faul et al., 2009) for *F* family tests involving a continuous variable (need-satisfaction), a categorical variable (MS vs. control), and their interactions, indicated that a minimum of 96 participants would be needed to detect a medium effect size of $f = .29$ (or stronger) at $p = .05$ with at least .80 power.

Participants

An initial 234 participants volunteered at a midsize university via a research exposure program, via an online recruitment website (SonaSystems). Data were collected using computerized research software (E-Prime). Eighteen participants either discontinued the study or experienced technical difficulties, such that their data were not saved upon completion. The remaining 216 participants comprised the final sample.

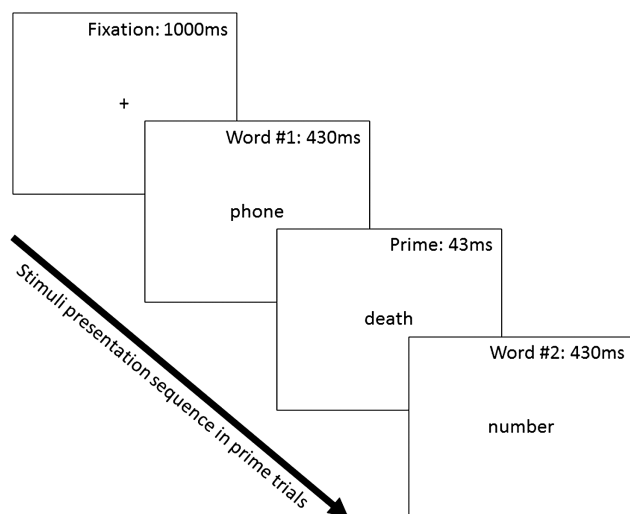
Materials and Procedure

Need-Satisfaction. As in Study 1, Study 2 used the 21-item measure (Gagné, 2003; Kasser et al., 2014) with a 10-point Likert-type scale (1 = *strongly disagree*, 10 = *strongly agree*). An overall composite mean score was computed for the 21 items ($\alpha = .89$), as were subscale means for autonomy ($\alpha = .67$), competence ($\alpha = .71$), and relatedness ($\alpha = .86$).

Mortality Salience. Following previous research (Arndt et al., 2007; Cox et al., 2019), a subliminal MS prime manipulation was conducted under the guise/cover story of a "word associations task." Participants were shown a series of word pairs and asked to judge whether or not the words were semantically related to each other. Each trial presented a fixation cross "+" for 1,000 ms, then one word (e.g., *door*) presented for 430 ms followed by another word (e.g., *bell*) presented for 430 ms. Participants were instructed to press the "A" key if the word pair was not related to each other (e.g., *soccer-cake*), and the "L" key if they were (e.g., *door-bell*).

Participants first completed a set of three practice trials to familiarize themselves with the task and bolster the cover story, followed by a set of 12 prime trials (in random order) that each flashed a prime word on the screen for just 43 ms between the first and second word in each word pair trial (Figure 2). Participants were

Figure 2
Stimuli Presentation Sequence in the Prime Trials



Note. Participants were instructed to indicate whether or not words 1 and 2 were related to each other. In the MS condition, a “death” prime (pictured) was briefly presented between the two words, whereas in the neutral condition, a “field” prime (not pictured) was presented instead. MS = mortality salience.

randomly assigned to either an MS or a neutral prime condition; following prior research (Arndt, Greenberg, Pyszczynski, & Solomon, 1997), the MS prime word was “death” and the neutral prime word was “field,” which match both number of letters and frequency of use. See online Supplemental Material for detailed instructions and stimuli.

Delay and Distraction. Because the present research used a validated subliminal MS manipulation (Arndt et al., 2007; Cox et al., 2019) to increase DTA without conscious awareness, this study did not include any delay/distraction tasks that are otherwise needed to observe nonconscious DTA (Kosloff et al., 2019, for review).

DTA Measure. Following previous research (J. Hayes et al., 2008; Schimel et al., 2007), DTA was measured using a computerized lexical decision task. Participants were presented with a series of letter strings and instructed to press the “A” key if the string did not form a word and the “L” key if the string did form a word and to do so as quickly and accurately as possible. The task consisted of 70 trials, presented in random order. Each trial presented a fixation cross “+” for 1,000 ms, then one word (e.g., *desk*) presented for 1,000 ms, then feedback (reaction time, correct/incorrect) presented for 1,500 ms. Of the 70 trials, 40 presented nonwords (e.g., *kugns, zudric, mablko*), 18 neutral words (e.g., *express, cloak, bottle*), six negative words (*punish, wrong, fail, fight, suffer, jerk*), and six death-related words (*buried, grave, skull, coffin, dead, killed*). The Corpus of Contemporary American English (Davies, 2008) was consulted to ensure each category of words involved a similar average character length and frequency of use per million (see online Supplemental Material for details).

E-Prime recorded response latencies and accuracy for each trial. On average, participants gave 91.02% ($SD = 10.46\%$) correct responses. Following prior recommendations (Bargh & Chartrand,

2000; J. Hayes et al., 2008; Schimel et al., 2007), incorrect responses and response latencies longer than 2,500 ms or shorter than 300 ms were cropped (excluded casewise). Mean RTs in milliseconds were computed for nonwords ($M = 627.76$, $SD = 110.14$), neutral words ($M = 561.34$, $SD = 83.75$), negative words ($M = 567.10$, $SD = 115.95$), and death-related words ($M = 573.35$, $SD = 109.33$). Faster (lower) RTs indicated the category of cognition was more readily accessible.

Results

Target Analyses: Need-Satisfaction \times MS Interaction on DTA

As in Study 1, multiple regression methods were used to analyze the Need-Satisfaction \times MS interaction on death-related word RT. There was a marginal main effect of MS, $t(214) = -1.68$, $d = -.23$, 95% CI $[-.50, .04]$, $p = .095$, such that death-related word RTs were faster in the MS ($M = 561.15$, $SD = 102.17$) than the field condition ($M = 586.01$, $SD = 115.42$). Need-satisfaction was not associated with death-related word RT, $\beta = .07$, $t(214) = 1.06$, $p = .29$. However, there was a significant Need-Satisfaction \times MS interaction, $\Delta F(1, 212) = 7.09$, $\Delta R^2 = .03$, $p = .008$ (Table 2, Figure 3).

Among those with lower ($-1 SD$) need-satisfaction scores, MS (vs. field primes) led to faster death-related word RTs, $\beta = -.29$, $t(212) = -3.06$, $p = .003$; among those with higher ($+1 SD$) need-satisfaction scores, MS did not impact death-related word RTs, $\beta = .07$, $t(212) = .73$, $p = .47$. Additionally, in the field prime condition, need-satisfaction was unrelated to death-related word RTs, $\beta = -.15$, $t(212) = -1.41$, $p = .16$; in the MS condition, need-satisfaction was associated with slower death-related word RTs, $\beta = .22$, $t(212) = 2.47$, $p = .014$.

Supplemental Analyses: Other Word Category RTs

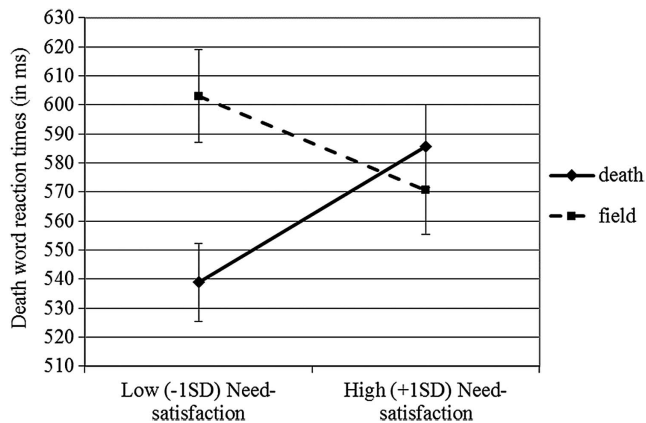
We also conducted Need-Satisfaction \times MS interaction analyses on the nonword, neutral word, and negative word RTs (see online Supplemental Material). There were no effects on nonword RTs. There were interactions on the neutral and negative word RTs, but the interaction patterns were not similar to the patterns observed on death-word RTs (neutral word RTs were slowed at $-1 SD$ need-satisfaction in the field prime condition and negative word RTs were slowed at $+1 SD$ need-satisfaction in the death prime condition). Additionally, controlling for nonword, neutral word, and negative word RTs did not alter the interaction pattern reported in the target analyses above.

Table 2
Estimated Mean Death-Related Word Reaction Times in Study 2

Variable	<i>n</i>	Low ($-1 SD$) need-satisfaction		High ($+1 SD$) need-satisfaction	
		<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
Death prime	110	538.81	13.37	585.77	14.30
Field prime	106	603.06	15.95	570.59	15.09

Note. Unstandardized coefficients. Reaction times scaled in milliseconds. *SE* = standard error.

Figure 3
Interaction Pattern Observed in Study 2



Note. In Study 2, “death” (vs. “field”) primes led to faster categorizations of death words at low ($-1 SD$), but not high ($+1 SD$), levels of need satisfaction. Error bars depict standard error.

