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The positivity effect in older adults: The role of affective interference and inhibition

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Aging and Mental Health

Abstract

Objectives: Research shows that aging often involves a decrease in the experience of negative affect and might even be associated with a stabilization or an increase of experience concerning positive affect. Because it has been suggested that these changes could be related to the processing of emotional information, the aim of this study was to investigate interference and inhibition towards sad and happy faces in healthy elderly people compared to a younger population.

Method: We used an affective modification of the negative priming task. If interference is related to enhanced inhibition, reduced interference from negative stimuli and a related weakened inhibition towards negative stimuli in the elderly group would be in line with the positivity hypothesis.

Results: As expected, the results indicated that interference from negative stimuli was significantly lower in older adults as compared to younger adults, whereas this was not the case for positive stimuli. Moreover, at inhibitory level a significantly reduced processing of negative stimuli was observed only in the older adult group, whereas there was no such effect in the case of positive material.

Conclusion: These observations are indicative for a decreased negative bias in older adults at information processing level. This provides new insights with regard to age-related differences in emotion processing.

Key words: older adults, interference, inhibition, positivity effect, emotion, negative priming

The positivity effect in older adults: The role of affective interference and inhibition

Introduction

Although from an information processing perspective a large body of research has demonstrated age-related declines in processing speed, memory function, attentional processes, reasoning, and problem solving (see Cabeza, Nyberg, & Park, 2004), which can be associated with structural deterioration and brain activity alterations (e.g. Cabeza, McIntosh, Tulving, Nyberg, & Grady, 1997), research shows that emotion regulation skills improve with aging (Birditt & Fingerman, 2005). Moreover, aging often involves a decrease in the experience of negative affect and is associated with a stabilization or even a slight increase in the experience of positive affect (Mroczek & Kolarz, 1998). Some authors have suggested that these changes might be related to the processing of emotional material (Mather & Carstensen, 2005).

An interesting theoretical framework to explain why emotion regulation would be relatively spared whereas cognitive control declines with age is the socio-emotional selectivity theory (Carstensen, Isaacowitz, & Charles, 1999). According to this theory, aging is characterized by a lifetime perspective motivational change. As people get older and their time perspective is reduced, current emotional goals associated with well-being become more important. Given that we selectively attend to information that is consistent with our current goals, information processing in the elderly might be characterized by a positivity bias. Based on this framework, it could be hypothesized that aging is accompanied by compensatory shifts in attention allocation aimed at regulating the emotional state, which means either decreased preference for negative information or an increased preference for positive information.

Reviews have concluded that there is some empirical evidence for age-specific emotional information processing (Carstensen & Mikels, 2005; Mather & Carstensen, 2005). Older adults seem to be characterized by preferential processing of positive information, and attention might be the crucial process involved. For example, in a study of Mather and Carstensen (2003) an emotional dot probe task was used to investigate attentional processing towards affective material in an older population. In this task, one emotional (negative or positive) and one neutral face were displayed side by side on a computer screen for 1000 msec. When the faces disappeared, a dot was displayed at the location of one of the faces. Results showed that older adults responded faster to the dot than younger adults when it was presented at the prior location of the neutral face as compared to when it was presented on the side where the negative face had been. Furthermore, faster reactions were recorded when the dot appeared behind positive faces as compared to neutral faces. These are indicative of avoidance of negative interpersonal information and the preferential allocation of attention towards positive information.

A similar age by valence interaction has been found in several memory studies in which older adults showed more forgetting of negative and more remembering of positive information as compared to younger adults (e.g. Charles, Mather, & Carstensen, 2003). However, in other studies no age differences were found in the ability to detect threatening information (Mather & Knight, 2006; Wurm, Labouvie-Vief, Aycock, Rebucal, & Koch, 2004). For example, using an emotional Stroop task as a measure of selective attention for threatening emotional stimuli Wurm and colleagues (2004) did not find any age-related valence differences. In the emotional Stroop task, participants are asked to name the color of a word, while ignoring its emotional (threatening or positive) or neutral content. In the study by Wurm, all the participants responded slower to the threatening words, indicating that the affective meaning of these words interfered with color-naming relative to neutral words, regardless of age.

