

BRIEF REPORT

Mortality salience biases attention to positive versus negative images among individuals higher in trait self-control

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Death is inevitable. One way people cope with awareness of death is to focus on the positive things in life. Consistent with this idea, reminders of personal mortality have been found to increase optimism and tune attention towards positive information. The current research tested the hypothesis that persons higher in trait self-control are especially likely to attend to positive (versus negative) stimuli under mortality salience (MS). Participants completed a measure of trait self-control, contemplated their own mortality or a control topic, and then viewed positive and negative affective images while their gaze patterns were recorded. MS increased the attention to positive (versus negative) images among participants higher in trait self-control, whereas those lower in trait self-control exhibited a non-significant trend in the opposite direction. Thus, participants higher in trait self-control showed a positivity bias after contemplating death, which may help explain why they tend to enjoy more positive outcomes in life.

Keywords: Terror management theory; Visual attention; Emotions; Motivation; Rewards; Threat.

From single-celled organisms all the way up the evolutionary ladder, all organisms have a drive towards self-preservation (Burris & Rempel, 2008). Unlike other organisms, however, humans are capable of contemplating their own inevitable death. The consequences of this capability have been investigated extensively under the umbrella of terror management theory (TMT), which proposes that mortality awareness elicits a potentially crippling anxiety that influences wide swaths

of human psychological experience and behaviour (Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989). Numerous studies have yielded support for TMT by finding that reminders of death trigger defensive reactions geared towards reducing psychological distress. For example, mortality salience (MS) has been found to motivate responses that bolster symbolic conceptions of reality and increase perceptions of order, meaning and stability in life (e.g., Landau, Kosloff, &

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Schmeichel, 2011; Vess, Routledge, Landau, & Arndt, 2009).

Another possible way to deal with the psychological distress that may attend thoughts of death is to focus on more positive information or events. Research inspired by TMT has begun to consider the effects of MS on attention to emotional information. The results of this research have been somewhat mixed. As reviewed below, MS has been observed to lead to a bias towards positive information in some studies and towards negative information in others. The present investigation sought to extend previous research by examining the effects of mortality salience on attention to emotional stimuli using eye-tracking and by exploring the moderating role of individual differences in trait self-control.

MS AND POSITIVE AFFECT

MS may increase attention to positive information. Prior research on emotion regulation, counter-regulation in attention allocation and positive tuning following MS lend support to this view. People tend to prefer the experience of positive emotions over negative ones, particularly when the negative emotions serve no immediate functional purpose (Erber, Wegner, & Theriault, 1996; Tamir, Chiu, & Gross, 2007). In so far as thinking about death increases the potential to experience negative emotions (e.g. anxiety), people may be motivated to respond to thoughts of death by focusing on something more pleasant. To be sure, diverting attention away from threatening events and towards more benign events is not always an adaptive response. However, ruminating about death could lead to getting stuck in an existential rut and may disrupt effective action and goal pursuit. In this view, attending to more positive information may be a useful way to distract oneself from or otherwise minimise the unpleasant reality of death.

Research on counter-regulation is consistent with the idea that thoughts of death may increase attention to positive emotional events. According to this research, individuals more easily process information opposite in valence to their prevailing

state. For example, one study found that participants who had received a negative feedback showed greater interference effects for positive emotional stimuli on a Flanker task (Rothermund, Voss, & Wentura, 2008). Koole and Jostmann (2004) found similar evidence among participants who performed a stressful (performance-contingent) arithmetic task; participants who performed the stressful task showed less interference for negative words on an affective Simon task if they were high in action orientation (Kuhl, 1994), compared to individuals who performed a non-stressful (non-contingent) task and individuals who were low in action orientation.

More direct support for the idea that MS increases attention to positive information emerged in a series of studies by DeWall and Baumeister (2007). They found evidence for 'positive tuning' under MS. For example, in a first study they had participants think and write about their death or a control topic before completing a simple word-stem completion task. The word stems could be completed to form a positive (or neutral) word or a negative (or neutral) word. Results showed that participants who had thought about death had a higher relative index of positivity (total positive words created minus total negative words created) than those in the control condition. Two subsequent studies provided conceptual replications of the positive tuning effect using different word-based dependent measures. The current study aimed to extend prior results by examining attention to emotional information at the psychophysiological level, as assessed by visual attention to positive versus negative emotional images.

