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The Moderating Role of Executive Functioning in Older Adults' Responses to a Reminder of Mortality

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Abstract

In previous research, older adults responded to mortality salience (MS) with increased tolerance, whereas younger persons responded with increased punitiveness. One possible explanation for this is that many older adults adapt to challenges of later life, such as the prospect of mortality, by becoming more flexible. Recent studies suggest that positively-oriented adaptation is more likely for older adults with high levels of executive functioning. We thus hypothesized that the better an older adult's executive functioning, the more likely MS would result in increased tolerance. Older and younger adults were randomly assigned to MS or control conditions, and then evaluated moral transgressors. As in previous research, younger adults were more punitive following reminders of mortality; executive functioning did not affect their responses. Among older adults, high functioning individuals responded to MS with increased tolerance rather than intolerance, whereas those low in functioning became more punitive.

Keywords

mortality salience; older adults; executive functioning

The aging process is characterized by many significant changes, including declines in physical stamina and cognitive ability, as well as changes in emotional experience and regulation. One inevitable challenge of later life is increasing temporal proximity to death. According to terror management theory (TMT; Greenberg, Pyszczynski, & Solomon, 1986), this is a potential problem because awareness of mortality increases one's potential for

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anxiety and therefore leads to a wide variety of defensive responses. Thus, as life's end nears, people may be more susceptible to anxiety and related problems. However, the presence of this looming existential challenge does not appear to prevent many older adults from achieving psychological well-being in the final chapters of life (e.g., Baltes & Baltes, 1990; Carstensen, Isaacowitz, & Charles, 1999; Heckhausen & Schulz, 1995).

TMT (Greenberg et al., 1986) suggests that humankind's unique cognitive capacities lead to awareness of the inevitability of one's death. According to the theory, this awareness conflicts with biological predispositions toward continued survival and therefore creates an ever-present potential for anxiety. People manage this potential for anxiety by maintaining faith in their cultural worldviews and self-esteem. One's cultural worldview provides meaning and permanence to existence and specifies standards and roles by which the individual can maintain self-esteem. By living up to the standards of one's worldview, the person can view her/himself as a valued contributor to a meaningful universe, rather than a mere physical animal fated to obliteration upon death.

The mortality salience (MS) hypothesis is the most widely investigated hypothesis derived from TMT and the focus of the present article: if faith in one's cultural worldview and self-esteem provide protection against death-related anxiety, then increased awareness of death should engender increased need for and defense of these constructs. Research has shown that when reminded of death, younger adults become more invested in their cultural worldview and exhibit increased preference for similar others (e.g., Greenberg et al., 1990), increased prejudice (e.g., Cohen, Jussim, Harber, & Bhasin, 2009) and aggression (McGregor et al., 1998) toward dissimilar others, and greater punitiveness towards those who violate cultural norms and standards (e.g., Florian & Mikulincer, 1997).

Aging presents a potent existential threat for older adults because of the increased frequency of reminders of mortality that they must face (e.g. increased medical problems, doctor's visits, death of close friends), as well as the knowledge that they are approaching the end of the typical human lifespan. Hundreds of studies with younger adults suggest that such death reminders lead to increased potential for anxiety, and as a result, increased defensive behaviors (for a recent review, see Greenberg, Solomon, & Arndt, 2008). Given the more frequent and potent reminders of mortality that older adults experience, one might expect older adults to display more extreme levels of the defensiveness observed in younger adults. Research shows, however, that older adults do not display the same defensive reactions to death reminders that younger persons do. An initial study assessing possible age differences in response to MS found that whereas younger persons responded to MS with the typical increased harshness in responses to moral transgressors found in many previous TMT studies, older adults shifted toward more lenient responses (Maxfield et al., 2007). In a conceptual replication, Weise et al. (2011) found that MS led older American adults to evaluate someone who criticized the U.S. less negatively. Another study showed that MS increased generative concern (as measured by the Loyola Generativity Scale; McAdams & de St. Aubin, 1992) in older adults, but not younger adults (Maxfield, Greenberg, Pyszczynski, Weise, & Kosloff, 2011).

