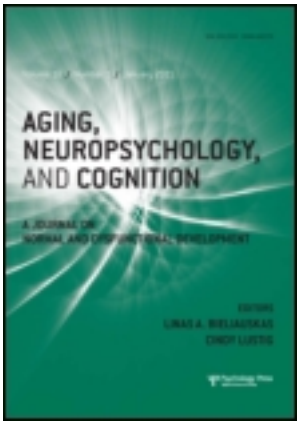

Aging, Neuropsychology, and Cognition: A Journal on Normal and Dysfunctional Development

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/nanc20

A positivity effect in autobiographical memory, but not phonemic fluency, in older adults

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Published online: 23 Jan 2012.

To cite this article: Jennifer C. Tomaszczyk & Myra A. Fernandes (2012) A positivity effect in autobiographical memory, but not phonemic fluency, in older adults, Aging, Neuropsychology, and Cognition: A Journal on Normal and Dysfunctional Development, 19:6, 699-722, DOI: 10.1080/13825585.2011.646940

To link to this article: http://dx.doi.org/10.1080/13825585.2011.646940

Aging, Neuropsychology, and Cognition, 2012, 19 (6), 699–722
http://www.psypress.com/anc
ISSN: 1382-5585 print; 1744-4128 online
http://dx.doi.org/10.1080/13825585.2011.646940

Psychology Press
Taylor & Francis Group

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ABSTRACT

To investigate whether processing fluency or cognitive control processes underlie aging-related positivity effects in memory, we compared retrieval of words on a fluency task, and of events on an autobiographical task, in younger and older adults. No positivity effect in word output was found on the fluency task, though older adults output more neutral words. For our autobiographical task, participants wrote descriptions of personal events related to cue words (3 each of positive, negative, neutral). They then classified their memories by valence, and subsequently rated how they 'felt now' about each. Older adults output more autobiographical memories classified as positive, and rated their memories more positively than did younger adults. We suggest the aging-related positivity effect emerges in service of emotion regulation, and is primarily observed when the cognitive task allows for personal evaluation and/or engages a reflective style of processing, as on an autobiographical but not a fluency task.

Keywords: Aging; Emotion; Autobiographical memory; Phonemic fluency; Positivity effect.

Recently there has been much interest in how the cognitive processing of emotional information changes during normal aging. The socioemotional selectivity theory (SST) posits that as people age they become more aware of the limited amount of time left in their lives and are subsequently more focused on maintaining a sense of positive well-being and a positive affective

This research was supported by a Natural Sciences and Engineering Research Council of Canada (NSERC) discovery grant to M.A.F. and an NSERC scholarship to J.C.T. We thank Michelle Manios, Cheryl Lee, Jackelyn Chung, Wei Min Lim, Christine Lo, Gillian Adams, and Mark Laframboise for help with data collection and/or entry.

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state (Carstensen, 1995; Carstensen, Isaacowitz, & Charles, 1999), which biases their cognitive processing in favor of positively valenced information. Whether this occurs strategically, and is under cognitive control, or whether this effect arises due to differences in processing fluency for positive relative to negative valence information, is unclear. The current study seeks to identify the potential cognitive mechanism underlying observations of a positivity effect in cognitive processing associated with normal aging, and thus contributes to the determination of boundary conditions under which aging-related enhancements in the cognitive processing of emotional information will most likely be observed.

