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Aging and Attentional Bias for Death-related and General Threat-related Information: Less Avoidance in Older as Compared with Middle-Aged Adults

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Abstract

Objectives. The aging literature suggests that life satisfaction and affective well-being stabilizes or even increases during the aging process, and that death anxiety would decrease with aging. Experimental psychology literature shows that emotions play a critical role in information processing. The aim of the current study was to investigate whether death-related versus non-death-related threat words would lead to differential attentional processing in middle-aged versus older adults.

Method. Twenty-seven older adults between 74 and 90 year and 31 middle-aged adults between 40 and 50 years participated in the study. We used questionnaires to asses death anxiety and an exogenous cueing task to measure attention towards death-related versus general threat words.

Results. Our results showed no age-related differences in self-reported death anxiety, but less attentional avoidance of threat in older adults. We failed to demonstrate differences between general and death-related threat.

Discussion. This is the first study investigating attentional processing of both death- and threat-related information in older versus younger adults. Less avoidance from threat suggests that with aging, death becomes less of a concern, which might be indicative of acceptance of the own finiteness at old age.

Key words: Aging, death anxiety, attentional bias, threat

Aging and Attentional Bias for Death-related and General Threat-related Information: Less Avoidance in Older as Compared with Middle-Aged Adults

According to many studies, life satisfaction and affective well-being stabilizes or even increases during the aging process (e.g., Kessler & Staudinger, 2009), which is surprising given that aging entails the confrontation with ever more reminders that the end of life is drawing nearer, such as physical health problems and loss of significant others (Wrosch, Schulz, & Heckhausen, 2004).

One explanation for this paradox may be motivational differences in older as compared to younger populations with regard to emotion regulation. The current formulation of Socioemotional Selectivity Theory (Carstensen, Isaacowitz, & Charles, 1999) postulates that older adults have a more limited time perspective, with a heightened focus on emotion regulation because current emotional goals associated with well-being become more important than long term goals. This change might be related to a differential information processing style for emotional information, as shown by both an attentional bias towards positive material (Isaacowitz, Wadlinger, Goren, & Wilson, 2006) and less interference and inhibition regarding negative information (Goeleven, De Raedt & Dierckx, 2010).

Attention plays an important role in selecting input from the vast amount of sensory information available at any given time that deserves further processing in function of current task demands or other motivational purposes (Desimone & Duncan, 1995). A wealth of research examined the influence of individual differences variables (e.g., trait anxiety) on attentive processing of emotional information (Cisler & Koster, 2010). However, research on influences of aging on attention for emotional information is new. Given that attentional biases in processing emotional information are implicated in emotional disorders (De Raedt & Koster, 2010), this research endeavor is particularly relevant because aging is often marked by threatening life events and the knowledge that one is moving closer to death.

Although there is already substantial research on attentional biases for emotional information at old age, these studies yield mixed results (see Murphy & Isaacowitz, 2008). It can be concluded that the positivity effect is highly dependent on the nature of the information processing task and its specific experimental parameters. One important experimental parameter is the type of stimulus material. For instance, an absence of age-related differences in attentional bias for threatening information (Wurm et al., 2004, Mather & Knight, 2006) is not surprising because fast processing of this type of material might be important for young as well as older individuals. One specific type of information that *a-priori* may be associated with a different attentional response in older versus younger people are death-related stimuli, because these may be related to death anxiety.

Importantly, although mixed findings have been reported, it can be concluded based on recent studies using psychometrically sound multidimensional questionnaires that death anxiety might decrease with aging (Neimeyer et al., 2004). The reason behind this finding might be assimilative and accommodative immunizing self-processes, which are well established in old age (Brandtstädter, 1999), and could be related to acceptance of the finiteness of life. A study by Maxfield et al. (2007) showed differences in the way older versus younger people responded to a mortality salience manipulation, which led these authors to speculate that increased proximity to death and more frequent reminders of mortality might reduce the potential for anxiety among older adults and enable them to come to a better acceptance of their inevitable mortality. In this perspective, less interference from death-related stimuli would be expected in older adults. In one of the few studies investigating attentional processing of death-related material, De Raedt and Vander Speeten (2008) found interference of death-related words only for a young age group, whereas no interference effects were observed in older adults, using a Stroop paradigm with death-related words.

In the present study we further investigated age-related differences in the attentive

processing of death-related words in comparison to neutral words. To determine the specificity of attentive processing for death-related words we also included non-death-related threatening words. These words were presented as cues in an affective modification of the exogenous cueing paradigm. In this task (Posner, 1980) participants are asked to detect a target presented at the left or right side of a fixation cross. On half of the trials, a peripheral cue precedes the target at the same spatial location (valid trials). On the remaining trials, the target is presented at the opposite spatial location of the cue (invalid trials). Cues that are presented for a short duration facilitate responding to target stimuli on valid trials, whereas on invalid trials a reaction time cost is observed. The magnitude of this cue validity effect indicates how much attention is drawn to or held at the spatial location of the cue. Previous work has indicated that the affective modification of this task is a sensitive measure of attentional bias for emotional information (Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2004; Leyman, De Raedt, Schacht & Koster, 2007).

The following differential prediction could be made: In middle-aged participants we expect a smaller cue validity effect for death-related as compared to neutral words, indicative of avoidance of death stimuli. If there is acceptance of death in older adults, attention for death-related and neutral words would not be different (similar cue validity effects for neutral and death-related), or this difference would be smaller as compared to the middle-aged people. Given that attention for general threat information might be important for young as well as older individuals, we would not expect age differences for this information. Because religious belief might have an influence on death anxiety (Cicirelli, 2002; Fortner & Neimeyer, 1999), we also investigated the relationship between our attention measure and religiosity. Because attentional bias for death-related stimuli is indicative for the salience and threatening value of these stimuli, differences between the younger and the older age cohort concerning their belief in an afterlife might explain age-related differences in this bias.