A recent meta-analysis involving 1085 older adults and 3150 younger adults investigating older and younger adults' preferences for processing emotional material showed that evidence for the positivity effect is highly dependent on the specific tasks that are used and that there are few age differences overall (Murphy & Isaacowitz, 2008). In the light of these mixed findings, we should be cautious with conclusions about the presence or absence of a positivity effect at attentional level. More research is needed to uncover possible specific attention mechanisms in the aging mind. Secondly, it is important to differentiate between different kinds of negatively valenced affective information. The absence of age-related differences in attentional bias for threatening information as found in the Wurm study (Wurm et al., 2004) does not rule out a possible positivity bias for depressogenic information such as sad faces. The positivity bias might not be present for threatening information, because the detection of threat is crucial for survival (see Mogg & Bradley, 1998). Furthermore, the instruments used to measure attentional processes in the above-mentioned studies do not allow for distinguishing between different information processing aspects. In the dot probe task and the (emotional) Stroop paradigm, attention is conceived as a unitary concept, whereas several attention models suggest that at least two different mechanisms may be involved, *active selection* of relevant information and *active inhibition* of irrelevant information (Hasher & Zacks, 1988). From this viewpoint, efficient selection of information is directly related to the inhibition of irrelevant information. Stimuli that elicit a reaction must be selected and irrelevant information must be inhibited. Therefore, it has been suggested that the more ‘interference’ a distracter causes, the more it has to be ‘inhibited’, which also means that distracters that cause less interference do not require strong inhibition (e.g. Milliken, Tipper, & Weaver, 1994; Neill, Valdes, & Terry, 1995; Tipper, 2001). Experimental studies have already demonstrated that inhibition is responsive to interference, suggesting a positive correlation between interference and inhibition, both for non-emotional information (Malley & Strayer, 1995) and for emotional information (Gotlib, Neubauer Yue, & Joormann, 2005). This idea offers interesting avenues for investigation of the positivity effect from an information processing perspective, i.e. from an affective interference/inhibition viewpoint.

The aim of the present study was to examine the role of age differences in the processing of emotional information. More specifically, we wanted to explore the interference of emotional information and the relationship with the inhibition of irrelevant emotional distracters when selecting relevant emotional information. Younger and older adults completed an information-processing task designed to examine interference and inhibition with respect to valenced distracters. For this purpose, we used an affective modification of the negative priming paradigm (NP, Tipper, 1985; Wentura, 1999; NAP, Joormann, 2004). This multi-stimulus task includes two separate trials: a prime trial and a probe trial. The participant is not aware of this separation into prime and probe trials. Both primes and probes involve a stimulus pair (e.g. pictures of emotional faces) consisting of a distracter and a target. The participant is instructed to evaluate the target (e.g. a picture in a black frame) as positive or negative, while ignoring (inhibiting) the distracter (e.g. a picture in a gray frame).

Because interference is measured using tasks in which participants are asked to respond to a target stimulus in the presence of a distracter stimulus, it is clear that in the above-mentioned NAP task the prime trial can be used to measure interference. In the control condition of the prime trial, the target and the distracter share the same valence (negative or positive), while in the experimental condition the valence between target and distracter is different. In the latter case, there is interference from incongruent emotional information. Interference scores can be calculated by subtracting the response time latencies from the control condition from the response time latencies in the experimental condition. In this way, interference scores can be calculated for both positive and negative stimuli.

To calculate an inhibition index, the correspondence between the valence of the distracter in the prime trial and the valence of the target in the probe trial is crucial. In the control condition, there is no similarity between the prime distracter and the probe target. However, in the experimental condition they have the same valence. Effective inhibition of the stimulus valence of the distracter in the prime trial slows down the response to the target in the probe trial when this target has the same valence as the distracter. In other words, the response to the probe target ‘negative face’ would be slower if the previous prime distracter had been a negative face (experimental condition) compared to the situation where the previous prime distracter had been a positive face (control condition). This response delay is referred to as the Negative Affective Priming (NAP) effect and can be considered as a valid index of inhibitory function towards affective material (Wentura, 1999; Goeleven, De Raedt, Baert, & Koster, 2006). Table 1 provides an overview of the different conditions used in a NAP task.

Based on the negative priming literature (May, Kane, & Hasher, 1995) and taking into account the methodological suggestions proposed in the discussion of earlier NAP studies (Joormann, 2004; Wentura, 1999), we developed a modified pictorial NAP paradigm with emotional faces as stimuli (instead of words; Joormann, 2004) and with a neutral probe distracter (see Wentura, 1999).

Based on the socio-emotional selectivity theory (Mather & Carstensen, 2003), it could be hypothesized that only emotional information that is congruent with current emotional goals is appraised as relevant and thus selected, in contrast to incongruent or irrelevant emotional information. According to this 'positivity' viewpoint, aging would be characterized by fostering positive over negative information for mood regulation purposes. If this age-related 'positivity bias' occurs at interference/inhibition level, it can be hypothesized that older adults should show less interference from negative stimuli in the prime trial, whereas no age difference would be expected with regard to the interference of positive stimuli. Based on the presumed positive correlation between interference and inhibition, this would result in a reduced NAP effect or inhibitory functioning on negative trials in the older age group. In the younger age group, we expect normal interference of negative information in the prime trial and, consequently, a normal inhibitory function towards negative information.

Method

Participants

The sample of older adults consisted of 27 participants (16 females, 11 males) between the ages of 67 to 82 (M = 74.3; SD = 4.0). To check that the older adults did not show any cognitive deficits or depressive symptoms, the Mini Mental State Examination (MMSE) and the Geriatric Depression Scale (GDS) were administered. All participants scored 24 or more on the MMSE, indicating good cognitive functioning. Furthermore, only participants scoring less than 11 on the GDS, indicating the absence of depressive symptoms, were included in the sample.