That older adults show arguably more positive responses to the death reminders is consistent with the many theories of aging which posit that positive psychological adaptations take place in later life. The selective optimization with compensation model (Baltes & Baltes, 1990) and life-span theory of control (Heckhausen & Schulz, 1995) suggest that older adults employ multiple methods of adapting to their internal and external circumstances, letting go of unattainable goals and relying on remaining skills and abilities to achieve optimal well-being. According to socioemotional selectivity theory (Carstensen et al., 1999), as future time perspective is increasingly limited by advancing age, people become more oriented

toward emotionally rewarding goals and experiences. For example, older adults are more attentive to positively valenced visual stimuli (e.g. Isaacowitz, Wadlinger, Goren, & Wilson, 2006) and have comparatively greater memory for positively valenced information (e.g. Charles, Mather, & Carstensen, 2003). From the perspective of socioemotional selectivity theory, these findings are the result of an intentional strategy aimed at regulating emotion to maximize positive affect, resulting from the time limitations experienced with increasing age. Taken together, the aging literature suggests that older adults use multiple strategies to adapt to age-related changes and limitations, which may be of particular value when facing increasing proximity to death.

Whether these adaptations occur consciously or intuitively, they presumably require cognitive resources. Dynamic integration theory (Labouvie-Vief, 2009) suggests that older adults' cognitive status inevitably affects their emotional processes. Consistent with this reasoning, older adults with stronger performance on assessments of cognitive control showed a greater positivity effect in the form of recall of positive over negative images, whereas those with poorer cognitive control did not (Mather & Knight, 2005; Study 2). Further, increased cognitive load or distraction eliminates the positivity effect among older participants (Knight et al., 2007; Mather & Knight, 2005; Study 3). These findings clearly point to the importance of cognitive resources in older adults' ability to engage in emotion-regulating adaptations.

To the extent that the age-related differences in responses to reminders of death (e.g., punitiveness, Maxfield et al., 2007; generative concern, Maxfield et al., 2011; evaluation of critical outgroup member, Weise et al., 2011) reflect the generally adaptive, yet cognitively demanding, shift posited by the theories noted above, these different responses to death reminders should be most pronounced among older adults with high levels of executive functioning. Conversely, individuals with lesser executive functioning may lack the cognitive resources required to enact this developmental shift toward a more positive or flexible orientation in response to death reminders. Thus, older adults lower in cognitive functioning in general and executive functioning in particular are more likely to respond to mortality salience in the same defensive manner exhibited by younger adults. The present study was designed to assess these possibilities. We primed thoughts of mortality in both a subtle and more blatant manner, as in Maxfield et al. (2007), and measured worldview defense by assessing punitiveness toward people who violated the culture's prevailing moral prescriptions. Although Maxfield et al. found stronger effects for the subtle induction, we suspect this may have been because the delay between the MS induction was insufficient, so we included a longer delay in the present study.

Given the important role that executive functioning is hypothesized to play in both cognitive and emotional aspects of adaptive behavior in later life (e.g. Labouvie-Vief, 2009), we focused our initial investigation on the role of executive functioning in the observed age differences in responses to reminders of mortality. Executive functioning seems especially important to this transition because of the role this cognitive domain plays in diverse and complex cognitive processes, such as moral judgment, decision-making, and cognitive flexibility (e.g., Albert & Kaplan, 1980; McCabe, Roediger, McDaniel, Balota, & Hambrick, 2010; West, 1996). As such, all of these judgmental processes are likely relevant to coping with one's mortality and subsequent responses to violations of the worldview. Of the cognitive domains studied within the aging and cognition literature, we hypothesized that the abilities associated with executive functioning (e.g. planning, strategizing, adjusting one's strategy, and shifting attention, rather than perseverating; Cummings & Miller, 2007) would be especially important cognitive resources for developing more benevolent methods for coping with the inevitability of death. We also considered several other characteristics, which might also explain the observed age differences in responses to moral transgressors;

to this end, we measured auditory-verbal memory, authoritarianism, personal well-being, and self-reported health to assess their potential role as alternative explanations for this age difference.

Because younger adults may lack the variability in executive functioning often associated with aging (e.g. West, 1996) as well as the positive psychological adaptations associated with high functioning older adults as observed in Mather and Knight's work (2005; Study 2), we expected younger adults to exhibit the usual MS-induced increase in punitiveness regardless of their level of executive functioning.