Moreover, because general anxiety levels can have an influence on attentional bias, we measured whether state and trait anxiety were different between the age groups.

Method

Participants

The sample consisted of 27 independently living older adults (17 females, 10 males; M_{age} = 79.2 years; *SD* = 3.8; range = 74-90 years) and 31 middle-aged adults (18 females, 13 males; M_{age} = 46.6 years; *SD* = 2.09; range = 40-50 years), who volunteered to participate in the study. These participants fulfilled the inclusion criteria of no general cognitive impairments (for the older adults, > 24 on the Mini-Mental State Examination; mean MMSE score = 28.19; *SD* = 1.50; range = 25-30) and no elevated depression scores (< 6 on the Geriatric Depression Scale for the older adults or < 14 on the Beck Depression Inventory for the middle-aged adults). All participants were Caucasian and native Dutch speaking.

In the older adult sample, all participants were retired. Their occupations were varied: 40.7% had been laborers (*n*=11), 14.8% house workers (*n*=4), 14.8% farmers (*n*=4), 14.8% independent business managers (*n*=4), 11.1% clerks (*n*=3), and 3.7% teachers (*n*=1).

In the middle-aged adult sample, 29.0% is laborers (*n*=9), 22.6% house workers (*n*=7), 3.3% soldiers (*n*=1), 6.5% independent business manager s(*n*=2), 22.6% clerks (*n*=7), 9.7% teachers (*n*=3), 3.3% government officials (*n*=1), and 3.3% executive managers (*n*=1).

Materials

Mini-Mental State Examination. The MMSE (Dutch translation by the authors) is a brief structured method to assess general cognitive status in an older population with good psychometric properties (Folstein, Folstein, & McHugh, 1975).

Multidimensional Fear of Death Scale. The MFODS (Hoelter, 1979) is a 42-item instrument consisting of 8 subscales. The items are scored on 5-point Likert scales ranging from 1 (agree) to 5 (do not agree), with lower scores indicating a higher level of death

anxiety. The MFODS has good psychometric properties and can be considered as an internal consistent and valid instrument to assess death anxiety in both adult and older adult populations (e.g., DePaola et al., 2003). We used only the total MFODS score for our purposes (Cronbach's alpha of .93 for the older adults and .90 for the middle-aged adults in our sample with the Dutch translation developed by the authors).

Beck Depression Inventory. The BDI-II (Beck, Steer, & Brown, 1996) is a self-administered 21-item (four point scale) self-report instrument to measure the degree of depressive symptoms in adolescents and adults. The Dutch translation of the BDI-II used in the present study meets general psychometric requirements (van der Does, 2002).

Geriatric Depression Scale. To exclude older participants with a depressive profile, a Dutch translation of the Geriatric Depression Scale was used (GDS; Yesavage, 1988, Dutch translation by the authors). The GDS, consisting of 30 items (yes/no answers), was developed as a basic screening instrument for depressive symptoms in older adults.

State and Trait Anxiety. To measure anxiety, the state and trait version of the STAI were administered (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983; Dutch translation by Van der Ploeg, Defares, & Spielberger, 2000). The two versions of the questionnaire each consist of 20 statements to be rated on a 4-point scale. The reliability and validity of the STAI is well-documented. Cronbach's alpha in a Dutch-speaking sample of older adults is .92 for the Trait Anxiety subscale, and .95 for the State Anxiety subscale (Van der Ploeg, Defares, & Spielberger, 2000).

Post-Critical Belief scale. To investigate the level of religious belief, we used the PCB (Hutsebaut, 1996). This 33 item questionnaire (each scored on a seven point Likert scale) is based on the conceptualization of Wulff (1991), measuring four basic attitudes towards religious belief (see Table 1). Internal consistency (Cronbach's alpha) of the

subscales (Dezutter et al., 2009) is satisfactory (α = .88 for Literal Affirmation, .85 for Literal Disaffirmation , .80 for Symbolic Affirmation , and .75 for Symbolic Disaffirmation).

Stimulus words. As cue stimuli, 15 neutral (e.g., book), 15 threatening (non death-related, e.g., sneaky), and 15 death-related (e.g., graveyard) words were used, matched on word length. Moreover, based on prior validation, death-related and non-death-related words that had similar arousal and valence ratings were selected. Because this validation was performed on undergraduate students, we also asked our participants to rate all words.

Modified Exogenous Cueing Task. The task was programmed in INQUISIT Millisecond software, and presented on a 60 Hz, 15.4-inch color monitor.

All stimuli in the ECT were presented against a black colored background. Every trial started with a 1500 ms presentation of two white rectangles, presented on the left and right location of the screen (4 cm high by 10 cm wide). The middle of these rectangles was 7.5 cm from the middle of the screen. In the middle of the screen a white fixation cross was presented which remained on screen for the entire trial. Then, a word cue (death-related, threatening, neutral) appeared for 300 ms (followed by a 17 msec mask), within one of the two white rectangles. The target, a small black square (1.1 cm height by 1.1 cm width) was presented immediately after cue offset in the middle of one of the two white rectangles and remained on the screen until a response was made. Responses had to be made by pressing one of two keys (target left: “q”, target right: “5”) with the left and right index finger on an AZERTY keyboard. Upon responding the next trial started.