MS AND NEGATIVE AFFECT

Despite evidence for positive tuning, there are also reasons to believe that MS may increase attention towards negative information. For example, Ford et al. (2010) investigated the effects of emotion inductions on visual attention to positive images and threats and found evidence that emotions bias attention towards images that are motivationally congruent with one's prevailing emotional state.

Most relevant for present purposes, they found that a fear induction caused an increase in attention towards negative versus positive emotional images. In so far as MS has the potential to induce anxiety or fear, it may cause a similar bias in attention towards negative versus positive images.

More direct support for the idea that MS increases attention to negative images emerged in a study by Hirschberger, Ein-Dor, Caspi, Arzouan, and Zivotofsky (2010, Study 2). They found that MS (versus pain salience) increases gaze duration towards images of threats (e.g. sharks, barking dogs). More specifically, participants in this study were subliminally primed with either the word 'death' or 'pain' during an innocuous distracter task. Next, visual attention to images was assessed using eye-tracking. Participants saw arrays of four images in which three were always neutral. In the physical injury condition the fourth image was of a physical injury (e.g. mutilation), in the physical threat condition the fourth image was of a physical threat (e.g. a gun) and in the control condition all four images were neutral. Average gaze duration towards the fourth image in the array was the dependent measure. Results indicate that death primes caused participants to gaze significantly longer at images of threats relative to images of physical injury or neutral images.

Further, one study found that MS elicits stronger fear responses to images of spiders among spider-phobic individuals (Strachan et al., 2007). Such evidence suggests that thinking about death can potentiate negative emotional responses or bias attention towards negative information. Note, however, that the studies by Hirschberger et al. (2010) and Strachan et al. (2007) cannot address the extent to which MS influences attention towards positive versus negative emotional information, as neither study included positive emotional images. Thus, the current study is the first one to investigate visual attention towards rewarding versus threatening stimuli following MS. Additionally, the current study quantified visual attention as average fixation durations, which are calculated by dividing the total gaze duration for an image by the number of fixations

on that image. This measure accounts for both duration and frequency of looking and as such yields a more precise measure of gaze behaviour than does gaze duration (Henderson & Hollingworth, 1998; see also Ford et al., 2010).

MS AND EMOTION REGULATION

MS manipulations typically elicit defensive responses without influencing explicit, self-reported affect (e.g. Rosenblatt et al., 1989). In contrast, MS does appear to influence more implicit affective responses (e.g. DeWall & Baumeister, 2007). Moreover, many defensive responses to MS are only observed following a delay period, when thoughts of death have escaped conscious awareness. This pattern suggests that defensive or regulatory processes that help to manage MS operate on an implicit rather than explicit level. This pattern is also consistent with evidence from the emotion regulation literature, which suggests that implicit emotion regulation strategies are crucial for managing the pervasive exposure to emotional stimuli one experiences in daily life (e.g., Koole & Rothermund, 2011).

Using dental pain as a control condition (as in the present study) may further elucidate the role of implicit regulatory processes involved in responses to MS. We maintain that dental pain does not trigger counter-regulation of attention. When a person thinks about or experiences dental pain, typically it is beneficial to acknowledge the pain and even to focus on it, because there may be something one can do about it (e.g. go to the dentist and have the problem fixed). Previous research has found that negative and threatening information is focused rather than inhibited or counter-regulated, if it is experienced as being controllable. For example, Rothermund, Brandstatter, Meiniger and Anton (2002) found that when a painful stimulus was perceived as being controllable (versus not controllable), sensitivity to pain decreased. Research by Brandstatter, Voss, and Rothermund (2004) found conceptually similar results when examining danger signals. By contrast, death poses an intractable problem that

cannot be fixed. In such cases (i.e. when a threat is uncontrollable), counter-regulation or implicit regulatory processes may be more likely to emerge. The current study is thus well-suited to reveal effects (i.e. a bias in visual attention towards positive versus negative information) that may be considered evidence of implicit emotion regulation.