Supplemental Analyses: Examining the Unique Role of Each Need

Multiple regression techniques examined the uniqueness of each need in moderating the effect of MS on DTA (see online Supplemental Material for details). The MS \times Autonomy interaction term had a unique effect, whereas the MS \times Competence nor MS \times Relatedness interaction terms did not.

Discussion

First, the data were consistent with the hypothesis that MS would increase DTA: The death-word RTs were faster in the MS condition than in the control word (field) condition. Second, the data did not support the second hypothesis that need-satisfaction would be associated with reduced DTA: Need-satisfaction was not significantly associated with death-word RTs; we return to this finding in the General Discussion section. However, the data were consistent with the third and overarching hypothesis. The death-word RTs were faster in the MS (vs. field) condition among those with low need-satisfaction, but not among those with high need-satisfaction.

Study 3

To more specifically examine the effect of self-determination in moderating the effect of MS on DTA, and the robustness of the effects, Study 3 was a conceptual replication of Studies 1 and 2 but with some important changes. First, we used a different MS manipulation. Second, whereas Studies 1 and 2 measured need-satisfaction (Gagné, 2003; Kasser et al., 2014), Study 3 sought to manipulate self-determination. Numerous studies have found self-determination is sensitive to situational primes (Hodgins et al., 2006, 2007; Levesque & Pelletier, 2003; Radel et al., 2009, 2013). Compared to both neutral and controlling primes, such self-determination primes increase cognitive accessibility of autonomy-related concepts, felt autonomy, intrinsic motivation, physiological effort, and improved behavioral performance on subsequent tasks

(Levesque & Pelletier, 2003; Radel et al., 2009, 2013). Of particular relevance to the present work, one such study found that MS increased worldview defensiveness, but not when participants were also primed to recall self-determined (vs. controlling) experiences (Vail et al., 2020).

Study 3a: Pilot Study

Building on that prior work, we also sought to manipulate self-determination orientation, in Study 3, by prompting participants to recall a previous self-determined experience (vs. a comparison prime). However, we first conducted an exploratory pilot study ($n = 72$; see online Supplemental Material for details) to learn more about the effects of such manipulation. Similar to previous research (Vail et al., 2020), participants were randomly assigned to one of three conditions that prompted them to either (a) recall a time when they felt *self-determined*; (b) recall a time they felt *controlled*; or (c) recall a time they felt *ordinary* (a true neutral condition). We then measured need-satisfaction (Gagné, 2003; Kasser et al., 2014) and found the manipulation did indeed increase felt autonomy, specifically (not competence or relatedness). Felt autonomy was significantly higher in the self-determination prompt condition compared to both the controlled and the neutral conditions (which did not differ from each other). Additionally, because we identified self-determined orientation as an area of conceptual overlap between TMT and SDT, we wanted to know if the effect of the self-determination orientation prime might be unique or whether it might have also boosted a possible TMT-relevant “protective” buffer (e.g., self-esteem) and/or a possible SDT-relevant growth orientation (e.g., exploration orientation). However, there were no effects of the condition on measures of self-esteem (e.g., Rosenberg, 1965) nor exploration orientation (Green & Campbell, 2000).

Thus, the self-determination prompt appeared to be a valid method to increase felt autonomy/self-determination, specifically. Further, because the self-determination prompt increased autonomy compared to both the controlled and the neutral conditions (which did not differ), we selected the more theoretically meaningful “controlled” prompt condition as the comparison condition for Study 3b (the primary study).

Study 3b: Primary Study

Study 3b used a 2 (MS vs. other topic) \times 2 (prompt: self-determined vs. controlled) between-subject experimental design, with DTA as the outcome. The hypotheses were similar to those in Studies 1 and 2: First, MS (vs. other topic) will increase DTA (death-related word-stem completions); second, the self-determination (vs. controlled) prompt will reduce DTA; third, the effect of MS on DTA will be attenuated by the self-determination prompt.

Method

Sample Size Planning

A meta-analysis (Steinman & Updegraff, 2015) found that manipulations of explicitly death-related (vs. unrelated) stimuli, such as that used in this study, produce a medium-large effect ($g = .60$; $f = .30$) on DTA. An a priori power analysis (G*Power; Faul et al., 2009) for F family tests involving a 2 (MS vs. control) \times 2

(self-determined vs. controlled) analysis of variance (ANOVA) indicated that a minimum of 90 participants would be needed to detect a medium effect size of $f = .30$ (or stronger) at $p = .05$ with at least .80 power.

Participants

A total of 188 participants were recruited via a psychology department research exposure program and compensated with partial credit in the program. All participants completed all the target materials; no data were excluded.

Materials and Procedure

Mortality Salience. Following previous research (Vail et al., 2020), participants were randomly assigned to complete one of two versions of a manipulation, disguised as a “Policy Importance” measure, to either prime MS or a neutral topic. In each condition, participants were instructed to use the numbers 1–6 to rank the importance of six public policy issues. In the MS condition, the policy issues all directly involved death-related concepts: terrorism; war or military intervention; abortion; gun control; capital punishment; and illness, health care, and health insurance. In the neutral condition, the policy issues were not death-related but involved other pressing topics such as trade regulation; tax reform; budget and economy; energy and oil; technology and infrastructure; and education. This comparison condition was chosen to test whether MS exerts effects beyond the salience of other concerning topics.

Self-Determination Manipulation. Following previous research (Vail et al., 2020), participants were randomly assigned to complete one of two versions of a “Projective Life Attitudes Assessment.” In the self-determination salience condition, participants responded to the prompt “Please briefly describe a time when you felt ‘self-determined,’ meaning a time in which you felt you were doing things or acting a certain way simply because *you* wanted to; not because of any outside pressure.” The control condition used a parallel prompt, but instead asked participants to “Please briefly describe a time when you felt ‘controlled,’ meaning a time in which you felt you were doing things or acting a certain way simply because of some outside pressure; *not* because you wanted to.”

Delay and Distraction. Next, participants completed the PANAS (Watson & Clark, 1992) to provide the task-switching distraction needed to observe the consequences of nonconscious death awareness (Pyszczynski et al., 1999; Routledge & Vess, 2018).

DTA Measure. As in Study 1, DTA was assessed using the 36-item word-stem completion task (Greenberg et al., 1994; Schmeichel & Martens, 2005; Vail et al., 2018). Death-related completions were scored as 1 and non-death-related completions as 0. DTA was computed by summing the number of death-related word completions ($M = 3.35$, $SD = 1.42$).

Results

Target Analyses: DTA

ANOVA methods were used to examine the 2 (task: MS vs. neutral topic) \times 2 (prompt: self-determined vs. controlling)

interaction on DTA. There was a main effect of MS, $F(1, 184) = 4.03$, $d = .27$, 95% CI [.02, .55], $p = .046$, such that DTA was higher in the MS ($M = 3.54$, $SD = 1.54$) than the neutral ($M = 3.16$, $SD = 1.29$) condition. There was also a main effect of self-determination prime, $F(1, 184) = 6.47$, $d = .35$, 95% CI [.06, .37], $p = .01$, such that DTA was higher in the controlled ($M = 3.60$, $SD = 1.48$) than the self-determination prime ($M = 3.11$, $SD = 1.33$) condition. However, there was also a significant interaction, $F(1, 184) = 7.28$, $\eta_p^2 = .04$, $p = .008$ (see Figure 4).

The nature of the interaction was examined using pairwise comparisons; mean DTA scores are reported in Table 3. In the controlled prime condition, DTA was higher in the MS condition than in the neutral condition, $t(88) = 3.26$, $p = .001$, $d = .67$, 95% CI [.24, 1.09]. In the self-determination prime condition, DTA did not statistically differ between the MS and neutral condition, $t(96) = -.22$, $p = .62$, $d = -.10$, 95% CI [-.50, .29]. From another perspective, when reminded of neutral topics, DTA did not statistically differ between the controlled and self-determined condition, $t(95) = -.11$, $p = .91$, $d = -.02$, 95% CI [-.42, .37]. But when reminded of death, DTA was higher in the controlled condition than the self-determined condition, $t(89) = 3.65$, $p < .001$, $d = .72$, 95% CI [.29, 1.14].

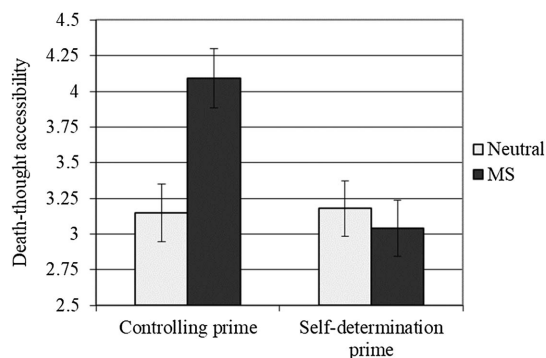
Supplemental Analyses: PANAS

There were no main effects or interaction on positive or negative mood (see online Supplemental Material).