Instructions were presented on the computer screen and were explained verbally to the participants. Participants were instructed to respond as quickly as possible to the location of the target without sacrificing accuracy. They were informed that a cue preceded the presentation of the target and that the cue was not predictive for the target location. It was emphasized that after each response they should return attention to the fixation cross.

Participants practiced the attentional task during 12 trials. The test phase consisted of 180 trials. Each word category was presented 60 times with an equal number of valid (left cue/left target and right cue/right target) and invalid (left cue/right target and right cue/left target) trials. The words (death, threat, and neutral) were presented at random at the left or right hemifield with an equal number of presentations.

Word ratings. Individuals rated all words presented in the spatial cueing tasks on three dimensions: Death relatedness, threat relatedness, and arousal value. These ratings were made with a 10-point Likert scale for the relatedness items ranging from 0 (*not at all related*) to 9 (*strongly related*) to the death, threat, or neutral category. A 6-point scale was used for arousal value, ranging from 0 (*not arousing*) to 5 (*very arousing*).

Procedure

The experiment was approved by the local ethics committee. Participants were tested individually at their homes. Individuals were informed about the purpose of the study and the nature of the stimuli and then provided informed consent. In the older adults, the MMSE was administered before the onset of the experiment. Then, a demographic questionnaire was administered. The participants were also asked to rate their general health status on a scale from 1 to 10. Participants were told that, if a question or a word was not clear to them, they should ask clarification. All participants perfectly understood all questions and words used in the questionnaires.

To perform the spatial cueing task, participants were seated at a distance of 60 cm from the laptop screen. After the experiment, the questionnaires were administered (in a counterbalanced order) to avoid any mood priming effects on attention. Finally, the word ratings were administered. At the end of the experiment participants were fully debriefed.

Data Analysis

Word ratings were analyzed separately for death relatedness, threat relatedness, and

arousal value, using 3 (Word Category: death-related, threat-related, neutral) x 2 (Age Group: middle-aged, older) mixed ANOVAs, to validate whether the selection of death-related, threat-related, and neutral words was confirmed by our older and middle-aged participants.

Reaction Times (RT) were subjected to a 3 (Word Category: death-related, threat-related, neutral) x 2 (Cue Validity: valid, invalid) x 2 (Age Group: older, middle-aged) mixed ANOVA. All variables were within-subjects except for Age Group. If the higher-order interactions including cue validity were significant, cue validity indices were calculated (= $RT_{invalid\ cue} - RT_{valid\ cue}$), which provide a measure of overall attention for the different cue types. Positive scores indicate attention towards a cue, whereas negative scores indicate attentional avoidance from the cue. Significant ANOVA omnibus effects were followed-up by planned comparison *t*-tests, testing our specific hypotheses.

For the correlational analyses between the attention measures and PCB, MFODS, STAI, BDI, GDS, MMSE and word ratings, we also calculated delta scores (Cue $validity_{emotional}$ – Cue $validity_{neutral}$). A positive score indicates enhanced cue validity (increased attention) for emotional stimuli in comparison with neutral control stimuli. We performed these analyses for the group as a whole (except for BDI, GDS & MMSE because these measures were only administered to one group), as well as for the age groups separately.

Results

Group Characteristics

Importantly, there were no group differences in gender distribution ($\chi^2 < 1$), death anxiety, trait and state anxiety, and perceived general health status (*t*s < 1.6). With regard to the post-critical beliefs scale there were between-group differences in literal affirmation, $t(56) = 5.14$, $p < .001$, and symbolic affirmation, $t(56) = 2.49$, $p < .05$, with higher scores for the older adults, but not on literal disaffirmation, $t < 1$, and symbolic disaffirmation, $t < 1$ (for means, see Table1).

Word Ratings

A first ANOVA with death relatedness as the dependent variable showed a main effect of Word Category, $F(2,55) = 1411.49$, $p < .001$, $\eta_p^2 = .98$, confirming that the death-related words were rated as more death related ($M = 8.03$, $SD = 0.77$) than the threat-related ($M = 1.05$, $SD = 1.07$), $t(57) = 37.91$, $p < .001$, and neutral words ($M = 0.26$, $SD = 0.52$), $t(57) = 54.07$, $p < .001$. Moreover, threat-related words were also rated as more death related than neutral words, $t(57) = 6.31$, $p < .001$. There also was a main effect of Age Group, $F(1,56) = 10.11$, $p < .05$, $\eta_p^2 = .15$, with the older adults rating the words overall as more death related ($M = 3.31$) than the middle-aged participants ($M = 2.95$). However, the interaction between Word Category and Age was not significant ($F < 1$).

A second ANOVA was performed with threat relatedness as the dependent variable. A main effect of Word Category was found, $F(2,55) = 68.29$, $p < .001$, $\eta_p^2 = .71$, indicating that both the threat-related words ($M = 2.44$, $SD = 1.67$), $t(57) = 10.66$, $p < .001$, and the death-related words ($M = 2.80$, $SD = 2.43$), $t(57) = 8.58$, $p < .001$, were perceived as more threatening than the neutral words ($M = 0.18$, $SD = 0.38$). Death-related words were not rated as more threat related than threat related words, $t<1.3$. There also was a main effect of Age Group, $F(1,56) = 4.59$, $p < .05$, $\eta_p^2 = .08$, with the older adults rating the words as more threatening ($M = 2.17$) than the middle-aged adults ($M = 1.49$). Again, the interaction was not significant ($F < 1.6$).