TERROR MANAGEMENT AND TRAIT SELF-CONTROL

A review of previous research reveals that MS may bias attention towards positive or negative information. Given that evidence exists to support either outcome, we reasoned that individual differences may help to determine which outcome emerges. The central role of individual differences in terror management processes has been evident since the early days of the theory. Initial interest focused on self-esteem, around which the theory was predicated. Briefly, evidence has suggested that trait self-esteem profoundly alters how people respond to thoughts of death (e.g. Harmon-Jones et al., 1997; Schmeichel et al., 2009). Several other individual differences have also proven useful for predicting MS effects.

In the current study, we predicted that the effect of MS on attention to positive versus negative information hinges on individual differences in self-control. Self-control refers to the capacity a person has to override or alter predominant response tendencies (Vohs & Baumeister, 2004). Trait self-control is positively correlated with grade point average (GPA), self-esteem, relationship satisfaction, interpersonal skills, secure attachment and optimal emotional responses (Tangney, Baumeister, & Boone, 2004). Trait self-control thus predicts adaptive outcomes and good behavioural and emotional regulation. Research further suggests that persons higher in trait self-control tend to avoid situations in which the exertion of self-control is necessary, whereas those lower in trait self-control face temptation more often and thus set themselves up for self-

regulatory failure (e.g. Hofmann, Baumeister, Förster, & Vohs, 2012).

In addition to predicting regulatory ability in general, several studies have linked trait self-control specifically to the successful regulation of death-related thoughts and feelings. A series of studies found that both trait and state self-control moderated the effects of MS on the accessibility of death-related thoughts and world-view defence, respectively (Gailliot, Schmeichel, & Baumeister, 2006). More specifically, higher trait and state self-control predicted lower death-thought accessibility and also lower world-view defence under MS. These findings were replicated in another pair of studies that controlled for trait self-esteem, suggesting that self-control predicts reactions to MS above and beyond the influence of self-esteem (Gailliot, Schmeichel, & Maner, 2007). Earlier research assessing individual differences in action orientation, which is linked to good self-control, found similar evidence in so far as persons higher in action orientation (Kuhl, 1994) were better able to suppress the threatening implications of a death-related construct (wilderness) and also better able to see the beauty within it (Koole & Van den Berg, 2005).

Previous research has identified trait self-control (and related constructs) as a consistent predictor of several different responses to MS. It thus seems reasonable to predict that trait self-control moderates other responses to reminders of death such as attention to emotional information, particularly in the light of established relationships between self-control and emotional well-being.

THE CURRENT STUDY

The current study examined the effects of MS on attention to emotional images as a function of individual differences in self-control. Participants completed a self-report measure of trait self-control before thinking and writing about their own mortality or an aversive control topic (i.e. dental pain). Then the participants viewed pairs of emotional images while their gaze patterns were monitored by an eye-tracking device. We

predicted that trait self-control would help to shape the impact of MS on attention to positive versus negative emotional information, such that those higher in trait self-control attend more to positive (versus negative) information under MS, consistent with prior research on emotion regulation, counter-regulation of attention and positive tuning. Conversely, in so far as fear and anxiety potentiate the mood-congruent processing and attention to threatening information (e.g. Ford et al., 2010), we predicted that participants lower in trait self-control will attend more to negative versus positive information under MS.

METHOD

Participants and design

Seventy-six undergraduate students reported individually to a laboratory study described as an investigation of the relationship between personality traits and event perception. They received credit towards a course requirement for their participation. Thirty-three additional participants completed the study but were not included in analyses, because the eye-tracker did not successfully monitor their gaze patterns. Sample size was determined following past research (see Gailliot et al., 2006; Study 5). Participants were randomly assigned between the MS ($n = 34$) and dental pain salience ($n = 42$) conditions.