Discussion

First, MS had a medium effect on DTA, supporting the first hypothesis. Second, the self-determination (vs. controlled) prompt reduced DTA. Third, the interaction pattern revealed greater DTA in the MS (vs. other topic) condition in the controlled condition, but not in the self-determination prompt condition. We also note that Study 3a (pilot study) found this self-determination manipulation exerted a unique effect on felt autonomy (not self-esteem or exploration orientation) and Study 3b (primary study) found the effects could not be explained by positive or negative mood.

Figure 4
Interaction Pattern Observed in Study 3b



Note. In Study 3b, MS increased the number of death-related word completions in the controlled prime condition, but not in the autonomy prime condition. Error bars depict standard error. MS = mortality salience.

Table 3
DTA Mean and Standard Deviation, and *n*, in Each Condition of Study 3b

Variable	Controlled prime			Self-determination prime		
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
Mortality salience	4.09	1.62	43	3.04	1.29	48
Neutral topic salience	3.15	1.20	47	3.18	1.38	50

Note. DTA = death-thought accessibility.

Study 4

Whereas Studies 1–3 investigated the capacity of self-determination to help mitigate the cognitive side of existential concern, Studies 4 and 5 focussed on the affective side of existential concern. Prior work has, for example, found that relatively intrinsic goal orientations are correlated with reduced death anxiety (van der Kaap-Deeder et al., 2020; Van Hiel & Vansteenkiste, 2009), which is suggestive because intrinsic goal orientation promotes a better integrated sense of self and feelings of autonomy, competence, and relatedness (Kasser & Ryan, 1996; Niemiec et al., 2009; Sheldon et al., 2010). But no research has yet directly investigated the relationship between need-satisfaction (self-determination) and death anxiety.

Thus, Studies 4a and 4b measured participants' need-satisfaction and death anxiety. Our primary hypothesis in each study was that need-satisfaction would be associated with reduced death anxiety. Further, because some have suggested mortality awareness is merely a threat to epistemic self-certainty, whereas epistemic certainty restores existential security (McGregor, 2006; McGregor & Marigold, 2003), one could wonder whether need-satisfaction might be associated with reduced death anxiety because it is associated with epistemic certainty. Thus, Study 4a also explored whether need-satisfaction might be associated with ideological certainty (dogmatism). Additionally, to further explore the nature of the possible conceptual overlap between SDT and TMT, Study 4b explored whether the relationship between need-satisfaction and death anxiety might be due to its association with self-esteem (a TMT-relevant "protective" buffer) and/or its association with growth orientation (an SDT-relevant orientation).

Study 4a: Method

Sample Size Planning

A priori power analysis (G*Power; Faul et al., 2009) for bivariate correlations, with an anticipated effect size of $|p| = .3$ (medium effect size; vs. $p = 0$) and power at .80 for detecting effects at $p = .05$, recommended a minimum of 84 participants in each of Studies 4a and 4b.

Participants

A total of 301 participants were recruited by a research assistant who visited classrooms on campus to make announcements, posted the study link to the survey on social media, and solicited passersby in various local public spaces (e.g., campus, downtown). There were

no missing data on either of the target measures; no data were excluded.

Materials and Procedure

Need-Satisfaction. As in Studies 1 and 2, Study 4a measured need-satisfaction using the 21-item measure (Gagné, 2003; Kasser et al., 2014) with a 10-point Likert-type scale (1 = *strongly disagree*, 10 = *strongly agree*). An overall composite mean score was computed ($\alpha = .88$), as were subscale means for autonomy ($\alpha = .61$), competence ($\alpha = .86$), and relatedness ($\alpha = .70$).

Ideological Dogmatism. Next, participants completed the 22-item ($\alpha = .88$) Dogmatism scale (Altemeyer, 1996, 2002) to assess the extent to which they view their beliefs as absolutely correct. This 9-point Likert-type scale (1 = *very strongly disagree*, 10 = *very strongly agree*) included items such as "I am absolutely certain that my ideas about the fundamental issues in life are correct," "Someday I will probably realize my present ideas about the big issues are wrong" (reverse-scored), and "My opinions are right and will stand the test of time."

Death Anxiety. Death anxiety was measured using the 15-item Death Anxiety measure (Conte et al., 1982; Cox et al., 2015). Participants indicated how anxious they felt about death (e.g., "Do you worry about dying?") on a 10-point Likert-type scale (1 = *strongly disagree*, 10 = *strongly agree*). Overall mean scores were computed ($\alpha = .90$) such that higher scores indicated greater death anxiety.

Study 4a: Results

Target Analysis

The zero-order correlation found that the need-satisfaction composite score was negatively associated with death anxiety ($r = -.15, p = .01$).

Supplemental Analyses: Examining the Unique Role of Each Need

Multiple regression techniques found death anxiety was uniquely negatively associated with autonomy but not competence or relatedness (see online Supplemental Material for details).

Supplemental Analyses: Dogmatism

Need-satisfaction was not correlated with ideological dogmatism, and multiple regression showed that need-satisfaction remained a unique predictor of death anxiety while controlling for dogmatism (see online Supplemental Material).

Study 4b: Method

Participants

A total of 1,849 participants were recruited via a psychology department research exposure program and compensated with partial credit in the program. One participant did not complete the target materials, so that person's data could not be included.

Materials and Procedure

Data were collected using an online survey platform (Qualtrics). Participants completed a large battery of measures, some of which were included by the present researchers, the following of which were related to the present work.

Self-Esteem. The single-item self-esteem measure (Robins et al., 2001) was used to assess global self-esteem, using a 9-point Likert-type scale (1 = *fully disagree*, 9 = *fully agree*) to measure agreement with the item “I have high self-esteem.”

Need-Satisfaction. Study 4b used a different need-satisfaction measure than was used in Studies 1, 2, and 4a. This nine-item measure (Chen, Vansteenkiste, et al., 2015) used a 5-point Likert-type scale (1 = *not true at all*, 5 = *completely true*) such that higher scores indicated greater satisfaction; example items are “I feel I have been doing what really interests me,” “I feel competent to achieve my goals,” and “I feel that the people I care about also care about me.” An overall composite mean score was computed ($\alpha = .87$), as were subscale means for autonomy ($\alpha = .65$), competence ($\alpha = .85$), and relatedness ($\alpha = .82$).

Growth Orientation. Two items from the personal growth subscale of Ryff’s (1989) psychological well-being measure assessed growth orientation. A 6-point Likert-type scale (1 = *strongly disagree*, 6 = *strongly agree*) measured agreement with the items: “For me, I would like life to be a more continuous process of learning, changing, and growth” and “I think it is important to have new experiences that challenge how you think about yourself and the world.”

Death Anxiety. Death anxiety was measured using five items ($\alpha = .89$) from the Death Attitude Profile–Revised (Wong et al., 1994). Participants indicated how anxious they felt about death (e.g., “I am disturbed by the finality of death.”) on a 7-point Likert-type scale (1 = *strongly disagree*, 7 = *strongly agree*) such that higher scores indicated greater death anxiety.

Study 4b: Results

Target Analysis

The zero-order correlation found the need-satisfaction composite score was negatively associated with death anxiety ($r = -.06$, $p = .018$).

Supplemental Analyses: Examining the Unique Role of Each Need

Multiple regression techniques found death anxiety was associated negatively with autonomy, positively with relatedness, and not associated with competence (see online Supplemental Material for details).

Supplemental Analyses: Self-Esteem and Growth Orientation

Need-satisfaction was positively correlated with both growth orientation and self-esteem, which were each negatively correlated with death anxiety. PROCESS model analysis (A. F. Hayes, 2022) revealed the negative association between need-satisfaction and death anxiety was mediated through self-esteem but not through

growth orientation (see online Supplemental Material for full details).

Discussion

Studies 4a and 4b each found that need-satisfaction was associated with lower death anxiety. Exploratory analyses found that need-satisfaction was not related to ideological certainty (Study 4a) and further found the negative association between need-satisfaction and death anxiety was mediated through self-esteem but not through growth orientation. We return to these exploratory analyses in the General Discussion section.

Study 5

To more directly test the causal role of self-determination in mitigating death-related anxiety, and the robustness of the effects, Study 5 used a fully experimental design similar to that of Study 3 but with the following three key methodological changes. First, we used yet another different MS manipulation. Second, we also manipulated self-determination in Study 5 using a previously validated method: Primes disguised as a sentence unscrambling task (Hodgins et al., 2006, 2007; Levesque & Pelletier, 2003). A prior study using this method also found that MS increased worldview defensiveness, but not when participants wrote about being self-determined (vs. controlled; Vail et al., 2020). Last, we measured death anxiety using a different measure (Lester, 1994; Routledge & Juhl, 2010) than the one used in the previous study.