Method

Participants

Older participants were recruited who participated in a previous session of cognitive testing. The 79 (53 female) older participants ranged in age from 56 to 89 years old ($M = 70.94$, $SD = 7.68$). To provide a younger comparison group, undergraduate students were recruited to complete both sessions at the same time. The 70 (51 female) younger participants ranged in age from 18 to 30 ($M = 21.21$, $SD = 2.69$). Because there were no sex differences in preliminary analyses, this variable was excluded from reported analyses.

Procedure

Older participants completed two separate sessions: the first consisting of a series of cognitive assessments and the second consisting of a questionnaire packet that assessed responses to MS. They were paid \$10 per hour of participation. Younger participants completed both sections of the study during the same testing session. Younger adults received partial credit for psychology courses in exchange for their participation. For both age groups, the study was presented as an assessment of personality, cognition, and aging.

Cognitive Tasks—As part of a study of cognition across the lifespan, older participants completed a variety of cognitive tests during 1 to 2 hour sessions. Following previous research assessing complex cognitive processes (e.g. Ganguli, Snitz, Vander Bilt, & Chang, 2009; Insel, Morrow, Brewer, & Figueredo, 2006; Mather & Knight, 2005), we chose a set of measures assessing multiple aspects of executive functioning, a multi-faceted aspect of cognition. Specifically, we created a composite index of executive functioning based on the following three tests: Controlled Oral Word Association task (COWA; Spreen & Strauss, 1998), Stroop test (Jensen & Rohwer, 1966), and Self-Ordered Pointing Task (SOPT; Petrides & Milner, 1982). Younger participants completed the same cognitive tasks.

The COWA assesses verbal fluency and strategic retrieval of words based on phonemic cues. Higher scores on this task indicate greater number of words generated, with greater capacity for retrieving words in this task, indicating greater executive functioning. The Stroop test assesses inhibitory capacity and attentional control (MacLeod, 1991). For this task, a proportional interference score was used; this score was calculated by first subtracting time on the color naming trial from time on the interference trial (in which participants name the ink color, which is inconsistent with the printed word), then dividing by time on color naming trial. This proportion score was used in order to control for the age-related differences in response time occurring in all trials. On this task, lower scores indicate better inhibition of interfering information, and the ability to minimize such interference is considered an aspect of effective executive functioning. The SOPT, an assessment of the highly correlated constructs of working memory and executive functioning (McCabe et al., 2010), involves the preservation of information while simultaneously attending to other information processing goals (Baddeley, 1997). On the SOPT task, we looked at total

percent correct, with higher scores indicating greater working memory; the ability to strategically keep and utilize multiple pieces of information in working memory is considered a key aspect of executive functioning. As McCabe et al. (2010) have suggested, using a combination of visually- and verbally-oriented tasks presumably assists in offsetting variance attributable to long-standing strengths or preferences for one modality over the other. For additional details of the tests and administration procedures, see Salthouse and Davis (2006).

To assess the possible moderating role of auditory-verbal memory functioning, we also examined performance on a task of verbal learning and memory for a list of 15 unrelated words (Rey Auditory-Verbal Learning Test; RAVLT; Rey, 1964). Total immediate recall over five consecutive trials and recall following a 20-min delay were both examined.

Questionnaire Packet—Within 6 months of cognitive testing, older participants were contacted for the second session, described as an assessment of personality, cognition, and aging that would use data from the prior cognitive testing. Participants were tested in small groups and completed questionnaires in individual cubicles. After signing consent forms, they completed a 28-item measure of authoritarianism (Sanford, Adorno, Frenkel-Brunswick, & Levinson, 1950) and a 42-item version of Ryff's personal well-being scale (1989). These questionnaires were included to assess whether these personality characteristics moderate responses to MS. Mean scores for each scale were calculated. For authoritarianism ($\alpha = .82$), scores could range from 1 to 4, with higher scores indicating greater authoritarianism. For personal well-being ($\alpha = .92$), scores could range from 1 to 6, with higher scores indicating greater well-being.

Participants were randomly assigned to one of three primes. Participants in the MS blatant condition responded to two open-ended questions regarding their own death ("Please briefly describe the emotions that the thought of your own death arouses in you." and "Jot down, as specifically as you can, what you think will happen to you as you physically die and once you are physically dead."; Greenberg et al., 1990). Those in the control condition responded to parallel questions about the experience of dental pain, an aversive experience unrelated to mortality. In the MS subtle condition, participants completed a word puzzle, in which they search for a list of neutral words (e.g. baseball) in a matrix of letters that included five death-related words (e.g. death, burial). This word puzzle subtly exposes participants to death-related words without explicitly instructing them to ponder mortality and has been shown to influence worldview related attitudes of both younger and older adults (Maxfield et al., 2007).