A third ANOVA with arousal ratings as the dependent variable again revealed a main effect of Word Category, $F(2,55) = 16.29$, $p < .001$, $\eta_p^2 = .37$, indicating that both the words in the death-related ($M = 2.00$¸ $SD = 1.09$), $t(57) = 5.40$, $p < .001$, and threat-related category ($M = 1.74$, $SD = 0.78$), $t(57) = 5.15$, $p < .001$, were perceived as more arousing than the neutral words ($M = 1.21$, $SD = 0.39$). The death-related words were also perceived as slightly more arousing than the threat-related words, $t(57) = 2.44$, $p < .05$. There was no main effect of

Age Group, $F < 1$, but there was a significant interaction between Word Category and Age Group, $F(2,55) = 4.30$, $p < .05$, $\eta_p^2 = .14$. However, follow-up *t*-tests showed no significant group differences for any of the word categories (all *t*s < 1.6 all *p*s >.1).

In summary, compared with the middle-aged adults, older adults rated the words as more threatening and death related.

Reaction Time Data

Data preparation. Trials with errors were discarded from analyses ($M = 1.14\%$). The number of errors was slightly higher in the older adults ($M = 1.72\%$) compared with the middle-aged ones ($M = 0.63\%$,), $t(56) = 3.42$, $p < .01$. On inspection of reaction time distributions using bar and whisker plots, RTs < 200 ms and RTs > 1250 ms were considered outliers, reflecting anticipatory responding and delayed responding, respectively. As with the errors, the number of outliers differed between the older adults ($M = 3.26$) and middle-aged ($M = 0.55$), $t(56) = 3.48$, $p < .01$. Statistical analyses were run on 97.1% of the data.

Overall effects. The 3 (Word Category) x 2 (Cue Validity) x 2 (Age Group) ANOVA on reaction times revealed a significant main effect for Age Group, $F(1,56) = 22.78$, $p < .001$, $\eta_p^2 = .29$, with faster responding in the middle-aged ($M = 474$ ms) compared with the older adults ($M = 589$ ms). A significant main effect was also found for Cue Validity, $F(1,56) = 48.10$, $p < .001$, $\eta_p^2 = .46$, showing the typical cue validity effect with faster responding to valid ($M = 516$ ms) compared with invalid cues ($M = 547$ ms). Moreover, there was a main effect of Word Category, $F(2,55) = 39.67$, $p < .001$, $\eta_p^2 = .59$, due to slower responding to trials containing neutral words ($M = 545$ ms) compared with trials containing threat-related ($M = 523$ ms) and death-related words ($M = 525$ ms).

There were several significant two-way interactions: Word Category x Cue Validity, $F(2,55) = 27.28$, $p < .001$, $\eta_p^2 = .50$; Word Category x Age Group, $F(2,55) = 6.16$, $p < .01$, $\eta_p^2 = .18$; Cue Validity x Age Group, $F(1,56) = 6.58$, $p < .05$, $\eta_p^2 = .11$. These two-way

interactions can be subsumed under the crucial significant three-way interaction of Word Category x Cue Validity x Age Group, $F(2,55) = 7.07$, $p < .01$, $\eta_p^2 = .21$. Because this three-way interaction directly related to our hypotheses, cue validity index scores (see Table 2 for means) were calculated for further analysis. Positive scores indicate attention towards a cue, whereas negative scores indicate attentional avoidance of the cue.

Within-group effects[1]. In the middle-aged participants, there was a significant effect of Word Category, $F(2,29) = 36.61$, $p < .001$, $\eta_p^2 = .72$, with paired *t*-tests showing a larger cue validity for neutral words compared with both threat-related, $t(30) = 7.14$, $p < .001$, as well as death-related words, $t(30) = 8.60$, $p < .001$. Only the cue validity effect for neutral words was significantly larger than zero (0 = no cue validity effect), $t(30) = 7.30$, $p < .001$, all other *t*s < 1. There was no significant difference between the cue validity effect for death- and threat-related material ($F < 1$).

In the older group there was only a trend towards a significant effect of Word Category on cue validity scores, $F(2,25) = 2.75$, $p = .08$, $\eta_p^2 = .18$. One sample *t*-tests indicate that the cue validity effects for all word types were significantly larger than zero ($CV_{neutral}$: $t(26) = 5.68$, $p < .001$; CV_{death}: $t(26) = 5.08$, $p < .001$; CV_{threat}: $t(26) = 4.01$, $p < .001$). However, comparing the cue validity index for neutral and threatening information, paired *t*-tests showed a larger cue validity effect for neutral compared to death-related, $t(26) = 2.27$, $p < .05$, and threat-related words, $t(26) = 2.11$, $p < .05$.

Between-group effects[1]. Planned comparison *t*-tests comparing the cue validity effect for each word category between the middle-aged and the older adult groups indicated no significant differences between cue validity for trials containing neutral words ($t < 1$). However, the older group displayed a significantly larger cue validity effect for death-related, $t(56) = 3.82$, $p < .001$, as well as threat-related information, $t(56) = 3.29$, $p < .01$. This pattern of findings is depicted in Figure 1.

Correlations between attentional bias and questionnaire data. No correlations reached significance (all *p*s > .05), both for the total group and for the age groups separately. In addition, there were no significant correlations between the word ratings and the CVI indices (all *p*s > .05).

Discussion

The current study investigated whether death-related versus non-death-related threat information would lead to differential attentional processing in middle-aged versus older adults. The results show more attentional avoidance of death- and threat-related words in middle-aged participants as compared to older adults.