Procedure

The experimenter first introduced the purpose of the study and then asked the participants to look at an array of dots on a computer screen; this calibration task trained the eye tracker to follow participants' eye movements. Eye tracking was conducted using an ASL Eye-Trac 6 system (Applied Science Laboratories, Bedford, MA) and Gaze Tracker 8.0 software.

Trait self-control

After the calibration task, participants completed the brief (13-item) version of the Self-Control

Scale (SCS; Tangney et al., 2004). In the current study, the possible range of scores on the SCS was 26–60, and the average total score was 44.19 ($SD = 7.64$). Sample items include 'I have a hard time breaking bad habits' (reverse scored) and 'People would say that I have iron self-discipline'.

Trait approach motivation

Approach motivation predicts attention to rewards and other appetitive stimuli (Gray & McNaughton, 2000). Thus, approach motivation was measured by Carver and White's (1994) behavioural approach system sensitivity scale (BAS) and included as a covariate in statistical analyses. In the current study, the possible range of scores on the BAS was 29–50, and the average total score was 39.98 ($SD = 4.68$). Sample items include 'I will often do things for no other reason than they might be fun' and 'If I see a chance to get something I want, I move on it right away'.

Mortality salience

Following previous research (e.g. Rosenblatt et al., 1989; Harmon-Jones et al., 1997), participants were randomly assigned to respond to two open-ended prompts related to either death or dental pain. In the MS condition, the prompts were 'Please briefly describe the emotions that the thought of your own death arouse in you' and 'Jot down, as specifically as you can, what you think will happen to you as you physically die and once you are physically dead'. In the control condition, participants responded to prompts about a painful dental procedure: 'Please briefly describe the emotions that the thought of a painful dental procedure arouses in you' and 'Jot down, as specifically as you can, what you think will happen to you as you have a painful dental procedure'.

Delay

After writing about death or dental pain, participants read an affectively neutral passage from 'The Growing Stone', a short story from the collection *Exile and the Kingdom* (Camus, 1957), and they

answered questions about the story's content and the gender of the author. This task functioned as a delay and distraction task and was intended to remove thoughts of death from focal awareness. This story is a commonly used delay and distraction task in the TMT literature (e.g. Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994).

Image-viewing task

Following the delay task, participants completed an image-viewing task. Images were taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008). Participants viewed pairs of images (i.e. two images presented side by side) on a computer screen and answered simple questions about them. Image pairs included neutral, positive and negative images in all nine possible pair-wise combinations (e.g. neutral/neutral, positive/negative, negative/negative, etc.). Positive images were rewarding in nature (e.g. depicting people winning an athletic event), whereas negative images were threatening in nature (e.g. depicting physical violence). Participants viewed 3 instances of each possible combination for a total of 27 image pairs in all. Participants viewed the image pairs in one of four random orders.

The picture-viewing task proceeded as follows: a fixation cross appeared at the centre of the screen for 1 sec, then an image pair appeared on screen for 2 sec, and then a simple yes or no question (e.g. 'Did you see a tree') appeared on screen for 4 sec. Participants answered the question aloud while the experimenter recorded their response. The questions were included to encourage the participants to look at each image in a pair. Last, participants were debriefed regarding the purpose of the experiment, given the opportunity to comment and ask questions, thanked and dismissed.

RESULTS

The central hypothesis that the effect of MS on attention to emotional information would be

moderated by trait self-control was confirmed. Visual attention to the images was quantified as average fixation durations (i.e. total fixation duration for an image divided by the number of fixations towards that image; Ford et al., 2010). Then, for each image pair we calculated difference scores to assess relative average fixation durations for each image in the pair. These difference scores represent relative visual attention to each image type (e.g. positive versus negative).

First, we regressed the difference in overt visual attention towards positive versus negative images on MS condition, trait self-control (centred) and their interaction. The main effect of MS condition was not significant, $b = -.873$, $t(73) = .09$, $p = .93$. The main effect of trait self-control was not significant, $b = 5.70$, $t(73) = .70$, $p = .48$. As predicted, the mortality salience \times trait self-control interaction was statistically significant, $b = 42.71$, $t(72) = 2.74$, $p = .008$, $\eta^2 = .10$.