Participants then completed a neutral word search puzzle (estimated to take 4-5 min) and the 20-item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Participants indicated the extent to which they were experiencing various forms of positive and negative affect at the present moment on a scale of 1 (very slightly or not at all) to 5 (extremely). Mean scores were calculated for the separate positive and negative affect scales, with higher scores indicating greater experience of positive and negative affect; measures of both positive ($\alpha = .89$) and negative ($\alpha = .86$) were of acceptable reliability. In addition to assessing affect, the PANAS provided a delay following experimental primes, which is required to produce MS effects on worldview-related attitudes; these effects occur when thoughts of death are highly accessible but not the object of focal, conscious attention (Pyszczynski, Greenberg, & Solomon, 1999).

Next, participants completed the Moral Transgressions Scale (Florian & Mikulincer, 1997), consisting of 10 vignettes describing various moral violations. Participants indicated on 15-point scales the severity of the transgression and extent to which the transgressor should be

punished. Mean scores were calculated; higher scores indicate harsher judgments of transgressions ($\alpha = .92$).

Finally, participants provided basic demographic information including years of education, ethnicity, and income. Participants were also asked to rate their current health on a scale of 1 (very poor) to 7 (excellent).

For older adults, the second portion of the study (which included everything except the cognitive tasks) took between 40 and 50 min. For younger adults, the entire testing session took between 55 and 60 minutes, as younger participants tended to complete the questionnaire packet more quickly than their older counterparts. Upon completing the questionnaires, participants were debriefed and provided the opportunity to ask questions about the study.

Results

Sample Characteristics

Participants were generally well-educated and healthy; older adults reported more years of education, $F(1, 114) = 5.88, p < .05$. The two age groups did not differ in their reported overall health, $F(1, 145) = .93, p = .34$. See Table 1 for means. Younger participants were more ethnically diverse than older participants, $\chi^2(1, N = 148) = 14.84, p = .01$. Among the younger participants, 70.0% identified themselves as Caucasian, 2.9% African American, 7.1% Asian/Asian-American, 10% Hispanic, and 10% identified as "Other." Among older participants, 89.9% identified themselves as Caucasian, 3.8% as Hispanic, 1.3% as Native American, 3.8% as "Other;" one individual did not report ethnicity. Compared to younger adults, older adults reported greater overall personal well-being, $F(1, 147) = 7.37, p < .01$; the groups did not differ in authoritarianism, $F(1, 147) = .60, p = .44$. See Table 1 for means.

Cognitive Functioning

One way analyses of variance (ANOVA) revealed significant differences in performance between older and younger adults on most cognitive tasks. Compared to older adults, younger adults showed greater inhibitory capacity on the Stroop task, $F(1, 139) = 20.13, p < .01$. Younger adults had a higher percentage of correct responses than older adults on the SOPT, $F(1, 136) = 19.11, p < .01$. Although younger adults tended to generate more words on the verbal fluency task, as assessed by the COWA, the age difference was not significant, $F(1, 142) = 2.17, p = .14$. Younger adults recalled more words than older adults on both the immediate recall, $F(1, 143) = 12.91, p < .01$, and delayed recall tasks, $F(1, 142) = 6.00, p < .05$. See Table 2 for mean scores on cognitive tasks for each age group.¹

Moral Transgressions

Following Mather and Knight's analyses (2005; Study 2), a composite score of performance on executive functioning tests was created. As suggested by Mather and Knight, individuals with solid performance on all measures included in a composite of a complex cognitive capacity (in this case, executive functioning) will be the most likely to possess strong functioning overall. Scores on the Stroop task were multiplied by -1, so that high scores indicate greater performance. Finally, all scores were converted to Z scores and averaged, such that high scores signified higher executive functioning. Correlations among these three indicators of executive functioning, as well as other individual difference measures, are

¹Degrees of freedom varied slightly because some older adults did not complete all tasks. Completion of two or more of the three executive functioning tasks was required for inclusion (this requirement resulted in the exclusion of five older participants); including only those who completed all three tests did not significantly change the reported results.

displayed in Tables 3 and 4. As in Mather and Knight (2005), the three measures of components of executive functioning did not correlate significantly with each other, most likely because they tap different aspects of effective executive functioning. However, scores on each component correlated highly with the composite index.