Study 5a: Pilot Study

Thus, we also sought to manipulate self-determination orientation, but we first conducted an exploratory pilot study ($n = 58$; see online Supplemental Material for details) to learn more about the effects of such manipulation. As in prior research (Hodgins et al., 2006, 2007; Levesque & Pelletier, 2003), participants were randomly assigned to one of three conditions that prompted them to unscramble and write sentences about either (a) being *self-determined*; (b) being *controlled*; or (c) *neither* (a true neutral condition). As in Study 3a, we then measured need-satisfaction (Gagné, 2003; Kasser et al., 2014), self-esteem (e.g., Rosenberg, 1965), and exploration orientation (Green & Campbell, 2000). Felt autonomy was significantly higher in the self-determination prompt condition compared to both the controlled and the neutral conditions (which did not differ). There were no effects of self-determination prime on measures of competence, relatedness, self-esteem, nor exploration orientation.

Thus, as in Study 3a, the self-determination prime increased felt autonomy, specifically. Further, because the self-determination prompt increased autonomy compared to both the controlled and the neutral conditions (which did not differ), we again selected the more theoretically meaningful “controlled” prime condition as the comparison condition prime for Study 5b (the primary study).

Study 5b: Primary Study

Study 5b used a 2 (MS vs. other topic) \times 2 (prime: self-determined vs. controlled) between-subject experimental design, with death anxiety as the outcome. The hypotheses were as follows:

First, MS (vs. other topic) will increase death anxiety; second, the self-determination (vs. controlled) prime will reduce death anxiety; third, the effect of MS on death anxiety will be attenuated by the self-determination prime. Further, because self-determination is associated with greater mindfulness (K. W. Brown et al., 2007; K. W. Brown & Ryan, 2003), and prior work found mindfulness moderated the effect of MS on DTA (Niemiec et al., 2010), Study 5b also explored whether mindfulness might similarly moderate the effect of MS on death anxiety.

Method

Sample Size Planning

A meta-analysis (Steinman & Updegraff, 2015) found that the traditional explicit MS prompt manipulation, used in this study, produces a medium effect ($g = .70$; $f = .35$) on DTA. But because Study 5b dependent variable (DV) was affective death anxiety, rather than cognitive DTA, we looked beyond the prior DTA data. A prior meta-analysis of MS studies (Burke et al., 2010) derived over a broad variety of outcomes (e.g., defense of national identity, health risk evaluations, sports team affiliations, physical aggression) found an overall MS effect size of $d = .75$ ($f = .37$; a large effect). However, prior research has tended to use small samples (associated with artificial effect size inflation, see Button et al., 2013) and has focused on motivational outcomes, whereas the present study had an outcome relevant to well-being (i.e., death anxiety). Therefore, we adopted the sample size planning strategy of anticipating a more modest effect size of $f = .27$ (a medium effect size). A priori power analysis (G*Power; Faul et al., 2009) for F family tests with one numerator df and four groups, with .80 power and $p = .05$, recommended a minimum of 110 participants to detect an effect size of $f = .27$ (or stronger).

Participants

A total of 131 participants were recruited via a psychology research exposure program. One participant discontinued immediately after providing informed consent and 11 other participants discontinued before completing the dependent measure and were therefore excluded listwise. The final sample included 119 participants.

Materials and Procedure

Mindfulness. The state mindfulness measure (K. W. Brown & Ryan, 2003) assessed participants' presence of mind on 15 items, using a 10-point Likert-type scale (1 = *not true at all*, 10 = *completely true*). Items were reverse-scored and means were computed ($\alpha = .88$) such that higher scores indicated greater mindfulness.

Mortality Salience. Following previous research (Greenberg et al., 1990), participants were randomly assigned to complete one of two versions of a "Projective Life Attitudes Assessment." 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." The control condition used a parallel prompt about dental

pain instead of death, chosen to test whether MS exerts effects above and beyond other negative stimuli.

Delay and Distraction. As in Study 1, participants completed the PANAS-X, brief reading task, and word-search task, to provide the task-switching distraction needed to observe the consequences of nonconscious death awareness.

Self-Determination Manipulation. Following previous research (Hodgins et al., 2006, 2007; Levesque & Pelletier, 2003; Vail et al., 2020), and our pilot study (5a, above), we used a scrambled sentence task to prime the concept of either being self-determined or being controlled. The task consisted of 30 items in which participants were given a set of five scrambled words and instructed to drop an extraneous word from each to form a grammatical four-word sentence. Fifteen neutral sentences were constant across conditions, and 15 were prime sentences that differed by condition. An example neutral sentence is "sale for by sweatshirts are" (sweatshirts are for sale). Example self-determination concept prime sentences are as follows: "to go and I decided" (I decided to go); "in we autonomous often are" (we are often autonomous); and "am I still for self-determined" (I am still self-determined). Example controlling concept prime sentences are as follows: "do we to this must" (we must do this); "was obey we're compelled to" (we're compelled to obey); and "so behavior my they restrict" (they restrict my behavior).

Death Anxiety. Death anxiety was measured using the 14-item Fear of Death Scale (Lester, 1994; Routledge & Juhl, 2010). Participants indicated how anxious they felt about death and dying (e.g., "the shortness of life," "the thought of never thinking or experiencing anything again," "the thought of the pain of dying") on a 10-point Likert-type scale (1 = *not at all disturbed/anxious*, 10 = *very disturbed/anxious*). Overall mean scores were computed ($\alpha = .85$) such that higher scores indicated greater death anxiety.

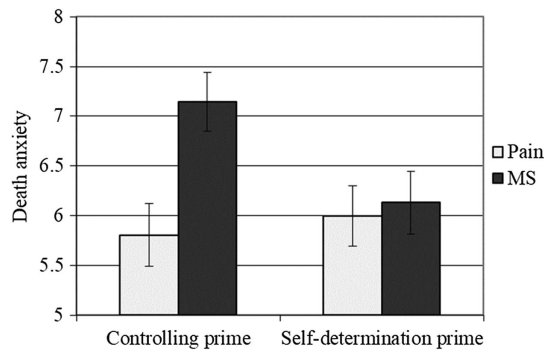
Results

Target Analyses: Death Anxiety

ANOVA methods were used to examine the 2 (MS vs. dental pain) \times 2 (prime: self-determined vs. controlled) interaction on death anxiety. There was no main effect of self-determination prime, $F(1, 115) = 1.77, p = .186, d = -.26, 95\% \text{ CI } [-.62, .10]$, though there was a main effect of MS, $F(1, 115) = 5.72, p = .018, d = .45, 95\% \text{ CI } [.08, .81]$, such that death anxiety was higher in the MS ($M = 6.67, SD = 1.90$) than the pain ($M = 5.91, SD = 1.48$) condition. However, that main effect was qualified by a significant interaction, $F(1, 115) = 3.82, \eta_p^2 = .03, p = .053$ (Figure 5).

The nature of the interaction was examined using pairwise comparisons; estimated mean death anxiety scores are reported in Table 4. In the controlled prime condition, death anxiety was higher in the MS condition than in the pain condition, $t(58) = 3.09, p = .003, d = .90, 95\% \text{ CI } [.36, 1.42]$. In the self-determination prime condition, death anxiety did not statistically differ between the MS and pain condition, $t(57) = .31, p = .76, d = .07, 95\% \text{ CI } [-.44, .58]$. From another perspective: When reminded of dental pain, death anxiety did not statistically differ between the controlled and self-determined condition, $t(57) = -.44, p = .66, d = -.13, 95\% \text{ CI } [-.64, .38]$. But when reminded of death, death anxiety was higher in the controlled condition than in the self-determined condition, $t(58) = 2.33, p = .021, d = .55, 95\% \text{ CI } [.03, 1.06]$.

Figure 5
Interaction Pattern Observed in Study 5b



Note. In Study 5b, MS increased death anxiety among participants in the controlling prime condition, but not in the self-determination prime condition. Error bars depict standard error. MS = mortality salience.

Supplemental Analyses: PANAS

MS had no effect on most of the PANAS subscales but did increase sadness. However, an analysis of covariance revealed that controlling for sadness did not alter the observed pattern reported above (see online Supplemental Material for details).

Supplemental Analyses: Mindfulness

Mindfulness was not correlated with death anxiety, and multiple regression on death anxiety showed there were no two-way Mindfulness \times MS or Mindfulness \times Self-Determination interactions nor three-way Mindfulness \times MS \times Self-Determination interaction. Additionally, when limiting the data to just those in the controlled prime condition (given the self-determined prime attenuated the effect), mindfulness was again not correlated with death anxiety and neither an overall multiple regression model nor follow-up analyses found any evidence of a Mindfulness \times MS interaction (see online Supplemental Material for details). Thus, mindfulness did not produce any effects similar to the effects of the self-determination prime.

Discussion

First, MS had a medium-large effect on death anxiety. Second, a not significant trend was observed such that the self-determination (vs. controlled) prime reduced death anxiety though not

significantly. Third, the interaction revealed greater death anxiety in the MS (vs. pain) condition than in the controlled condition, but not in the self-determination prime condition. Also, note that Study 5a (pilot study) found this self-determination manipulation exerted a unique effect on felt autonomy (not self-esteem or exploration orientation) and Study 5b (primary study) found mindfulness did not similarly moderate the effects of MS on death anxiety.