The younger group also consisted of 27 participants (17 females, 10 males) aged between 23 and 49 (M = 32.3; SD = 8.0). Some of the younger participants had already been included in another study (Goeleven et al., 2006). In this younger adult group, the Beck Depression Inventory (BDI-II) was applied for exclusion purposes. Only participants with a score of less than 14, indicating the absence of depression, were included in the study. All participants had a BDI-II score of less than 14.

The gender distribution did not significantly differ between the two groups, χ^2 (1, N = 54) =.08, p >.1. All the participants had normal or corrected-to-normal vision and had volunteered to take part in the experiment. The research was approved by the local ethics committee.

Materials

Mini Mental State Examination

The (Dutch) MMSE is a structured test used to assess general cognitive status in an older adult population with good psychometric properties (Folstein, Folstein, & McHugh, 1975; Crum, Anthony, Bassett, & Folstein, 1993). An MMSE score of less than 24 has been suggested as indicating cognitive impairment (Anthony, LeResche, Niaz, Von Korff, & Folstein, 1982; Tombaugh & McIntyre, 1992). The Dutch translation was developed by the authors.

Beck Depression Inventory

The BDI-II (Beck, Steer, & Brown, 1996) is a self-administered 21-item self-report scale in multiple choice format that is designed to measure the presence and degree of depression in adolescents and adults. Each of the items corresponds to a specific category of depressive symptoms and/or attitudes and is followed by four self-evaluative statements, ranging from neutral to maximum severity. A score of 13 or lower is the threshold separating depressed patients (≥ 14) from non-depressed patients (<14). The Dutch translation of the BDI-II that was used in the present study met the general psychometric requirements (van der Does, 2002).

Geriatric Depression Scale

The Geriatric Depression Scale (GDS; Yesavage, 1988), consisting of 30 items, was developed as a basic screening measure for depression in older adults. We used a Dutch version that was translated by the authors. The items should be answered by 'yes' or 'no'. A score of 11 or less is the threshold separating depressed patients (≥ 11) from non-depressed patients (<11) (Jongenelis et al., 2005).

Negative affective priming paradigm

The negative affective priming task was programmed using the INQUISIT Millisecond software package (Inquisit, 2005) and was run on a Dell Inspiron 2650 laptop with a 60-Hz, 15-inch color monitor. Inquisit measures RTs with millisecond accuracy (De Clercq, Crombez, Buysse, & Roeyers, 2003).

As stimulus material, 88 colored pictures of emotional faces with no hairline were selected from the Karolinska Emotional Directed Faces database (Lundqvist, Flykt, & Öhman, 1998). This selection was based on a valence and arousal rating obtained from prior validation (Goeleven, De Raedt, Leyman, & Verschuere, 2008). Negative and positive pictures with the highest hit rate and similar arousal levels (low = 1; high = 9) were selected for our study.

The selected pictures were positive (happy; n = 33; mean arousal = 3.97, SD = .34), negative (sad; n = 33; mean arousal = 3.68, SD = .33), or neutral (n = 22; mean arousal = 2.51, SD = .23). In order to exclude possible 'feature-based' negative priming effects, eight separate lists of 11 different randomly chosen pictures sharing the same valence were used: one negative and one positive prime target list, one negative and one positive prime distracter list, one negative and one positive probe target list, and two neutral probe distracter lists. Pictures for each prime and probe trial were drawn from these separate lists to exclude presentation of the same face on prime and probe trials. The pictures were 5 cm wide by 5.5 cm high and were indicated as target or distracter by a 3 mm black- or gray-colored frame on a light gray background. The distance between the distracter and the target pictures was 1 cm. The middle of each picture was 3.3 cm from the fixation cross, which was displayed in the center of the computer screen before each prime and probe trial.

Procedure

At the start of the experiment, all the participants were asked to put their glasses on if needed, after which they completed a written informed consent form. To avoid cognitive priming by the questionnaires, the NAP task was performed before the questionnaires were administered. The instructions for the negative priming task were displayed on the computer screen. Participants were told that two pictures would appear in the upper and lower half of the computer screen, one with a black frame and the other with a gray frame. They were asked to evaluate the valence of the target picture - indicated by one specific color of the frame (either black or gray) - as accurately as possible by pressing the corresponding key on the computer keyboard (q or m). Furthermore, they were instructed to ignore the distracter picture. The spatial position of the target and the distracter and the presentation of the control and experimental trials were randomly assigned from trial to trial, with an equal number of presentations in each condition. Every picture appeared an average of 11.6 times. The response cue (gray or black frame) and the key assignments were counterbalanced between subjects. One negative affective priming trial consisted of the following sequence: a fixation cross appeared in the middle of the screen 1000 msec before the display of the prime and probe trials. Then a blank screen was displayed for 1000 msec. Immediately after the blank screen, the stimuli were displayed and remained on the screen until the participants responded. Incorrect answers were followed by a 500 msec ‘error’ message. A complete NAP trial is shown in Figure 1.