Using multiple regression, preliminary analyses showed that the MS subtle and blatant conditions did not differ; they were therefore collapsed into one death condition (MS). MS and age group were dummy-coded, allowing for comparisons between the MS conditions and the control condition, as well as the younger and older adult groups (Aiken & West, 1991). The continuous independent variable (executive functioning) was centered around the mean. Based on the significant differences in older and younger adults' executive functioning, age specific means were used to center continuous variables for the two age groups. For the primary analysis, dummy-coded and continuous predictor variables were included in step one, two-way interactions were included in step two, and the three-way interaction was included in step three.

There was a significant main effect for age, with older adults indicating greater punitiveness than younger adults, $\beta = .43$, $SE = .25$, $t(145) = 5.75$, $p < .01$ (partial $r^2 = .18$). No other main effects were significant, $ps > .10$. The only two-way interaction reaching statistical significance was the MS $\times$ executive functioning interaction, $\beta = -.29$, $SE = .36$, $t(142) = -2.07$, $p < .05$ (partial $r^2 = .03$). This two-way interaction was qualified by the significant three-way MS $\times$ age $\times$ executive functioning interaction, $\beta = -.59$, $SE = .72$, $t(141) = -2.49$, $p = .01$ (partial $r^2 = .04$). Following the method of Aiken and West (1991), this three-way interaction was plotted at one SD above (high functioning) and below (low functioning) the centered executive functioning mean, allowing for display in Figure 1 of the effect of MS on older and younger adults with high and low levels of executive functioning. To explore this higher order interaction, the two-way MS $\times$ executive functioning interactions among younger and older adults were examined separately.

Among younger adults, there was a main effect for MS, $\beta = .25$, $SE = .36$, $t(67) = 2.05$, $p < .05$ (partial $r^2 = .06$), indicating that younger adults reminded of mortality were more punitive toward moral transgressors when compared with younger adults in the control condition. Among younger adults, there was no main effect for level of executive functioning and the MS $\times$ functioning interaction did not approach significance, $ps > .60$.

Among older adults, there was no main effect for MS, $p = .84$, but executive functioning significantly predicted punitiveness, $\beta = -.23$, $SE = .24$, $t(76) = -2.04$, $p = .05$ (partial $r^2 = .05$). This main effect among older adults was qualified by a significant MS $\times$ executive functioning interaction, $\beta = -.56$, $SE = .48$, $t(75) = -3.14$, $p < .01$ (partial $r^2 = .12$). To explore this interaction, simple slope analyses were performed; again following the method of Aiken and West (1991), the interaction was plotted at one SD above (high functioning) and below (low functioning) the centered executive functioning mean, allowing for assessment of the effect of MS on older adults with high and low levels of executive functioning. These analyses revealed that among older participants with high executive functioning, death reminders produced lower punitiveness than the control condition, $\beta = -.33$, $SE = .54$, $t(75) = -2.15$, $p < .05$ (partial $r^2 = .06$). Conversely, among older adults with low executive functioning, death reminders produced higher punitiveness than the control condition, $\beta = .36$, $SE = .52$, $t(75) = 2.39$, $p < .05$ (partial $r^2 = .07$).

Examining the slopes, as older adults' level of executive functioning increased, punitiveness decreased within death conditions, $\beta = -.45$, $SE = .28$, $t(52) = -3.66$, $p < .01$ (partial $r^2 = .21$). Although there was an opposite tendency for punitiveness to increase with executive

functioning in the control condition, this effect was not significant, $\beta = .24$, $SE = .41$, $t(23) = 1.20$, $p = .24$.