We used a within-cell regression approach to probe the nature of the interaction. Please refer to Figure 1, which depicts the scatterplot and least-squares regression lines for the two conditions. Simple slopes analysis indicated that participants higher (versus lower) in trait self-control demonstrated a bias in visual attention towards positive (versus negative) images in the MS condition, $B = 2.21$, $t(32) = 2.39$, $p < .03$, but not in the dental pain salience condition, $B = -0.21$, $t(40) = -1.38$, $p > .17$.

We also examined the effects of MS on visual attention at ± 1 SD from the mean trait self-control score. Predicted values of t tests indicated that among participants higher in trait self-control (+1 SD), MS increased the attention towards positive images (decreased the attention towards negative images) relative to dental pain salience, $t(72) = 2.02$, $p < .05$. Among participants lower in trait self-control (-1 SD), the MS manipulation tended to have the opposite effect. Specifically, among those lower in trait self-control, MS exerted a marginal increase in attention towards negative images (decreased attention towards positive images) relative to dental pain salience, $t(72) = -1.78$, $p < .08$.

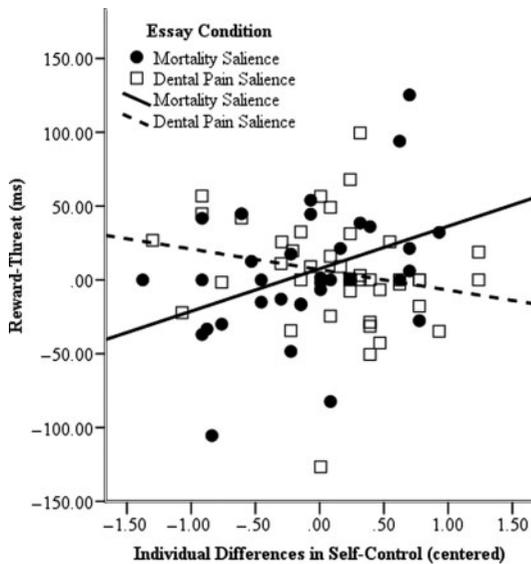


Figure 1. Trait self-control correlates positively with visual attention for those in the MS condition. Self-control was unrelated to visual attention in the dental pain control condition.

We repeated our regression analysis, this time including trait approach motivation (BAS) as a statistical covariate. The key interaction between trait self-control and MS on visual attention towards positive (versus negative) images remained significant with BAS included in the model, $b = 42.41$, $t(71) = 2.69$, $p = .009$. We also repeated this analysis using a hierarchical model. Level-one predictors included the MS manipulation, trait self-control and BAS (a measure of trait approach motivation). Level-two predictors included the MS \times self-control and MS \times BAS interactions. The key interaction between trait self-control and MS on visual attention towards positive (versus negative) images remained significant above and beyond the effects of the level-one predictors and controlling for the MS \times BAS interaction, $b = 2.95$, $t(70) = 2.39$, $p < .02$. None of the regression terms including BAS were statistically significant, $ps > .21$. Further, when controlling for multiple comparisons, no notable significant effects emerged when the other difference scores (e.g.

positive versus neutral) were used as the dependent measure.

DISCUSSION

Does thinking about death influence attention to emotional information? The current study revealed biases in visual attention towards positive versus negative emotional images following MS, with the particular manner of bias being dependent upon individual differences in self-control. After thinking about death, participants higher in trait self-control attended more to positive (versus negative) emotional images, whereas those lower in trait self-control exhibited a non-significant trend in the opposite direction (i.e. towards negative versus positive images).