After the instructions were shown on the computer screen, participants completed 32 practice trials. Following these practice trials, participants were asked if everything was clear, including the visual aspects of the trials. Participants then completed a total of 256 trials randomly arranged in 8 blocks of 32 trials (prime + probe). The four trial conditions were presented at random, with an equal number of presentations in each condition. For an overview of all conditions, see Table 1.

After performing the NAP task, all the participants filled in the BDI-II form. Furthermore, the older participants were screened for mental status with the MMSE and for depressive symptomatology with the GDS. Debriefing was subsequently provided.

Results

Group characteristics

The mean MMSE score was 28.4 (*SD* = 1.2), which indicates good cognitive functioning in the older adult group. For the older adults, the mean GDS score was 3.9 (*SD* = 2.6) and the mean BDI-II score was 6.0 (*SD* = 4.4), indicating the absence of depressive symptomatology. In the younger adult group, the average BDI-II score was 2.0 (*SD* = 2.0), also indicating the absence of depression.

Negative affective priming

Data reduction

Only trials with correct responding in both the prime and the probe trials were used in the analyses. Extreme response times were considered as outliers and eliminated from the analyses. The cut-off response scores were set at minimum 300 msec and maximum 4000 msec[1].

Interference effects

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[1] Footnote

[1] In order to obtain a similar point of comparison with the younger adult group (e.g. with regard to processing time), the same response cut-off response score of 4000 ms was used. However, in the younger adult group the same result pattern was found when using a cut-off score of 2000 ms.

In order to investigate interference effects, a 2 x 2 x 2 Analysis Of Variance (ANOVA) was conducted with the response latencies on the targets of the prime trials as dependent variables, and with Group (younger vs. older adults) as between-subjects variable and Priming Condition (control vs. experimental) and Picture Valence (negative vs. positive) as within-subject variables (see Table 2 for mean RTs and corresponding SDs in the prime trial). The results revealed a main effect for Priming Condition, $F(1,52) = 4.58$, $p < .05$, $\eta^2 = .081$, and an interaction between Priming Condition and Picture Valence $F(1,52) = 11.77$, $p < .001$, $\eta^2 = .185$. The main effect of Group also reached significance, $F(1,52) = 85.5$, $p < .001$, $\eta^2 = .622$, with overall slower response latencies in the older population. Moreover, the crucial Priming Condition x Picture Valence x Group interaction effect was significant, $F(1,52) = 4.92$, $p < .05$, $\eta^2 = .086$. No other effects reached significance, *F*s < 1.

Thereafter, interference effects were calculated by subtracting the response latencies for the prime-trial control condition from the response latencies for the prime-trial experimental condition (see Table 2 for mean RTs and corresponding SDs in the prime trial). Positive values reflect relatively greater interference. The interference index for positive and negative stimuli was calculated for each individual.

Independent t-tests were used to compare interference for both positive and negative stimuli separately between younger and older adults. These analyses indicated that no age-related difference was found concerning the interference score for positive stimuli, $t(52) = .711$, *ns*. However, in line with the age-related positivity effect, the interference score for negative stimuli was significantly lower in the older adult group than in the younger group, $t(52) = 2.57$, $p < .015$, $d = .71$. Moreover, the interference score for negative stimuli was significantly lower for negative as compared with positive stimuli, $t(52) = 3.23$, $p < .01$, $d = .86$, in the older population.

Inhibition effects

To determine the inhibition effects, response latencies on the targets of the probe trials were used as dependent variables in a 2 x 2 x 2 Analysis of Variance (ANOVA) with Group (younger vs. older adults) as between-subjects variable and Priming condition (control vs. experimental) and Picture Valence (negative vs. positive) as within-subject variables (see Table 2 for mean RTs and corresponding SDs in the probe trial). A main effect of Picture Valence was found, $F(1,52) = 13.53$, $p < .01$, $\eta^2 = .206$, indicating that the mean reaction time to negative trials (*M* = 1165 msec; *SD* = 339 msec) was slower than in the positive trials (*M* = 1113 msec; *SD* = 315 msec). The main effect of Group also reached significance, $F(1,52) = 79.08$, $p < .01$, $\eta^2 = .603$, with overall slower response latencies in the older population. Furthermore, the results revealed a nearly significant two-way interaction effect between Picture Valence and Priming condition, $F(1,52) = 3.72$, $p = .059$, $\eta^2 = .067$. In addition, the crucial three-way interaction effect, $F(1,52) = 5.0$, $p < .05$, $\eta^2 = .088$, was significant.