Looked at differently, within the control group, there was a main effect of age, with older adults displaying greater punitiveness, $\beta = .55$, $SE = .44$, $t(46) = 4.43$, $p < .01$ (partial $r^2 = .30$), but no other effects reached significance, $ps > .33$. In the mortality conditions, a similar main effect of age remained, $\beta = .39$, $SE = .30$, $t(97) = 4.26$, $p < .01$ (partial $r^2 = .16$), and a main effect for functioning was observed, with increasing functioning predicting lesser punitiveness, $\beta = -.24$, $SE = .23$, $t(97) = -2.62$, $p = .01$ (partial $r^2 = .07$). Further, the age $\times$ functioning interaction was significant, $\beta = -.40$, $SE = .46$, $t(96) = -2.70$, $p = .01$ (partial $r^2 = .07$). Simple slope analyses revealed that among low functioning individuals, older adults were more punitive than younger adults in both the mortality, $\beta = .68$, $SE = .43$, $t(96) = 5.12$, $p < .01$ (partial $r^2 = .21$), and control conditions, $\beta = .43$, $SE = .61$, $t(45) = 2.48$, $p < .05$ (partial $r^2 = .12$). Further, among high functioning individuals, older adults were more punitive than younger adults in the control condition, $\beta = .67$, $SE = .60$, $t(45) = 3.97$, $p < .01$ (partial $r^2 = .26$); however, age differences in punitiveness did not exist among high functioning individuals in the mortality conditions, $p = .49$.²

Parallel analyses found no moderating role for immediate ($ps > .16$) or delayed memory ($ps > .29$), as measured by the RAVLT.

Inclusion of the other individual differences assessed, including personal well-being, authoritarianism, and subjective health rating, as covariates did not significantly affect reported analyses.

Affect

Multiple regression analyses revealed that older adults reported lower negative affect than younger adults, $\beta = -.43$, $SE = .08$, $t(145) = -5.45$, $p < .01$ (partial $r^2 = .19$). Older adults also endorsed greater positive affect compared to younger participants, $\beta = .38$, $SE = .12$, $t(145) = 4.99$, $p < .01$ (partial $r^2 = .15$).³ Inclusion of positive and negative affect as covariates in the primary analyses did not significantly impact reported results.

Discussion

The present study offers the first examination of the role of executive functioning in people's responses to reminders of death. As in previous research (e.g. Florian & Mikulincer, 1997; Maxfield et al., 2007), younger adults displayed greater punitiveness following reminders of mortality compared to those in the control condition; level of executive functioning did not moderate MS effects for younger individuals.⁴ However, older individuals' responses to mortality reminders depended on their level of executive functioning. Whereas older adults with higher executive functioning responded to reminders of death with increased leniency

²In separate regressions, testing for the possibility that executive functioning could be moderating the effects of MS in the older adults in a nonlinear (quadratic) way, we found no hint of such moderation, $ps > .14$.

³Parallel MS $\times$ age $\times$ executive functioning analyses were completed for measures of negative and positive affect. Aside from the reported main effect of age on negative affect, there were no other significant main effects or interactions, $ps > .25$. For positive affect, there was a significant main effect for executive functioning, revealing a positive relationship with positive affect, $\beta = .18$, $SE = .09$, $t(145) = 2.33$, $p < .05$ (partial $r^2 = .04$). Further, the age $\times$ executive functioning interaction was significant, $\beta = -.26$, $SE = .18$, $t(142) = -2.16$, $p < .05$ (partial $r^2 = .03$). Simple slope analyses revealed that among younger adults, greater executive functioning was associated with greater positive affect, $\beta = .32$, $SE = .15$, $t(68) = 2.77$, $p = .01$ (partial $r^2 = .10$); among older adults, functioning and positive affect were not significantly related, $p = .57$. No other significant effects emerged, $ps > .68$. This age $\times$ executive functioning interaction lies outside the focus of the present paper but appears to support existing evidence that positive affective states are related to stronger performance on verbal fluency, a measure of executive functioning also included in the present paper (Carvalho & Ready, 2010). This may warrant additional research to provide clarification regarding the role of age in the relationship between executive functioning and affect.

toward moral transgressors, older adults with lower executive functioning responded to reminders of death with increased punitiveness. The finding for low functioning older adults was similar to what was found with younger adults (regardless of level of cognitive functioning).

These results shed light on Maxfield et al.'s (2007) previous finding of increased leniency in response to MS among older adults, a pattern which clearly differs from that observed in studies of younger adults (e.g. Florian & Mikulincer, 1997). The present study showed that although older adults with lower levels of executive functioning responded to death reminders in the same way that younger adults typically do, older adults with higher levels of executive functioning showed the shift toward leniency observed by Maxfield et al., (2007) in a study in which older participants were generally high functioning, independent adults, who likely possessed high cognitive functioning as well. Indeed, in those studies, older adults who failed a cognitive screen were excluded from analyses; whereas in the present study, efforts were made to include participants with a wider range of functioning, and no exclusions were made based on participant scores on cognitive tasks. These results are consistent with the idea that this shift toward leniency in responses to MS reflects a developmental adaptation that requires cognitive resources, specifically a high level of executive functioning.