Study 6

Whereas Studies 1–5 focused on cognitive and affective sides of existential concern (DTA, death anxiety), Studies 6 and 7 focused on broader expressions of well-being. A growing body of work has studied the impact of death awareness on well-being (Juhl, 2019; Juhl & Routledge, 2016). Some studies using MS manipulations, and others using measures of death awareness (e.g., word-stem completion DTA measures), have found that death awareness was associated with reduced meaning in life and SWL among those with low self-esteem (Routledge et al., 2010), no religious faith (Vail & Soenke, 2018), weak sociocultural structure (Vess et al., 2009), and extrinsic goal aspirations (Vail et al., 2019). Such findings show that death awareness can undermine well-being and that effectively buffering death awareness is important for healthy psychological functioning. But no prior work has examined whether need-satisfaction might help attenuate the relationship between death awareness and well-being.

Thus, Study 6 measured the levels of need-satisfaction, DTA, and SWL. Data were analyzed by regressing SWL on the Need-Satisfaction \times DTA interaction. The hypotheses were similar to those in the prior studies: First, DTA will be associated with lower SWL; second, need-satisfaction will be associated with greater SWL; third, the association between DTA and SWL will be attenuated among those with greater need-satisfaction.

Additionally, although Study 5b considered whether mindfulness might have similarly moderated the effect of MS, that study used an experimental manipulation of self-determination which made it difficult to consider measured mindfulness as a competing moderator. Therefore, we measured mindfulness again in Study 6 to explore the uniqueness of any possible effects of need-satisfaction. Likewise, because self-determination facilitates Openness (Ryan & Deci, 2017; Vansteenkiste & Ryan, 2013), and prior work found Openness moderated the effects of death awareness (Boyd et al., 2017), Study 6 also explored whether the effects of need-satisfaction might be due to its association with Openness (among other Big Five personality dimensions).

Method

Sample Size Planning

Prior work (Routledge et al., 2010) found death awareness (DTA) had a medium association with SWL ($f = .30$). Thus, an a priori power analysis (G*Power; Faul et al., 2009) recommended a minimum of 90 participants to detect a medium effect size of $f = .30$.

Participants

A total of 271 participants were recruited by a research assistant who solicited university psychology instructors to make a brief

Table 4
Death Anxiety Mean, Standard Deviation, and *n*, in Each Condition of Study 5b

Variable	Controlled prime			Self-determination prime		
	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
Mortality salience	7.15	1.64	32	6.13	2.05	28
Dental pain salience	5.81	1.28	28	6.00	1.66	31

Note. Death-related anxiety scores ranged from 1 (*low*) to 10 (*high*).

announcement about the study and collect data. There were no missing data on any of the target measures, so no cases were excluded.

Materials and Procedure

SWL. Participants completed a standard measure of SWL (Diener et al., 1985), which is comprised of five Likert-type items (1 = *strongly disagree*, 5 = *strongly agree*) including statements such as “I am satisfied with life” and “The conditions of my life are excellent.” Overall mean scores were computed ($\alpha = .79$) such that higher scores indicated greater SWL.

Affect. Next, participants completed the 20-item PANAS.

Need-Satisfaction. Studies 6 and 7 used a different need-satisfaction measure than was used in the prior studies. This 18-item measure (Chen, Van Assche, et al., 2015; Sheldon & Hilpert, 2012) used a Likert-type scale (1 = *strongly disagree*, 5 = *strongly agree*) to assess need-satisfaction. Participants were asked to reflect on their past week and indicate how much they agreed/disagreed with each item. All items were scored/recoded such that higher scores indicated greater satisfaction; example items are “I was free to do things my own way,” “I did well, even at the hard things,” and “I felt close and connected with other people who are important to me.” An overall composite mean score was computed ($\alpha = .83$), as were subscale means for autonomy ($\alpha = .66$), competence ($\alpha = .72$), and relatedness ($\alpha = .70$).

Mindfulness. Next, participants completed the 15-item state mindfulness measure (K. W. Brown & Ryan, 2003), using a 5-point Likert-type scale (1 = *almost never*, 5 = *almost always*). Means were computed ($\alpha = .85$) such that higher scores indicated greater mindfulness.

Openness. Participants also completed the brief 10-item measure of the “Big Five” personality domains (Gosling et al., 2003) using a 5-point Likert-type scale. Pearson correlations indicated significant correlations between the two items measuring Openness ($r = .34, p < .001$), Conscientiousness ($r = .36, p < .001$), Extraversion ($r = .49, p < .001$), Agreeableness ($r = .31, p < .001$), and Neuroticism ($r = .44, p < .001$).

Death-Thought Accessibility. Following previous research (e.g., Routledge et al., 2010; Vess et al., 2009), naturally occurring variations in levels of death-related cognitions were assessed by a brief word-stem completion task. Fifteen partially completed words were presented; six of them could be completed in either neutral or death-related ways depending on participants’ levels of active death-related cognition. The six target words were *coffin*, *killed*, *murder*, *skull*, *grave*, and *dead*; death-related completions were scored as 1 and non-death-related completions were scored as 0. DTA was computed by summing the number of death-related word completions ($M = 1.75, SD = 1.12$).

Results

Target Analyses: Need-Satisfaction \times DTA on SWL

Multiple regression methods were used to examine the Need-Satisfaction \times DTA interaction on SWL. Need-satisfaction and DTA scores were each centered on their means, and the interaction term was computed by multiplying them. Need-satisfaction and DTA were entered in the first step and the interaction term in the

second step. DTA was negatively associated with SWL ($r = -.19, p = .002$), and need-satisfaction was positively associated with SWL ($r = .55, p < .001$). Additionally, there was a significant Need-Satisfaction \times DTA interaction on SWL, $\Delta F(1, 267) = 11.57, \Delta R^2 = .03, p = .001$ (Figure 6).

The nature of the interaction was examined by analyzing the DTA slope when adjusting the need-satisfaction scores $\pm 1 SD$ and the need-satisfaction slope when adjusting the DTA scores $\pm 1 SD$; adjusted estimated mean SWL scores are reported in Table 5. Among those with lower ($-1 SD$) need-satisfaction scores, DTA was negatively associated with SWL, $\beta = -.31, t(267) = -4.22, p < .001$. In contrast, among those with higher ($+1 SD$) need-satisfaction scores, DTA was no longer associated with SWL, $\beta = .02, t(267) = .36, p = .72$. From another perspective: Among those with lower ($-1 SD$) DTA scores, need-satisfaction was positively related to SWL, $\beta = .37, t(267) = 5.14, p < .001$; and among those with higher ($+1 SD$) DTA scores, need-satisfaction was strongly positively associated with SWL, $\beta = .70, t(267) = 10.24, p < .001$.

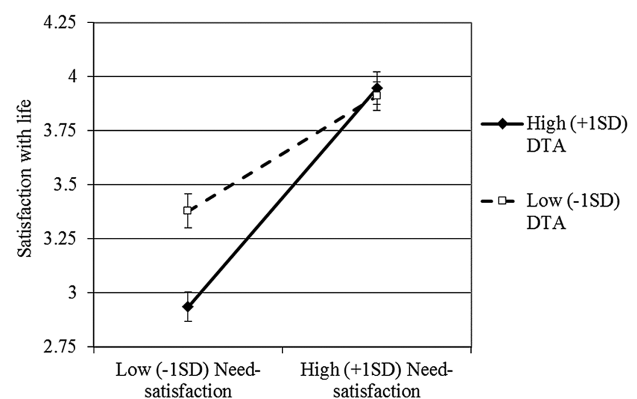
Supplemental Analyses: Examining the Unique Role of Each Need

We also examined the uniqueness of each specific need as competing moderators of the effect of DTA on SWL (see online Supplemental Material for details). Although the overall interaction model was significant, neither the DTA \times Autonomy, DTA \times Competence, nor DTA \times Relatedness coefficients were uniquely significant, indicating that each accounted for overlapping variance in SWL, consistent with the idea that need-satisfaction is often appropriately analyzed as a composite.

Supplemental Analyses: PANAS, Mindfulness, and the Big Five Domains

There was no Need-Satisfaction \times DTA interaction on positive affect, $\Delta F(1, 267) = 1.83, \Delta R^2 = .005, p = .18$, nor negative affect,

Figure 6
Interaction Pattern Observed in Study 6



Note. In Study 6, increased DTA ($+1 SD$) was associated with reduced satisfaction with life among participants with low need-satisfaction ($-1 SD$), but not among those with high need-satisfaction ($+1 SD$). Error bars depict standard error. DTA = death-thought accessibility.

Table 5

Estimated Mean Satisfaction With Life Scores in Study 6, With Need-Satisfaction and DTA Adjusted ± 1 SD

Variable	Low (-1 SD) need-satisfaction		High ($+1$ SD) need-satisfaction	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
High ($+1$ SD) DTA	2.94	.07	3.96	.07
Low (-1 SD) DTA	3.38	.08	3.91	.07

Note. Satisfaction with life scores ranged from 1 (*low*) to 5 (*high*). DTA = death-thought accessibility; *SE* = standard error.