To explore in more depth this three-way interaction effect, a 2 x 2 repeated measure ANOVA with Priming condition and Picture Valence as within-subject variables was used for the two groups separately. Mean RTs and SDs are shown in Table 2 as a function of Group. For the young adult group, the results revealed a significant main effect for Priming condition, $F(1,26) = 4.33$, $p < .05$, $\eta^2 = .143$. Mean RT to experimental trials (*M* = 898 msec; *SD* = 144 msec) was slower as compared to control trials (*M* = 885 msec; *SD* = 140 msec), indicating a valence-independent NAP effect. Moreover, a main effect for Picture Valence was found, $F(1,26) = 6.50$, $p < .05$, $\eta^2 = .199$. Mean RT shows slower response latencies to negative trials (*M* = 908 msec; *SD* = 147 msec) as compared to positive trials (*M* = 875 msec; *SD* = 135 msec). In line with our expectations, the interaction between Priming condition and Picture Valence did not reach significance, $F < 1$.

For the older adult group, the results yielded a main effect of Picture Valence, $F(1,26) = 7.91$, $p < .01$, $\eta^2 = .233$. Mean RT shows slower response latencies to negative (*M* = 1422 msec;

SD = 277 msec) as compared to positive trials (*M* = 1352 msec; *SD* = 256 msec). Furthermore, the expected significant interaction effect between Priming condition and Picture Valence was obtained, $F(1,26) = 4.96$, $p < .05$, $\eta^2 = .160$. To explore this interaction effect in more depth, paired-sample *t*-tests were used that compared control and experimental conditions for negative and positive trials separately. Faster response times were observed in the experimental (*M* = 1399 msec; *SD* = 267 msec) as compared to the control condition (*M* = 1444 msec; *SD* = 289 msec) for negative trials, $t(26) = 2.17$, $p < .05$, $d = .16$, whereas no differences between experimental trials (*M* = 1366 msec; *SD* = 259 msec) and control trials (*M* = 1339 msec; *SD* = 259 msec) emerged for positive trials, $t < 1.3$.

To compare the NAP scores between groups, the NAP effects were calculated for negative and positive trials separately by subtracting the response latencies to the control trials from the response latencies to the experimental trials (see Figure 2). Positive values indicate strong inhibitory function.

A comparison of the NAP effects between the older adult group and the younger adult group using an independent *t*-test revealed that the NAP effect for negative trials was significantly lower in the group of older adults (-45 msec) as compared to the NAP effect in the younger adults (16 msec), $t(52) = 2.70$, $p < .015$, $d = .73$. However, no significant differences between groups were found for the positive trials, $t<1$.

Correlations between interference and inhibition

To examine the association between interference and inhibition, Pearson correlations were calculated between the interference scores and the NAP effects for positive and negative trials separately across all participants. The results indicate a significant correlation not only between interference scores for negative stimuli and NAP effect for negative trials, $r(54) = .36$, $p < .01$, but also between interference scores for positive stimuli and NAP effect for positive trials, $r(54) = .30$, $p < .03$. This result clearly indicates that, as expected, interference and inhibition are intercorrelated.

Discussion

The aim of this study was to investigate interference and inhibitory processes towards emotional information in healthy older adults compared to a younger population using an affective modification of the negative priming task (NAP). In line with our hypothesis, the results of the present study suggest that, as compared to younger adults, older adults show a reduced interference of negative stimuli, leading to reduced inhibitory processing. More specifically, a significant difference was found between the older and younger group for the interference of negative information: a significantly lower interference score for negative stimuli was observed in older as compared to younger adults. This difference was not present with regard to the interference of positive stimuli. Compared with younger adults, older adults also showed less inhibition of negative stimuli, whereas no differences between the age groups emerged for positive information. The older participants showed reduced inhibition for negative information, but not for positive information. In the younger participants, normal inhibition of all emotional information was found. Moreover, in line with other studies (e.g. Gotlib et al., 2005), the level of interference was related to the level of inhibition. A positive correlation was found between the interference of negative stimuli and negative NAP and between the interference of positive stimuli and positive NAP, across all participants. The latter result confirms that interference and inhibition are related in this study.