The fact that better executive functioning in older adults was associated with more lenient responses to a reminder of death argues against interpretations of this effect based on the idea that older persons' become more lenient because of cognitive deficits. Rather, it appears that older persons with lesser cognitive functioning respond to MS more like younger persons, with the greater punitiveness that has been displayed in numerous previous studies (Greenberg et al., 2008). This, of course, is consistent with the idea that the shift toward lenient responses to MS requires cognitive resources.

These results are largely consistent with previous research documenting the importance of cognitive resources in the positivity effect among older adults. Whereas previous studies have shown that older adults' superior cognitive control predicted greater recall of positively valenced stimuli (Mather & Knight, 2005) and older adults' freedom from distraction predicted greater attention to positive stimuli (Knight et al., 2007; Mather & Knight, 2005), the present findings show that superior executive functioning among older adults predicted a shift from the more defensive, punitive pattern of responses to death reminders typically found among younger persons. The tendency for older adults to be more harsh in their evaluations of moral transgressions than younger adults overall, with this age effect being eliminated in the mortality conditions, indicates that the orientation toward positivity in these judgments was not general; rather, it was specifically activated in response to the death-related induction. Taken together, these studies support the existence of a relatively broad change in emotion regulation that occurs in later life among those with the cognitive resources needed to make such adjustments. More generally, the present findings are consistent with the family of theories that predict adaptations to the challenges of later life that help preserve the emotional well-being and functioning of the older adult (e.g., Baltes & Baltes, 1990; Carstensen et al., 1999; Labouvie-Vief, 2009; McCoy, Pyszczynski, Solomon, & Greenberg, 2000).

⁴It may be worth considering whether the lack of moderation by executive functioning in young adults could reflect their overall higher functioning and a restricted range in their performance on the components of the executive functioning measure. Table 2 shows that younger adults were somewhat higher in executive functioning scores and the variance in scores was somewhat lower than that for older adults. However, results from the Brown-Forsythe test for homogeneity of variance revealed that the difference in variance between younger and older adults did not approach significance for measures of executive functioning, all $ps > .63$. In addition, there was no hint of the interaction in younger adults, and, as Figure 1 shows, the results for the high functioning younger adults were quite different than the results for the high functioning older adults.

The present findings suggest that older adults' positively-oriented shift in response to reminders of mortality is predicted by executive functioning but not memory, self-reported health, psychological well-being, or authoritarian personality tendencies. Given Mather and Knight's (2005) finding that a conceptually similar variable, cognitive control, predicts positivity effects in older persons (and had no impact on younger adults' performance), evidence is mounting that these changes depend on complex cognitive processes related to self-regulation. This series of findings is consistent with the view that this shift is a way of regulating one's emotional responses to the challenges of later life (cf., Scheibe & Carstensen, 2010).

Interestingly, unlike the findings of Maxfield et al. (2007), older participants in the subtle and blatant death conditions did not differ in this study. Previous research shows that death reminders are most powerful when outside of focal attention (Pyszczynski et al., 1999); thus, the longer delay included in the present study (neutral word search puzzle and PANAS) compared to previous work (neutral word search puzzle alone) likely provided more time for death-related thoughts to leave conscious awareness following the more obvious MS manipulation.

In sum, the primary hypothesis regarding the moderating role of older adults' executive functioning was clearly supported. MS decreased punitiveness relative to the control condition for high executive functioning older adults, and in the MS condition, those with high executive functioning were more lenient than participants with low executive functioning. In addition, MS increased punitiveness relative to the control condition for participants lower in executive functioning, just as it does for younger adults. Results also indicate that executive functioning does not impact younger adults' reactions to increased awareness of mortality. The present findings add to a growing body of evidence suggesting an important role of executive functioning in adjusting to the challenges of later life. Future investigations should focus on the specific events that set these adaptations in motion and the ways that these capacities are used to facilitate emotional well-being and adaptive functioning.

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Figure 1. Effects of priming condition and level of executive functioning on overall harshness of judgments toward moral transgressors.