First, all participants rated the words used in the exogenous cueing task. The data show that, compared with the middle-aged adults, the older adults rated all words as more threatening and death related, but there was no association between these word ratings and our attention measures. Moreover, in spite of these differences in word ratings, the questionnaires measuring death anxiety and trait-state anxiety revealed no significant differences between the age groups. The absence of a difference in death anxiety between our middle-aged and older adults is in line with former research (e.g., De Raedt & Vander Speeten, 2008) and shows that, in spite of an increased confrontation with death in the environment and with increasing probability of being confronted with one's own death, self-reported death anxiety is not higher in older adults. Although many studies have found lower death anxiety in older adults, a large review reveals that studies on age-related changes in death anxiety yield mixed results, with many studies also reporting no changes (Neimeyer, Wittkowski & Moser, 2004).

Interestingly, concerning the attention measures, we observed a higher cue validity index for neutral words compared with both general threat-related and death-related words in the middle-aged adults, which is indicative of avoidance of threat. Indeed, there was, in contrast to the normal cue validity effect for neutral words, no such effect for threat words. In

the older group, the cue validity effect was also different between neutral words and both death-related and general threat-related words, but in contrast to the middle aged group we observed a normal cue validity effect for all word categories. Moreover, there was no difference between the middle-aged and older group concerning the cue validity effect of neutral words, whereas the older group showed a larger cue validity effect for both death-related and general threat-related information. The latter confirms less avoidance of threat in the older adults as compared to the middle-aged people. This finding corroborates a previous Stroop study on attention for death-related information where similar effects were observed (De Raedt & Vander Speeten, 2008).

The higher attentional avoidance effect for death- and threat-related material in middle-aged participants is an interesting finding. Considering attention processes in a goal pursuit framework, it might be that younger people are more avoidant of death-related information because a focus on the finiteness of their existence would interfere with their future-oriented goal pursuit. In general, healthy participants tend to show attentional avoidance of information that is negative and threatening if the threat level of such information is low to moderate (e.g., Koster, Crombez, Verschuere, Vanvolsem, & De Houwer, 2007), which, based on the ratings, was the case for the threat- and death-related words used in this study. Thus, the pattern of findings obtained in the middle-aged participants is in line with previous studies, which attests to the reliability of the present data.

The level of attentional avoidance of threat in the older adults is clearly different from that of the middle-aged group. First, given the absence of any correlation between attention for threat- and death-related information and death anxiety scores, and also the absence of group differences in death anxiety (and general anxiety), it is unlikely that enhanced attention to this information in older versus middle-aged adults is due to increases in anxiety levels. Instead, the lower level of fast attentional avoidance of threat might be due to a specific age-

related process. That is, attentional avoidance can be considered as an emotion regulation strategy that one can to apply in confrontation with information that contrasts ones goals (Cisler & Koster, 2010). As such, it can be a component of general avoidance of information related to mortality (cf. terror management theory, Greenberg et al., 1990), which seems to decrease in old age. This means that death- related information would be less threatening for older people as compared to a younger cohort, which can be considered a positivity effect, in line with Socioemotional Selectivity Theory. This theory proposes that constraints of time perspective shift motivational priorities in such a way that the regulation of emotional states becomes more important than other goals (Carstensen, 2006). When considering the absence of attentional avoidance of threat as a positivity effect, several aspects require some discussion. These results seem in contrast with former research, showing that, compared with young adults, older people showed more avoidance of threatening information, with an advantage in disengaging from angry faces (e.g., Hahn, Carlson, Singer, & Gronlund, 2006). However, we posit that the differential findings may be caused by the inclusion of death-related information in our study. As argued in the introduction, death- related information could specifically trigger an age-related differential pattern, indicative of less death concern in older adults. Being confronted more often with the finiteness of life, older people could have accepted the inevitable character of death and inserted it in their world view, leading to less avoidance of death-related information because there is no need to repress it (McCoy, Pyszczynski, Solomon, & Greenberg, 2000). Many questionnaire studies suggest that old age is not necessarily a period of anxious preoccupation with personal death (Neimeyer et al., 2004). In a recent study using another paradigm (Negative Affective Priming), less interference and a reduced inhibition for negative stimuli was also found in older adults (Goeleven, De Raedt, & Dierckx, 2010).

However, the fact that we found no differences between general threat information and death-related information warrants further discussion. One could argue that this compromises any account of the present findings in terms of death anxiety. However, this result may also be explained by carry-over effects from the death-related words to the threat-related words. Indeed, we observed, in our rating data, that the older adults rated both the threat and the death-related words as more death related, which could have driven the overall effect. Because we randomized both words in the same task, the death-related task context might have concealed differences between the two stimulus categories (the correlation between the cue validity index for death-related and general threat-related words, controlling for neutral words, was .75 for the whole group). Future research should investigate this possibility, using a between-subjects design, randomizing tasks with death-related versus non death-related words over older versus younger populations. Another possible limitation is that we did not assess vocabulary level of our participants, which might be different between the age groups. However, the participants were encouraged to ask clarification if necessary.

Notwithstanding these limitations, a particular strength of the study is that we used middle-aged people as a younger comparison group. In many other studies undergraduate samples are used, which limits generalizability. (e.g., Lee & Knight, 2004)

In our study we also examined influences of religious belief on attentive processing of death-related information. Although the relationship between religiosity and death attitudes is far from straightforward (Neimeyer et al., 2004), cohort differences in religiosity and a belief in an afterlife might explain the difference between the older and middle-aged adults. Although religious attitudes were different between the age groups, they did not correlate with the attention effects.