Based on the above results, we can conclude that, in line with our age-related ‘positivity’ hypothesis, older adults experience significantly less interference of negative information as compared to younger adults. Inhibition was responsive to interference (e.g. Tipper, 2001), which further confirms the positivity hypothesis at the level of inhibitory processing. The ‘lowered interference’ fits the hypothesis that increased age is associated with reduced allocation of processing resources to negative stimuli. In a study based on a visual search paradigm using happy, neutral, and angry faces, Hahn, Carlson, Singer, & Gronlund (2006) found that, in contrast to a younger population, older adults showed no difference as regards the neutral target-angry distracter condition and the neutral target-happy distracter condition, which means that older adults show less interference from these negative stimuli, which is completely in line with our results. Our findings are also in line with other studies that use different selective attention tasks based on different methodologies such as the dot probe task and eye tracking (e.g. Isaacowitz, Wadlinger, Goren, & Wilson, 2006). However, the positivity effect has been observed both in cases where older adults attend less to negative stimuli than younger people and in cases where older adults attend more to positive stimuli, which is a protective bias (see Mather & Carstensen, 2005). We found no significant differences between age groups for the positive trials, neither at interference nor at inhibition level. We observed age differences only at the level of decreased interference and inhibition for negative information. The differences between the two age groups could therefore also be related to a negativity bias in younger populations. In fact, there is evidence of a negativity bias in younger adults (for a review, see Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Our results are in line with the conclusions based on the meta-analysis of Murphy and Isaacowitz (2008) that, if anything, there is more evidence of an age-related decrease of negativity preference as compared to an increased positivity preference. This has important implications, because it suggests that aging is not characterized by an overoptimistic view of life, but rather by an increasing ability to be less influenced by negative information. This is a very important coping strategy, given that as people grow older they are increasingly confronted with negative experiences such as loss. An experimental study investigating older people in a real-life stressful situation also demonstrated that decreased physical resources are related to a realistic appraisal of performance and less depressive feelings (De Raedt & Ponjaert-Kristoffersen, 2006). All these results are in line with developmental theories of self-immunizing processes (e.g. Brandtstädter, 1999).

It is important to mention that only non-depressive older adults took part in this study. The question remains whether this decreased negativity effect disappears when people get depressed. Therefore, an important next step will be to study interference and inhibitory function towards affective material in a group of depressed older adults. In former NAP studies using the same task (e.g. Goeleven, De Raedt, Baert, & Koster, 2006), inhibition of negative information was considered as adaptive, whereas deficient inhibition of negative information was considered to be maladaptive and was related to depression. However, in this previous study we found no correlations between interference and inhibition. The interpretation of the NAP effect is thus crucially dependent on the presence or absence of a relationship between interference and inhibition. Indeed, it is logical to assume that a stimulus that provokes no interference cannot possibly cause inhibition, which is reflected in the weakened inhibitory capacity of the older adults as compared to our younger group. However, the question as to why we found a correlation between interference and inhibition only in a population that included older participants remains unanswered. Future studies should tackle this research question.

Furthermore, it would also be interesting to examine inhibitory capacity towards negative information other than depressogenic stimuli, such as anger and disgust. It might thus be possible to uncover possible affect-specific sensitivities in old age. Moreover, it might be interesting in future studies to correlate the experience of affect (negative and positive) with age-related processing of affective information. Future research might address this question using affect measures, for example the Profile of Mood Scale (POMS; McNair, Lorr, & Droppelman, 1971).

A number of limitations must be noted in connection with this study. Firstly, the selection of facial pictures that were used for the NAP has been validated only in young adults (Goeleven et al., 2008). Although the mean arousal level between positive and negative pictures is similar (see method), it is not possible to rule out the possibility of an age-related difference with regard to susceptibility to the arousal level of emotional stimuli. Moreover, no index of facial affect processing ability was included in our study. This implies that, based on the data of our study, it is not possible to rule out possible age-related influences of differential facial processing.

Secondly, we assumed that the slowdown on the to-be-ignored trials in the probe trials is the consequence of the inhibitory processes of the distracter in the prime trial (cf. Tipper, 2001). However, an alternative explanation for this effect is the episodic retrieval account (e.g. Neill, Valdes, Terryn, & Gorfein, 1992; Rothermund, Wentura, & De Houwer, 2005). From this theoretical perspective, the N(A)P effect is a result of a 'backward' mechanism or retrieval process during the probe trial whereby the subject attempts to recover relevant information (valence or perceptual features) about the target in the probe trial. Based on this memory hypothesis, the response delay on the target of the probe trial could be the result of incompatibility between the response elicited during the probe trial ("respond" for a negative trial) and the response that was elicited for a similar stimulus in the prime trial ("do not respond" for a negative trial). Based on the positivity hypothesis, the reduced NAP effect for negative information could also be interpreted as an effect of the memory hypothesis. The observed age-related reduction in NAP effect for negative information would in this case be the logical consequence of reduced memory processing of negative information. This alternative explanation is therefore also in line with a positivity bias at information processing level.

In conclusion, this study was the first to focus on the role of interference and the related inhibitory processing of affective information in older adults using the negative affective priming paradigm. We observed significantly lowered interference for negative stimuli and a related reduced inhibition for negative information. Because the processing of emotional information appears to develop in a specific way over time, the NAP task could lead to new insights with regard to age-related differences in the process of selective attention towards affective information.

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Footnote

[1] In order to obtain a similar point of comparison with the younger adult group (e.g. with regard to processing time), the same cut-off response score of 4000 ms was used. However, in the younger adult group similar results were found when using a cut-off score of 2000 ms.

Table 1.

Experimental and Control Conditions for Negative and Positive Trials in a Negative Affective Priming task

		Negative trials		Positive trials	
		Control condition	Experimental condition	Control condition	Experimental condition
Prime trial					
	Distracter	+	-	-	+
	Target	+	+	-	-
Probe trial					
	Distracter	**N**	**N**	**N**	**N**
	Target	-	-	+	+

Note: + positive picture, - negative picture, N neutral picture.