Table 1
Demographic Information and Individual Differences

	Younger	Older
	M (SD)	M (SD)
Gender (% Female)	51 (72.9%)	54 (67.1%)
Years of Education *	14.30 (1.50)	15.41 (3.01)
Perceived Health	5.94 (1.02)	5.77 (1.11)
Authoritarianism	2.38 (.24)	2.34 (.37)
Overall Personal Well-Being **	4.52 (.63)	4.78 (.55)
Positive Affect **	3.21 (.85)	3.83 (.65)
Negative Affect **	1.63 (.63)	1.17 (.29)

NOTE:

*
 $p < .05$,

**
 $p < .01$.

Table 2
Performance on Cognitive Tasks

	Younger	Older
	M (SD)	M (SD)
Controlled Oral Word Association Task	41.77 (9.29)	39.12 (11.97)
Stroop Task **	1.24 (1.08)	2.59 (2.26)
Self-Ordered Pointing Task **	84.44 (11.14)	74.79 (14.51)
RAVLT Immediate Recall (Trials 1-5) **	56.29 (7.66)	51.35 (8.77)
RAVLT Delayed Recall *	13.12 (1.83)	12.22 (2.47)

NOTE:

*
 $p < .05$,

**
 $p < .01$.

Table 3
Correlations Between Harshness of Judgments, Cognitive Functioning, and Individual Difference Measures Among Younger Adults

	1	2	2a	2b	2c	3	4	5	6	7	8	9	10
1. Harshness of Judgments	--												
2. Overall Executive Functioning	.00	--											
2a. COWA	.25*	.62**	--										
2b Stroop (reverse scored)	-.11	.56**	-.02	--									
2c. SOPT	-.12	.63**	.07	.05	--								
3. RAVLT Immediate Recall	-.09	.36**	.41**	-.06	.22	--							
4. RAVLT Delayed Recall	-.06	.26*	.42**	-.17	.13	.75**	--						
5. Health	.12	-.09	.02	-.20	.00	.16	.06	--					
6. Authoritarianism	.11	-.02	-.11	.22	-.16	-.19	-.16	-.08	--				
7. Personal Well-Being	-.01	.25*	.20	.26*	-.01	.12	.15	.29*	-.18	--			
8. Positive Affect	-.01	.32**	.22	.09	.26*	.19	.21	.19	-.09	.61**	--		
9. Negative Affect	-.08	-.15	.06	-.36**	.02	.05	.18	-.06	.24*	-.39**	-.12	--	
10. Years of Education	.24	-.06	.12	-.12	-.11	.14	-.02	-.03	-.12	-.17	-.10	-.13	--

NOTE:

* $p < .05$,

** $p < .01$; COWA = Controlled Oral Association Task; SOPT = Self-Ordered Pointing Task; RAVLT = Rey Auditory-Verbal Learning Task.

Table 4
Correlations Between Harshness of Judgments, Cognitive Functioning, and Individual Difference Measures Among Older Adults

	1	2	2a	2b	2c	3	4	5	6	7	8	9	10
1. Harshness of Judgments	--												
2. Overall Executive Functioning	-.23*	--											
2a. COWA	-.15	.64**	--										
2b. Stroop (reverse scored)	.04	.67	.18	--									
2c. SOPT	-.12	.67	.15	.13	--								
3. RAVLT Immediate Recall	-.06	.16	.20	.16	.11	--							
4. RAVLT Delayed Recall	-.01	.12	.12	.20	-.02	.77**	--						
5. Health	-.10	-.11	.00	-.09	-.02	.23*	.13	--					
6. Authoritarianism	.21	-.34**	-.51**	-.16	.01	-.34**	-.22	-.03	--				
7. Personal Well-Being	.02	.01	.17	.20	-.09	.24*	.18	.30**	-.21	--			
8. Positive Affect	.12	.07	.04	.03	.06	.06	.10	-.02	.09	.32**	--		
9. Negative Affect	-.31**	-.03	-.06	-.21	.01	-.32**	-.26*	-.05	.06	-.26*	.01	--	
10. Years of Education	-.10	.24	.26*	.08	.04	.07	.00	-.05	-.35**	.00	-.16	-.20	--

NOTE:

*
 $p < .05$,

**
 $p < .01$; COWA = Controlled Oral Association Task; SOPT = Self-Ordered Pointing Task; RAVLT = Rey Auditory-Verbal Learning Task.