Another intriguing finding is the lack of correlation between the attention and the questionnaire data. Importantly, self-report measures are susceptible to social desirability,

conscious denial of death anxiety (Pyszczynski, Greenberg, & Solomon, 1999), or even a lack of awareness about one's own negative implicit death attitudes. This may explain why, in the context of a threatening and difficult topic such as death anxiety, there are only small correlations between self-reported and performance-based measures, which is a common finding both in death-related studies (e.g., Lundh & Radon, 1998) and in other domains (Karpinski & Hilton, 2001).

To summarize, our results indicate less avoidance of both death-related and general threat words among older adults as compared to those in middle age. Less avoidance of threat suggests that with aging, death becomes less of a concern. Importantly, to the best of our knowledge, this is the first study investigating attention for both threat- and death-related information in older versus middle-aged adults.

Footnote

[1]To take into account individual differences in baseline performance, we also performed the analyses with $(RT_{invalid\ cue} - RT_{valid\ cue}) / RT_{valid\ cue}$ as dependent variable. All the effects based on these analyses were similar or more significant.

References

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory* (2nd ed). San Antonio, TX: The Psychological Association.

Brandtstädter, J., Rothermund, K., & Schmitz, U. (1998). Maintaining self-integrity and self-efficacy through adulthood and later life: The adaptive functions of assimilative persistence and accommodative flexibility. In J. Heckhausen & C.S. Dweck (Eds.), *Motivation and self-regulation across life span* (pp. 365-388). New York: Cambridge University Press.

Brandtstädter, J. (1999). Sources of resilience in the aging self: Toward integrating perspectives. In T.M. Hess & F. Blanchard-Fields (Eds.), *Social cognition and aging* (pp. 123-141). San Diego: Academic Press.

Carstensen, L.L., Isaacowitz, D.M., & Charles, S.T. (1999). Taking time seriously - A theory of socioemotional selectivity. *American Psychologist, 54*, 165-181. DOI:10.1037//0003-066X.54.3.165

Carstensen, L. L. (2006). The influence of a sense of time on human development. [Editorial Material]. *Science, 312*, 1913-1915. DOI: 10.1126/science.1127488

Carstensen, L.L., & Mikels, J.A. (2005). At the intersection of emotion and cognition – Aging and the positivity effect. *Current Directions in Psychological Science, 14*, 117-121. DOI: 10.1111/j.0963-7214.2005.00348.x

Cicirelli, V.G. (2002). Fear of death in older adults: Predictions from terror management theory. *Journals of Gerontology, Psychological Sciences and Social Sciences, 57*, 358-366.

Cisler, J.M., & Koster, E.H.W. (2010). Mechanisms underlying attentional biases towards

Threat: An integrative review. *Clinical Psychology Review, 30,* 203-216. DOI: 10.1016/j.cpr.2009.11.003

DePaola, S. J., Griffin, M., Young, J. R., & Neimeyer, R. A. (2003). Death anxiety and attitudes toward the elderly among older adults: the role of gender and ethnicity. *Death Studies, 27,* 335- 354. DOI: 10.1080/07481180390199091

De Raedt, R., & Koster, E. H. W. (2010). Understanding vulnerability for depression from a cognitive neuroscience perspective: A reappraisal of attentional factors and a new conceptual framework. *Cognitive, Affective, and Behavioral Neuroscience, 10,* 50-70. DOI: 10.3758/CABN.10.1.50

De Raedt, R., & Van der Speeten, N. (2008). Discrepancies between direct and indirect measures of death anxiety disappear in old age. *Depression and Anxiety, 25,* E11-E17. DOI 10.1002/da.20336

Desimone, R., & Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual Review of Neuroscience, 18,* 193-222. DOI: 10.1146/annurev.ne.18.030195.001205

Dezutter, J., Soenens, B., Luyckx, K., Bruyneel, S., Vansteenkiste, M., Duriez, B., & Hutsebaut, D. (2009). The role of religion in death attitudes: Distinguishing between religious belief and style of processing religious contents. *Death Studies, 33,* 73-92. DOI: 10.1080/07481180802494289

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-Mental State: A practical method for grading the cognitive status of patients for the clinician. *Journal of Psychiatric Research, 12,* 189-198. DOI: 10.1016/0022-3956(75)90026-6

Fortner, B.V., & Neimeyer, R. A. (1999). Death anxiety in older adults: A quantitative review. *Death Studies, 23,* 3877411. DOI: 10.1080/074811899200920

Goeleven, E., De Raedt, R., & Dierckx, E. (2010). The positivity effect in older adults: The role of affective interference and inhibition. *Aging and Mental Health, 14,* 129-137. DOI: 10.1080/13607860903228754

Greenberg, J., Pyszczynski,T., Solomon, S., Rosenblatt, A.,Veeder,M., Kirkland, S., & Lyon, D. (1990). Evidence for terror management II: The effects of mortality salience on reactions to those who threaten or bolster the cultural world view. *Journal of Personality and Social Psychology, 58,* 3087318. DOI: 10.1037//0022-3514.58.2.308

Hahn, S., Carlson, C., Singer, S., & Gronlund, S. D. (2006). Aging and visual search: Automatic and controlled attentional bias to threat faces. *Acta Psychologica, 123,* 312–336. DOI: 10.1016/j.actpsy.2006.01.008

Hintze, J.,Templer, D. I., Cappelletty, G. G., & Frederick,W. (1993). Death depression and death anxiety in HIV-infected males. *Death Studies, 17,* 333-341. DOI: 10.1080/07481189308252629

Hoelter, J.W. (1979). Multidimensional treatment of fear of death. *Journal of Consulting and Clinical Psychology, 47,* 996–999.