In the experimental condition, the valence of the prime trial distracter and of the probe target are the same. In the control condition, there is no such similarity between prime and probe.

Table 2.

Mean Reaction Times (M) and Corresponding Standard Deviations (SD) in msec for Negative and Positive trials in the Control and Experimental Conditions in Prime and Probe trials. The Age-related Interference Score and Inhibition Score (NAP effect) is indicated for both Positive and Negative trials.

	Control condition		Experimental condition		Interference score*		Inhibition score **	
	Negative trials M (SD)	Positive trials M (SD)	Negative trials M (SD)	Positive trials M (SD)	Negative M (SD)	Positive M (SD)	Negative M (SD)	Positive M (SD)
YOUNG ADULTS								
Prime trial	953 (156)	928 (167)	972 (156)	969 (147)	19 (68)	41 (70)		
Probe trial	900 (140)	870 (140)	916 (156)	880 (132)			16 (46)	10 (47)
OLDER ADULTS								
Prime trial	1507 (274)	1452 (263)	1468 (259)	1513 (277)	-39 (93)	61 (135)		
Probe trial	1444 (289)	1339 (259)	1399 (267)	1366 (259)			-45 (109)	27 (105)

*Positive values reflect relatively greater interference.
** Positive values indicate adequate inhibition.

Figure caption 1

Figure 1. Negative Affective Priming Design. One complete NAP trial.