$\Delta F(1, 267) = 1.96$, $\Delta R^2 = .005$, $p = .16$. Need-satisfaction was correlated: positively with positive affect and negatively with negative affect; positively with mindfulness; and positively with Openness, Conscientiousness, Extraversion, Agreeableness, and negatively with Neuroticism. Thus, we regressed SWL on the Need-Satisfaction \times DTA interaction while controlling for the PANAS subscales, mindfulness, and the Big Five domains as competing moderators. In each case, the Need-Satisfaction \times DTA interaction term remained uniquely significant, whereas none of the other interaction terms were significant (see online Supplemental Material for details).

Discussion

First, data were consistent with the hypothesis that DTA would be negatively associated with SWL. Second, need-satisfaction was positively associated with SWL. Third, however, the interaction pattern revealed that although DTA was negatively associated with SWL, the effect of DTA was eliminated among those with greater need-satisfaction. Also, note that the moderating effect of need-satisfaction was unique and not due to its association with positive affect, negative affect, mindfulness, nor Openness (nor the other Big Five personality dimensions).

Study 7

Study 7 also measured need-satisfaction and DTA, as in Study 6. But rather than SWL, Study 7 measured happiness (Lyubomirsky & Lepper, 1999). The hypotheses were similar to those in the previous study: First, DTA will be associated with lower happiness; second, need-satisfaction will be associated with greater happiness; third, the association between DTA and happiness will be attenuated among those with greater need-satisfaction. Additionally, Study 7 again explored whether the effects of need-satisfaction might be due to its association with Openness (among the other Big Five personality dimensions).

Method

Sample Size Planning

Study 7 followed the same sample size planning strategy as in Study 6 and thus aimed for a minimum sample size of at least 90 participants.

Participants

A total of 228 participants were recruited by a research assistant who solicited university psychology instructors to make a brief announcement about the study and collect data. There were no missing data on any of the target measures, so no cases were excluded.

Materials and Procedure

Happiness. Participants completed a standard measure of happiness (Lyubomirsky & Lepper, 1999), with four items using 5-point Likert-type scales, such as “In my life right now, I consider myself” (1 = *not a very happy person*, 5 = *a very happy person*). Overall mean scores were computed ($\alpha = .83$) such that higher scores indicated greater happiness.

Affect. Next, participants completed the 20-item PANAS.

Need-Satisfaction. Study 7 used the same 18-item measure of need-satisfaction that was used in Study 6 (Chen, Van Assche, et al., 2015; Sheldon & Hilpert, 2012). An overall composite mean score was computed ($\alpha = .85$), as were subscale means for autonomy ($\alpha = .76$), competence ($\alpha = .65$), and relatedness ($\alpha = .78$).

Openness. Participants also completed the brief 10-item measure of the “Big Five” personality domains (Gosling et al., 2003) using a 5-point Likert-type scale. Pearson correlations indicated significant correlations between the two items measuring Openness ($r = .24$, $p < .001$), Conscientiousness ($r = .33$, $p < .001$), Extraversion ($r = .61$, $p < .001$), Agreeableness ($r = .31$, $p < .001$), and Neuroticism ($r = .53$, $p < .001$).

Death-Thought Accessibility. Participants completed the same measure of naturally occurring variations in death-related cognitions that was used in Study 6 ($M = 1.93$, $SD = 1.21$).

Results

Target Analyses: Need-Satisfaction \times DTA on Happiness

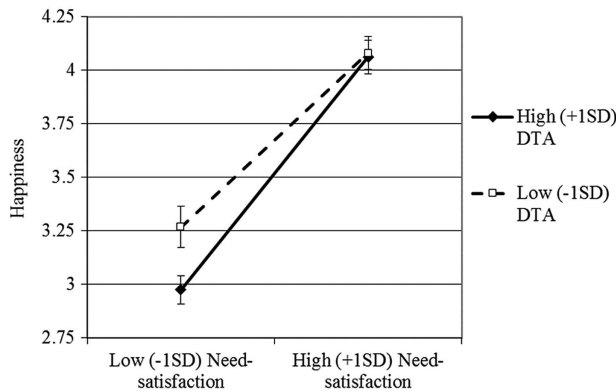
DTA was negatively associated with happiness ($r = -.25$, $p < .001$), and need-satisfaction was positively associated with happiness ($r = .63$, $p < .001$). Additionally, there was a significant Need-Satisfaction \times DTA interaction, $\Delta F(1, 224) = 4.65$, $\Delta R^2 = .01$, $p = .03$ (see Figure 7, Table 6).

Among those with lower (-1 SD) need-satisfaction scores, DTA was negatively associated with happiness, $\beta = -.19$, $t(224) = -2.96$, $p = .003$. In contrast, among those with higher ($+1$ SD) need-satisfaction scores, DTA was no longer associated with happiness, $\beta = -.01$, $t(224) = -.17$, $p = .87$. From another perspective: Among those with lower (-1 SD) DTA scores, need-satisfaction was positively related to happiness, $\beta = .50$, $t(224) = 6.81$, $p < .001$; and among those with higher ($+1$ SD) DTA scores, need-satisfaction was strongly positively associated with happiness, $\beta = .66$, $t(224) = 11.19$, $p < .001$.

Supplemental Analyses: Examining the Unique Role of Each Need

We again examined the uniqueness of each specific need as competing moderators of the effect of DTA on happiness (see online Supplemental Material for details). Again, the overall interaction model was significant, and again neither the DTA \times Autonomy, DTA \times Competence, nor DTA \times Relatedness coefficients were

Figure 7
Interaction Pattern Observed in Study 7



Note. In Study 7, increased DTA was associated with reduced happiness among participants with low need-satisfaction ($-1 SD$), but not among those with high need-satisfaction ($+1 SD$). Error bars depict standard error. DTA = death-thought accessibility.

significant, indicating that each accounted for overlapping variance in happiness, consistent with the idea that need-satisfaction is often appropriately analyzed as a composite.

Supplemental Analyses: PANAS and the Big Five Domains

There was no Need-Satisfaction \times DTA interaction on positive affect, $\Delta F(1, 224) = .42$, $\Delta R^2 = .011$, $p = .52$, nor negative affect, $\Delta F(1, 224) = .009$, $\Delta R^2 < .001$, $p = .93$. Need-satisfaction was correlated: positively with positive affect and negatively with negative affect; and positively with Openness, Conscientiousness, Extraversion, Agreeableness, and negatively with Neuroticism. Thus, we regressed SWL on the Need-Satisfaction \times DTA interaction while controlling for the PANAS subscales and the Big Five domains as competing moderators. In each case, the Need-Satisfaction \times DTA interaction term remained uniquely significant, whereas none of the other interaction terms were significant (see online Supplemental Material for details).

Discussion

Consistent with the first hypothesis, DTA was negatively associated with happiness. Second, need-satisfaction was positively associated with SWL. Third, however, a significant interaction

Table 6

Estimated Mean Happiness Scores in Study 7, With Need-Satisfaction and DTA Adjusted $\pm 1 SD$

Variable	Low ($-1 SD$) need-satisfaction		High ($+1 SD$) need-satisfaction	
	<i>M</i>	<i>SE</i>	<i>M</i>	<i>SE</i>
High ($+1 SD$) DTA	2.97	.07	4.06	.08
Low ($-1 SD$) DTA	3.27	.10	4.08	.08

Note. Happiness scores ranged 1 (*low*) to 5 (*high*). DTA = death-thought accessibility; *SE* = standard error.

revealed that although DTA was negatively associated with happiness, that effect was eliminated among those with higher need-satisfaction. Again, note the moderating effect of need-satisfaction was unique and not due to its association with positive affect, negative affect, nor Openness (nor the other Big Five personality dimensions).

General Discussion

The present work explored the overarching idea that although death awareness is typically an existential stressor, self-determination should mitigate existential concern and buoy well-being. Table 7 presents a summary of some key methodological information for each study. Our first two guiding hypotheses were about the main effects. One was that increased death awareness would increase existential concerns and undermine well-being. Indeed, a variety of MS manipulations each led to increased DTA (Studies 1–3) and death-related anxiety (Study 5), and measures of DTA were associated with lower SWL and happiness (Studies 6 and 7). The second hypothesis was that need-satisfaction⁵ and self-determination would help reduce existential concerns and bolster well-being. Indeed, multiple measures of need-satisfaction (Studies 1 and 2, 4) and self-determination primes (Studies 3, 5) were associated with lower DTA and death anxiety⁶; and still, other measures of need-satisfaction (Studies 6 and 7) were associated with greater SWL and happiness. Thus, using a variety of methods, data consistently supported these first two hypotheses about the main effects of death awareness and self-determination on existential concern and well-being.

There was also strong support for the third guiding hypothesis of interactions such that self-determination would mitigate the effects of death awareness on existential concern and well-being. Studies 1–3 found that although MS increased DTA, that effect was attenuated among those with high need-satisfaction or situationally primed self-determination. Study 5 found that although MS increased death anxiety, that effect was attenuated among those with situationally primed self-determination. Last, Studies 6 and 7 found that DTA was associated with lower SWL and happiness, but not among those with high need-satisfaction.