These findings have implications for research on both terror management and trait self-control, respectively. First, the current results join a growing body of research looking at novel forms of emotion-related responding under MS. Researchers have consistently observed null effects of MS on self-reported emotional states (e.g. Harmon-Jones et al., 1997; Rosenblatt et al., 1989). Such null results are consistent with the view that individuals quickly defend against or down-regulate thoughts and fears of death, thus minimising the subjective experience of negative emotions. But the current results join other recent findings (e.g. Dewall & Baumeister, 2007) to suggest that MS nonetheless has important emotional consequences. In the current study, one such consequence was a shift in attention towards positive (versus negative) emotional images, particularly among individuals higher in trait self-control. This finding may help to explain the lack of anxiety or fear following MS inductions, in so far as some participants appear to counter-regulate and thus attend to positive emotional information under MS. Presumably a bias towards positive emotional information helps to shield individuals from existential anxieties. This may be particularly true for individuals higher in trait self-control, whereas those lower in self-control may be more

susceptible to emotional distress under MS. Additional research is needed to test this hypothesis.

Future research could also examine the extent to which biases in visual attention mediate the relationship between individual differences in trait self-control and other types of defensive responding under MS. The current study was not equipped to address this possibility, so additional studies including more traditional measure of defensive responding are needed to determine whether attending to positive images reduces other forms of defensiveness. Further, although we consider the evidence of positivity bias in visual attention to be an instance of implicit affect regulation, we measured visual attention only after a delay period following the MS induction. The delay period between the MS and picture-viewing tasks afforded the participants ample opportunity to engage in voluntary, explicit emotion regulation (e.g. Gailliot et al., 2006). Thus, explicit emotion regulation processes may have had some impact on the present results and cannot be ruled out. Future studies should examine the interplay between explicit and implicit emotion regulation strategies as they relate to biases in visual attention.

The current findings are consistent with previous evidence that trait self-control moderates terror management defences. For example, Gailliot and colleagues (2007) found that MS causes an increase in cultural world-view defence only among individuals lower (but not higher) in trait self-control. The attentional bias towards positive (versus negative) emotional images observed in the current study may help to explain why persons higher in trait self-control are less defensive under MS. Presumably, counter-regulation of attention helps persons higher in trait self-control to offset the threatening nature of MS; if the threat of death is reduced, then the motivation to engage in defensive self-enhancement or outgroup derogation as a means of defending against the threat of death may also be reduced. Note that previous research on counter-regulation has contrasted negative (self-threatening) and positive conditions, whereas the current research compared two negative conditions (death salience versus dental pain salience). We found evidence of counter-regulation only

in the condition that posed an existential threat. This pattern suggests that counter-regulation processes operate among high self-control individuals especially under conditions of threat against the symbolic self, though more research is needed to test this hypothesis.

Persons with higher trait self-control tend to experience a myriad of positive outcomes in life (Tangney et al., 2004). One explanation for differential outcomes associated with trait self-control is that individuals higher in trait self-control are better able to override unwanted impulses (e.g. Schmeichel & Zell, 2007). However, an alternate perspective has begun to emerge, namely that participants higher in trait self-control are better at avoiding temptations or other situations that call for self-control (see Hofmann et al., 2012). The current results may speak to this latter possibility. In the face of MS, the psychophysical response of individuals with higher trait self-control was to orient visual attention towards positive emotional images, whereas those lower in self-control tended to orient towards more negative images. Unlike individuals lower in trait self-control, then, those higher in self-control were able to neutralise a potential threat that had the potential to disrupt goal pursuit or increase negative emotions. By orienting attention away from potentially threatening information, individuals higher in trait self-control may have avoided the potentially disruptive and resource-depleting consequences of thinking about death (Gailliot et al., 2006; see also Koole & Van den Berg, 2005). Thus, individuals higher in self-control may be prone to succeed at self-regulation because of a bias in attention towards positive information that reduces the need to muster limited regulatory resources, whereas those lower in self-control may be prone to failure because they lack this tendency to focus on the sunny sides of life and must contend with a more distressing (and more depleting) existential dilemma.

The current study revealed that trait self-control influences fast psychophysical reactions to MS. In turn, the results may shed light on critical questions to researchers interested in mortality awareness and self-regulation alike.

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