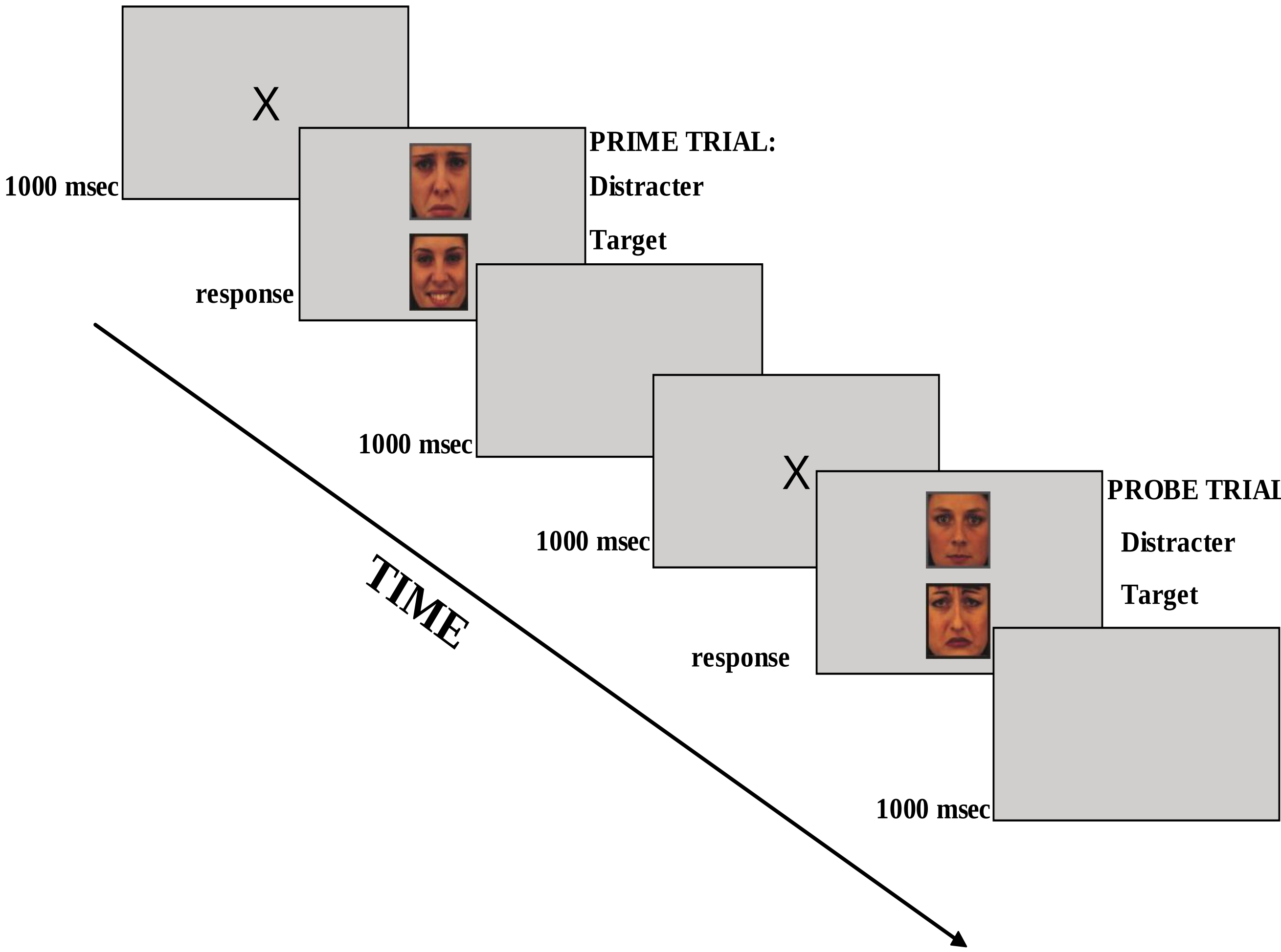
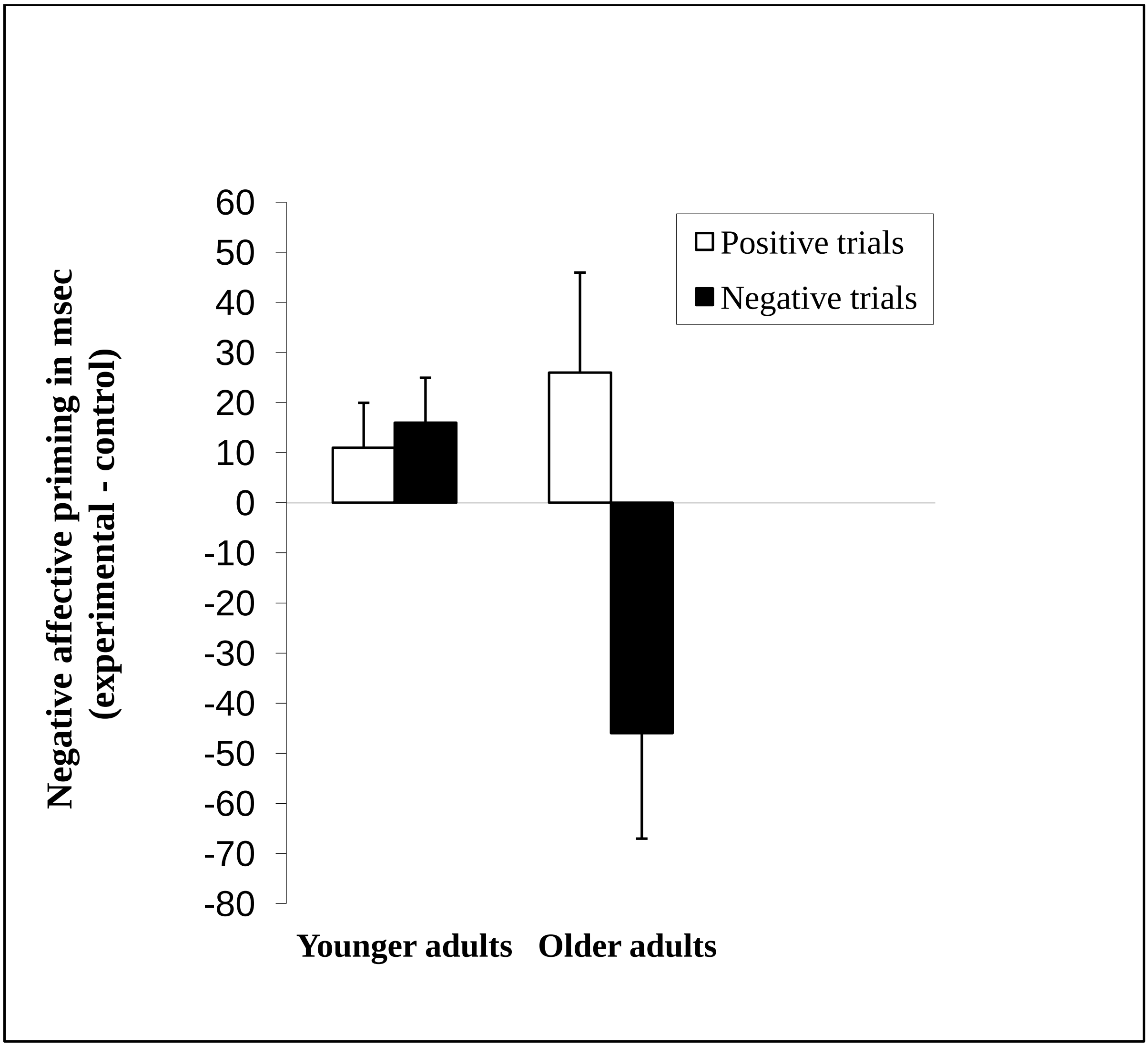

X
1000 msec
PRIME TRIAL:
Distracter
Target
response
1000 msec
X
1000 msec
PROBE TRIAL
Distracter
Target
response
1000 msec
TIME

Figure caption 2

Figure 2. Mean Negative Affective Priming (experimental-control; in msec) and standard errors for negative and positive trials as a function of Group.


Negative affective priming in msec
(experimental - control)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Positive trials
Negative trials
Younger adults
Older adults