Self-Determination and Existential Concern: Intersecting Ideas

Together, these findings support the present analysis that, in addition to its known growth-oriented function, a self-determined

⁵ As mentioned in Footnote 3, we focused on the effects associated with the need-satisfaction composite. Still, we also conducted exploratory analyses of the roles of each component need. The overall pattern across those exploratory analyses was that the component needs were related in sensible ways to the outcome measures, but analyzing the component need subscales did not add any particularly novel information. None of the component needs consistently exerted a *unique* effect, in line with the idea that it is often appropriate to score and interpret need-satisfaction as a single composite indicator of self-determination (Gagné, 2003; Thøgersen-Ntoumani et al., 2011).

⁶ Although the main effects were not significant in Study 2 and Study 5b, they were nevertheless in the expected direction: Greater need-satisfaction was associated with longer RTs on death-related words (Study 2), and self-determined (vs. controlled) prime was associated with lower death anxiety (Study 5b).

Table 7
A Summary of Some Key Methodological Information for Each Study

Study	<i>n</i>	Need-satisfaction or self-determination predictor variables			Death awareness predictor variables			Target outcome variables	
		Technique	Conditions	Reference	Technique	Conditions	Reference	Measure	Reference
Study 1	160	21-item measure	—	Gagné (2003)	Song titles prime manipulation	Death versus sadness	Novel	DTA, word-stem completion	Greenberg et al. (1994)
Study 2	216	21-item measure	—	Gagné (2003)	Subliminal prime manipulation	“Death” versus “field”	Arndt et al. (2007)	DTA, lexical decision task	Schimmel et al. (2007)
Study 3a, pilot	72	Recall prompt manipulation	Self-determined versus controlled	Vail et al. (2020)	—	—	—	Need-satisfaction	Gagné (2003)
Study 3b, primary	188	Recall prompt manipulation	versus ordinary	Vail et al. (2020)	Public policy rating manipulation	Death-related versus neutral	Vail et al. (2020)	DTA, word-stem completion	Greenberg et al. (1994)
Study 4a	301	21-item measure	Self-determined versus controlled	Gagné (2003)	—	—	—	Death anxiety	Conte et al. (1982)
Study 4b	1849	Nine-item measure	—	Chen, Vansteenkiste, et al. (2015)	—	—	—	Death anxiety	Wong et al. (1994)
Study 5a, pilot	58	Sentence writing manipulation	Self-determined versus controlled	Hodgins et al. (2007)	—	—	—	Need-satisfaction	Gagné (2003)
Study 5b, primary	119	Sentence writing manipulation	versus neutral	Hodgins et al. (2007)	Writing prompt manipulation	Death versus dental pain	Greenberg et al. (1990)	Death anxiety	Lester (1994)
Study 6	271	18-item measure	Self-determined versus controlled	Sheldon and Hilpert (2012)	DTA, word-stem completion	—	Vess et al. (2009)	Satisfaction with life	Diener et al. (1985)
Study 7	228	18-item measure	—	Sheldon and Hilpert (2012)	DTA, word-stem completion	—	Vess et al. (2009)	Happiness	Lyubomirsky and Lepper (1999)

Note. DTA = death-thought accessibility.

orientation can help buffer existential concerns and buoy well-being. Our analyses stemmed from observations that although SDT and TMT might have some important differences, they might also have more in common with each other than appears at first glance.

Various earlier thinkers (N. O. Brown, 1959; Rank, 1936), including Becker (1973), argued that as people socialize from infants into adults, they endlessly encounter people and experiences that expose them to a variety of beliefs and values; they integrate some of those beliefs/values into their self, which can then be *autonomously* expressed and pursued. Thus, although they may of course experience some values as being externally imposed by society (e.g., wealth, fame, physical attractiveness), an individual could develop an internalized passion for theater and music, a deep-seated political or religious conviction, or recognize the intrinsic value of taking the time to stop at red traffic lights, teach students, or contribute to one's community through city government or charitable organizations. Additionally, both TMT and SDT find common ground in the experience of genuine *competence*, which can bolster self-esteem and provide a platform for personal growth. Likewise, the experience of *relatedness*, in addition to promoting growth, serves a buffering function as a source of existential security.

Therefore, if—as decades of SDT research have demonstrated (Ryan & Deci, 2017)—self-determination means a person feels oriented toward their own internalized beliefs and values (autonomy), feels capable of effective action (competence), and feels a sense of social connection (relatedness), then—from a TMT perspective—self-determination should buffer existential concern and buoy well-being because people with more self-determined orientations would feel more confidently affirmed of the internalized aspects of their worldviews, feel an intrinsic sense of worth within that sociocultural system, and feel positively connected to others in a community larger and longer lasting than oneself.

The present work, however, is among the first to directly intersect SDT and TMT to investigate whether self-determination can mitigate the effects of death awareness on existential concern and well-being. Prior research consistent with that view has been merely indirect. Work indirectly related to autonomy found MS effects on DTA, and worldview defenses are mitigated when participants expressed and affirmed (presumably autonomously) their nearest and dearest values (Schmeichel & Martens, 2005; Vail et al., 2018) or were exposed to an autonomy prime (Vail et al., 2020). Work surrounding competence found that among those who based their self-esteem on their physical strength or basketball prowess, MS motivated genuine improvement in strength output and performance in basketball games (Peters et al., 2005; Zestcott et al., 2016). And work surrounding relatedness found that MS effects on DTA were mitigated after thinking about relationship partners (Cox & Arndt, 2012) and that MS increased the desire to form close relationships (Hirschberger et al., 2002).

The present work converges with such prior work and extends beyond it to explicitly and directly address the role of the broader and more developed concept of self-determination as articulated by SDT, using well-established methods (e.g., self-determination primes, need-satisfaction measures) commonly used in SDT research on personal growth and well-being.

Exploring Possible Mechanisms of the Mitigating Effect of Need-Satisfaction

First, the effect was not simply due to associations with positive/negative affect (Studies 1, 6, 7). Second, some have argued mortality awareness is a threat to epistemic self-certainty (McGregor, 2006; McGregor & Marigold, 2003), raising the possibility that need-satisfaction might have been associated with reduced existential concern to the extent it was associated with epistemic certainty; but need-satisfaction was not associated with dogmatism (Study 4a), thus its effect on death-related anxiety was not due to epistemic certainty. Third, some have argued a key existential experience of self-determination is potentially a mindful sense of engagement with life (Ryan & Deci, 2004). Indeed, self-determination is associated with greater mindfulness (K. W. Brown et al., 2007; K. W. Brown & Ryan, 2003), and some studies have found that mindfulness can moderate the effects of MS (e.g., DTA; Niemiec et al., 2010). However, the present Studies 5 and 6 found mindfulness was not associated with DTA or death anxiety; and, although need-satisfaction was associated with mindfulness, the moderating effect of need-satisfaction was not due to mindfulness.

Fourth, we also explored whether the moderating effects of need-satisfaction might have been due to a potential protective function, beyond its known growth-oriented Openness and nondefensiveness (Vansteenkiste & Ryan, 2013). Specifically, we tested whether its effects might be associated with a possible TMT-relevant “protective” buffer (e.g., self-esteem) and/or possible SDT-relevant growth orientations (e.g., exploration orientation, Openness). Pilot Studies 3a and 5a found the self-determination primes uniquely increased felt autonomy and did not influence self-esteem nor exploration motivation, though we note these were pilot studies with low power and potential effects of the order of dependent measures after the manipulations. However, Studies 4b, 6, and 7 had sufficient power and used no such manipulations. In those studies, need-satisfaction was related to self-esteem, personal growth orientation, and Openness. Yet, need-satisfaction was associated with lower existential concern via self-esteem and not via growth orientation (Study 4b), and the moderating effect of need-satisfaction was not due to its association with Openness (Studies 6 and 7). Together, these findings could be seen as consistent with the idea of need-satisfaction being an area of theoretical overlap between SDT and TMT, serving a protective function (e.g., bolstering self-esteem) alongside its known growth-oriented functions. Nevertheless, additional research on the protective versus growth-oriented mechanisms is certainly warranted.

Fifth, we note that none of the present primary studies included both a self-determination prime manipulation and a need-satisfaction measure, to explore whether the effect of a self-determined orientation on existential concern was mediated by autonomy (vs. competence vs. relatedness). Thus, future research could make a point of adopting either a single-study mediation approach or a multistudy “causal chain” approach (Spencer et al., 2005) to further explore the role of each of the three needs in the mitigating impact of a self-determination prime manipulation on existential concern.