Hutsebaut, D. (1996). Post-Critical Belief: A new approach of the religious attitude problem. *Journal of Empirical Theology, 9,* 48-66.

Isaacowitz, D.M., Wadlinger, H.A., Goren, D., Wilson, H.R. (2006). Is there an age-related positivity effect in visual attention? A comparison of two methodologies. *Emotion, 5,* 511-516. DOI: 10.1037/1528-3542.6.3.511

Karpinski, A. & Hilton, J.L. (2001). Attitudes and the implicit association test. *Journal of Personality and Social Psychology, 81,* 774 – 788. DOI: 10.1037//0022-3514.81.5.774

Kessler, E.M., & Staudinger, U.M. (2009). Affective experience in adulthood and old age: The role of affective arousal and perceived affect regulation. *Psychology and Aging, 24,* 349-362. DOI: 10.1037/a0015352

Koster, E.H.W., Crombez, G., Van Damme, S., Verschuere, B., & De Houwer, J. (2004). Does imminent threat capture and hold attention? *Emotion, 4,* 312-317. DOI: 10.1037/1528-3542.4.3.312

Koster, E.H.W., Crombez, G., Verschuere, B., Vanvolsem, P., & De Houwer, J. (2007). Attentional cueing by threatening scenes. *Experimental Psychology, 54,* 161-171. DOI: 10.1027/1618-3169.54.2.161

Lee, L.O., & Knight, B.G. (2004). Attentional bias for threat in older adults: Moderation of the positivity bias by trait anxiety and stimulus modality. *Psychology and Aging, 24,* 741-747. DOI: 10.1037/a0016409

Leyman, L., De Raedt, R., Schacht, R., & Koster, E.H.W. (2007). Attentional biases for angry faces in unipolar depression. *Psychological Medicine, 37,* 393-402. DOI: 10.1017/S003329170600910X

Lundh, L.G. & Radon, V. (1998). Death anxiety as a function of belief in an afterlife. A comparison between a questionnaire measure and a Stroop measure of death anxiety. *Personality and Individual Differences, 25,* 487 – 494. DOI: 10.1016/S0191-8869(98)00072-5

Mather, M., Knight, M. R. (2006). Angry faces get noticed quickly: Threat detection is not impaired among older adults. *Journals of Gerontology. Series B: Psychological sciences and Social Sciences.*

Maxfield, M, Pyszczynski, T., Kluck, B., Cox, C.R., Greenberg, J., Solomon, S., & Weise, D. (2007). Age-related differences in responses to thoughts of one's own death: Mortality

salience and judgements of moral transgressions. *Psychology and Aging, 22,* 341-353. DOI: 10.1037/0882-7974.22.2.341

McCoy, S.K., Pyszczynski, T., Solomon, S., & Greenberg, J. (2000). Transcending the self: A terror management perspective on successful aging. In: A. Tomer A. (Ed). *Death attitudes and the older adult: Theories, concepts and applications.* Philadelphia: Brunner-Routledge (pp. 37–63).

Murphy, N.A., & Isaacowitz, D.M. (2008). Preferences for Emotional Information in Older and Younger Adults: A Meta-Analysis of Memory and Attention Tasks, *Psychology and Aging, 23,* 263–286. DOI: 10.1037/0882-7974.23.2.263

Neimeyer, R.A., Wittkowski, J., & Moser, R.P. (2004). Psychological research on death attitudes: an overview and evaluation. *Death Studies, 28,* 309-340. DOI: 10.1080/07481180490432324

Posner, M. I. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology, 32,* 3-25. DOI: 10.1080/00335558008248231

Pyszczynski, T., Greenberg, J., & Solomon, S. (1999). A dual process model of defense against conscious and unconscious death-related thoughts: An extension of terror management theory. *Psychological Review, 106,* 835 – 845. DOI: 10.1037//0033-295X.106.4.835

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory.* Palo Alto, CA: Consulting Psychologists Press.

van der Does, A.J.W. (2002). *De Nederlandse versie van de Beck Depression Inventory - Tweede Editie*. [The Dutch version of the Beck Depression Inventory - Second Edition]. Lisse: Swets & Zeitlinger b.v.

Van der Ploeg, H.M., Defares, P.B., & Spielberger, C.D. (2000). *Handleiding bij de Zelf-Beoordelings Vragenlijst. Een Nederlandstalige bewerking van de Spielberger State-Trait Anxiety Inventory*. [Manual for the State-Trait Anxiety Inventory]. Lisse: Swets and Zeitlinger b.v.

Wilson, T.D., Lindsey, S. & Schooler, T.Y. (2000). A model of dual attitudes. *Psychological Review, 107,* 101 – 126. DOI: 10.1037//0033-295X.107.1.101

Wrosch, C., Schulz, R., & Heckhausen, J. (2004). Health stresses and depressive symptomatology in the elderly: A control-process approach. *Current Directions in Psychological Science 13*, 17-20. DOI: 10.1111/j.0963-7214.2004.01301005.x

Wulff, D. M. (1991). *Psychology of religion: Classic and contemporary views.* New York: Wiley.

Wurm, L. H., Labouvie-Vief, G., Aycock, J., Rebucal, K. A., & Koch, H. E. (2004). Performance in auditory and visual emotional Stroop tasks: A comparison of older and younger adults. *Psychology and Aging, 19*, 523-535. DOI: 10.1037/0882-7974.19.3.523

Yesavage, J.A. (1988). Geriatric Depression Scale. *Psychopharmacological Bulletin, 24,* 709-711.

Table 1

Group Characteristics

	Middle-aged		Older adults	
	M	*SD*	*M*	*SD*
MFODS	126.47	28.91	129.85	25.68
BDI-II	6.58	6.04	/	
GDS	/		1.44	1.45
PCD literal affirmation	20.16	9.55	33.56	10.27
PCD literal disaffirmation	35.52	10.64	36.22	10.11
PCD symbolic affirmation	35.11	9.18	40.77	7.95
PCD symbolic disaffirmation	37.30	7.89	38.26	5.90
Trait anxiety (STAI-T)	35.71	7.95	34.46	10.60
State anxiety (STAI-S)	32.19	9.74	28.48	9.55
Health status	8.45	1.50	7.89	1.67

Note. MFODS = Multidimensional Fear of Death Scale; BDI = Beck Depression Inventory; GDS = Geriatric Depression Scale; PCB = Post-Critical Belief; STAI = State Trait Anxiety Inventory

Table 2

Mean Reaction Times (in ms), Standard Deviations, and Cue Validity Index (CVI) as a Function of Word category, Cue Validity, and Age Group

		Adults			Older adults		
Word category	Cue Validity	*M*	*SD*	*CVI*	*M*	*SD*	*CVI*
Neutral	Valid	465	52	55	571	122	54
	Invalid	520	70		625	121	
Threat-related	Valid	464	50	2	564	122	36
	Invalid	466	58		599	132	
Death-related	Valid	464	56	1	568	123	37
	Invalid	465	58		605	120	

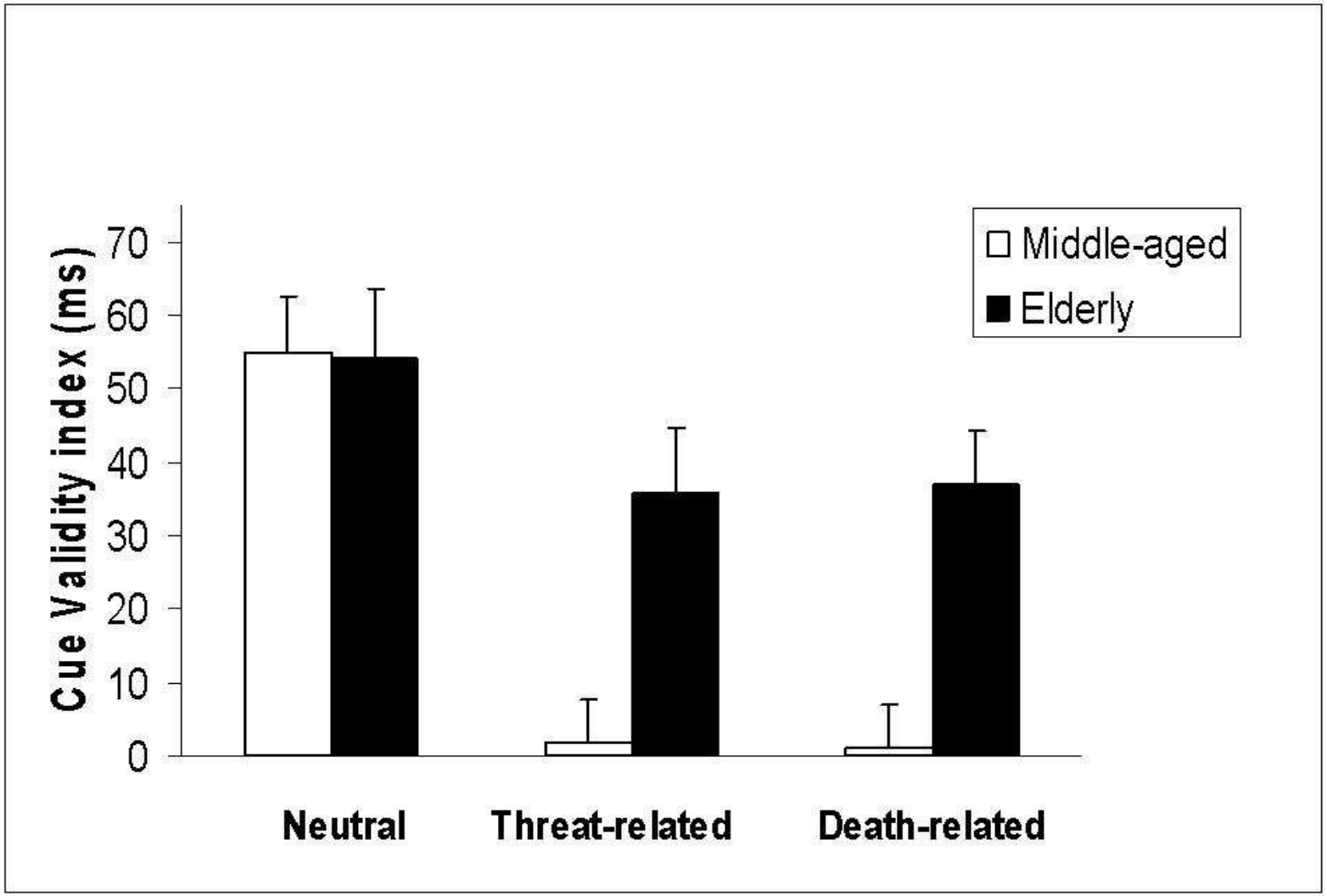

Figure 1. Mean cue validity indices and standard error (in ms) as a function of word category and age group.