The Broader Intersection of Defensive and Growth-Oriented Existential Dynamics

While it may be fashionable to view existential growth and defense as opposing forces, it is also possible—indeed likely—that they sometimes work together as complementary forces. In some circumstances, they may operate as opposing forces: Existential concern might motivate defensive responses that inhibit growth-oriented exploration (e.g., closed-minded anti-immigrant prejudice and conflict) and, vice-versa, growth-oriented open-mindedness and exploration might expose one to information and experiences that challenge or undermine one's familiar defenses (e.g., a religious believer seeking to better understand atheism by reading Richard Dawkins). But in some circumstances, they may operate in concert, as complementary forces: Certain conditions may produce a sense of security (thus mitigating existential concerns and preserving well-being) that, in so doing, *enables* one to more open-mindedly engage with potentially uncomfortable situations and information, explore and experience all the world has to offer, and grow as a person. Need-satisfaction may characterize that latter set of conditions—the intersection where existential security and growth orientations meet and blend together in concert.

To be sure, decades of prior SDT research show that need-satisfaction facilitates personal growth, including intrinsic motivation, Openness, and exploration (Ryan & Deci, 2017). But the present research can be taken as evidence that self-determination also serves a protective function—protecting against existential concern and the otherwise potentially detrimental effects of death awareness on well-being. Some earlier SDT research consistent with this interpretation has found, for example, that self-determined goal orientations and need-satisfaction were associated with reduced existential concern (lower perceived risk to physical safety) regardless of history of life-threatening danger and injury (Lynch et al., 2005), reduced suicidal ideation and behavior (Britton et al., 2014; Rowe et al., 2013), and both reduced death anxiety and better well-being (van der Kaap-Deeder et al., 2020; Van Hiel & Vansteenkiste, 2009). Other studies (Vail et al., 2019) found MS undermined SWL among those with extrinsic (controlled) goal orientations, but not among those with more intrinsic (self-determined) goal orientations. Correlational work also found that autonomy is associated with a sense of symbolic immortality and meaning in life (Horner et al., 2021). The present research converges with the abovementioned work to suggest that, in addition to its known growth-oriented functions, need-satisfaction also protects against existential concern and the detrimental effects of death awareness on well-being.

However, future research is needed to better understand how, and to what extent, self-determination serves both security/protective *and* growth-oriented existential functions. For example, additional research is needed to test whether the awareness of death might motivate efforts to experience self-determined orientations and need-satisfying goals and activities. Such work would help to better understand whether the motivation to defend/protect oneself against existential concerns could motivate people to seek the very experiences (e.g., self-determination, need-satisfaction) that are known to promote personal growth and well-being.

Additional research is also needed to investigate whether self-determined orientation simply buffers existential concern (as seen in the present research) or whether it also makes people more likely to take death awareness itself as an occasion to better appreciate the

fleeting beauty of life and open-mindedly explore the world while they can. The former would mean self-determination simply neutralizes death awareness as an existential motivator (renders it a passive/inert stimuli), clearing the way for the individual to pursue and experience personal growth by engaging other stimuli elsewhere. The latter would mean self-determination equips people to not simply cope with death awareness nor to simply render it a passive/inert stimuli, but instead to more actively appraise it as a positive reminder to more appreciatively look on the bright side of life, engage and explore the world with wonder and awe, and thus take death awareness as an occasion to stimulate further personal growth and well-being.

Research inspired by TMT has done much to advance the understanding of existential defense-oriented motivation, and the research inspired by SDT has done much to advance the understanding of existential growth-oriented motivation. But so far, these research traditions have coexisted separately and without much empirical interface. The value of the present work is in bringing together these two “big” theoretical traditions, at the broadest empirical levels—represented by the conceptual and methodological tools offered by TMT and SDT—to better understand the interface between existential security and growth-oriented dynamics. If, in addition to the present findings, additional research continues to find that self-determination is one of the intersections between protective and growth-oriented existential dynamics, it would open the door to more comprehensive and unifying perspectives about how people can both manage their existential concerns *and* grow and improve themselves and their communities.

Strengths and Limitations

One strength of the present research is that it took a methodologically programmatic approach (see Table 7). The role of death awareness was examined using five separate techniques: manipulations of death-related song titles (Study 1), subliminal word primes (Study 2), political topics (Study 3), short essay prompts (Study 5), and measures of DTA (Studies 6 and 7). The role of self-determination was also examined using five separate techniques: manipulations of self-determination via short essay prompts (Study 3) and sentence unscrambling tasks (Study 5), and three different measures of need-satisfaction (21-item, Studies 1, 2, 4a; nine-item, Study 4b; 18-item, Studies 6 and 7). And the key dependent measures of DTA, death anxiety, and well-being were each measured using different techniques. Thus, the present findings were robust across a variety of methods.

One limitation is that Studies 6 and 7 did not manipulate MS or self-determination when measuring SWL or happiness; thus, the data patterns concerning well-being were correlational, and readers should be cautious about making causal inferences. Another limitation is that the present work is largely restricted to young, White American Christian females. Most people in the world, however, bear little resemblance to these kinds of samples (Henrich et al., 2010). Even amid the American context, there is substantial heterogeneity in psychological processes across generations (Twenge et al., 2012), racial and ethnic groups (Markus & Kitayama, 1991), sex (Wood & Eagly, 2002), religion (Li et al., 2012; Norenzayan et al., 2016), and regions of the United States (Vandello & Cohen, 1999). The generalizability of the present findings is therefore limited. Yet, because SDT and TMT literatures

are built on research data obtained from dozens of countries and every continent, there may be reason to expect that the presently relevant conceptual processes are generalizable. Nevertheless, future research should of course investigate the relationships between self-determination, existential concern, and well-being in other demographic and cultural contexts.

Last, one other complexity worth considering concerns the differences in the SWL, happiness, and PANAS data patterns in Studies 6 and 7. The present studies were designed to include the PANAS largely as a TMT-related methodological filler,⁷ focused instead on measuring well-being using the well-validated target measures of SWL (Diener et al., 1985) and happiness (Lyubomirsky & Lepper, 1999). Indeed, results indicated DTA was associated with lower SWL and happiness, but not among those with high need-satisfaction—consistent with the overarching idea that although death awareness is typically an existential stressor, self-determination should buoy well-being. However, supplemental analyses in those same studies failed to find similar interactions on positive or negative affect. That difference raises some questions when one considers that “subjective well-being” has long been considered to involve SWL, pleasant affect, and unpleasant affect (Diener et al., 1999). If one assumes that each of those three components functions exactly the same way, then the results of Studies 6 and 7 might appear contradictory—did need-satisfaction and DTA impact subjective well-being, as indicated by the SWL and happiness results, or not, as indicated by the PANAS results? However, much prior research has shown that although the three components are associated, they reflect different functions. Measures such as the present SWL and the happiness measures appear to be more about thoughtful and appreciative enjoyment, whereas measures such as the PANAS appear to be more about immediate psychophysiological emotions and moods (Diener et al., 1999, 2018; Diener & Ryan, 2009). Thus, it is possible that Studies 6 and 7 suggest, more specifically, that DTA undermined participants’ appreciative sense of satisfaction and happiness rather than their more visceral emotions/moods. Nevertheless, given that these studies were not designed to address this issue, the topic remains an open and interesting direction for future research.

Conclusion

The present findings help to better understand why being the “captain of one’s soul” would move bards like Henley to pen works like *Invictus* and why such poetic celebrations of self-determined experiences have resonated so strongly. In the present work, the main effects of death awareness were consistent with TMT, the main effects of self-determination orientations were consistent with SDT, and the observed interaction patterns consistently pointed to new ideas about the intersection of existential security and growth orientations. Together, the present studies highlight the role of self-determination in managing the cognitive and affective sides of existential concern and in mitigating the deleterious effect of existential concern on well-being.

⁷ The placement of the PANAS in the present research designs was strongly influenced by the TMT research tradition. For a variety of reasons, mainly having to do with the dual-process model of TMT (Kosloff et al., 2019; Pyszczynski et al., 1999), when TMT studies use an explicit MS prime

it is often soon followed by one or more distracter tasks (e.g., PANAS) to ensure death-related thoughts are moved out of “proximal” conscious awareness where researchers can observe their more “distal” nonconscious influence on the target DVs (Cox et al., 2019). Similarly, in the present research designs, all the target DVs were positioned either after subliminal MS primes (no distracter task necessary), after an explicit MS prime and a delay/distracter task (e.g., PANAS), or the study measured all variables’ naturally occurring levels in a correlation study (no distracter necessary), to ensure they would be able to detect the impact of any distal/nonconscious existential concern. This methodological technique impacted whether and when the PANAS was administered, which impacted the analyses and interpretation of those data. Studies 2, 4a, and 4b did not include the PANAS because they either used a subliminal prime (outside of conscious awareness, no distracter needed) or were correlational (no explicit prime, no distracter needed); in Study 5b, the PANAS was presented after the MS prime but before the self-determination manipulation, which rendered any interaction analyses on PANAS inappropriate; and in Studies 1 and 3b, it was presented immediately after the MS manipulation, during the “proximal” period, which means it would not have been a similar position as all the other target DVs nor theoretically in the correct position to detect any distal/nonconscious existential concern—and, indeed, in Studies 1 and 3b, there was no interaction on any PANAS subscale. For these reasons, the PANAS data from Studies 1–5 are not appropriate for interpretation parallel to the interpretations of SWL, happiness, and PANAS data in Studies 6 and 7.

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