The goal of increasing well-being is postulated to affect the way in which older adults cognitively process information (e.g., Isaacowitz, Toner, Goren, & Wilson, 2008; Isaacowitz, Toner, & Neupert, 2009). For example, a number of studies have demonstrated aging-related positivity effects or negativity reductions for various aspects of older adults' cognition, most notably in the domains of attention (e.g., Isaacowitz, Wadlinger, Goren, & Wilson, 2006; Mather & Carstensen, 2003, Experiment 1) and memory (e.g., Charles, Mather, & Carstensen, 2003, Experiment 1; Grady, Hongwanishkul, Keightley, Lee, & Hasher, 2007; Mather & Knight, 2005; Mikels, Larkin, Reuter-Lorenz, & Carstensen, 2005; Tomaszczyk, Fernandes, & MacLeod, 2008). However, not all studies of age differences in the cognitive processing of emotional material have found aging-related positivity effects and sometimes these inconsistencies occur within the same set of experiments (e.g., Charles et al., 2003, Experiment 2; Grühn, Smith, & Baltes, 2005; Kensinger, Growdon, Brierley, Medford, & Corkin, 2002; Mather & Carstensen, 2003, Experiment 2). It is currently unclear which methodological factors (e.g., type of task, or study material) most strongly influence the manifestation of these effects (for a review and meta-analysis, see Murphy & Isaacowitz, 2008). Knowing the circumstances or conditions that do and do not give rise to a positivity effect in aging can shed light on how the effect manifests. Notably, a number of studies have demonstrated that experimenter-activated goals to regulate emotions, by asking participants to focus on their emotional state while completing a task, makes it more likely that a positivity effect will be observed (e.g., Holland, Tamir, & Kensinger, 2010; Kennedy, Mather, & Carstensen, 2004). Emotion-focus instructions also increase the likelihood of observing positivity biases in decision making (e.g., Löckenhoff & Carstensen, 2007). Here we examine whether a task which arguably primes emotional goals, and reflective thinking (e.g., through use of emotional cue words and requirement to produce and classify autobiographical memories by valence) would lead to a positivity effect whereas a task which primes accuracy goals (e.g., output on the FAS task) would not.

More recently, two accounts have emerged regarding the cognitive mechanisms underlying positivity effects which seek to account for the

variable emergence of positivity effects in the literature. These two accounts attempt to discern whether positivity effects are observable only on tasks which require older adults to engage in deliberate, strategic or reflective processes, or whether they are the result of greater processing fluency of positive material in older adults. The first, referred to as the 'cognitive control' account, suggests that positivity effects arise due to older adults' application of cognitive control processes to achieve the goal of maintaining a positive affective state. In this literature, cognitive control is conceptualized as those processes involved in directing behavior and use of attention resources, such as those required for goal maintenance (active/working memory) and representation, inhibition of goal-irrelevant responses, self-initiated retrieval, and selective attention (e.g., Miller, 2000). Support for this account comes from two sets of behavioural studies. First, studies on the effect of individual differences in executive functions as measured by neuropsychological tasks, on performance in episodic memory or sustained attention tasks, have shown that older adults who perform better on the executive function tasks are also more likely to show positivity effects in the memory and attention tasks (e.g., Isaacowitz et al., 2009; Mather & Knight, 2005; Petrican, Moscovitch, & Schimmack, 2008). Second, positivity effects found when tasks are performed under full attention conditions are nullified or even reversed when performed under divided attention (Knight et al., 2007; Mather & Knight, 2005), suggesting control processes, or attentional resources, disrupted under divided attention are required for the effect to emerge in older adults.

The second account is based in processing fluency. It suggests that positive information may be more accessible to, or have a processing fluency advantage for, older adults, and/or that negative information may be less accessible to older than younger adults (e.g., Yang & Hasher, 2011). To the best of our knowledge, the first study which directly examined the processing fluency account of positivity effects in the memory domain, compared performance on a semantic retrieval task (speeded word fragment completion) for positive, negative, and neutral words, in younger and older adults (Yang & Hasher, 2011). In that study accessibility of words was operationally defined as the proportion of word fragments that participants could spontaneously solve, for words of different valence. They found that older adults completed a larger proportion of word fragments with neutral relative to negative and positive words, whereas younger adults completed a greater proportion of word fragments with negative than neutral words, providing some evidence for an aging-related negativity reduction in semantic memory (though no evidence of a positivity effect or enhancement). Yang and Hasher concluded that neutral words may be more accessible to older adults in the context of more automatic or implicit memory tasks. Our current study allowed us to examine the generalizability of Yang and Hasher's findings, using a different measure of fluency.

In our study, we examined the extent to which processing fluency and cognitive control could account for the appearance of aging-related positivity effects in memory. We hypothesized that positivity effects may emerge more reliably on tasks that allow a more reflective style of processing (e.g., Charles & Carstensen, 2009). It is important to note that by 'reflective style of processing' we are referring to cognitive processing directed at personal assessment or evaluation, in the context of a cognitive task. To this end, we compared performance within a sample of younger and older adults on a fluency task, as in Yang and Hasher (2011), albeit a different one, the FAS test. Here participants are given letters one at a time and asked to say aloud as many words that begin with each of the target letters as they can in a short period of time. We predicted that, as in Yang and Hasher, older adults would output more neutral words than emotional words. This prediction is also based on the assumption that because in the FAS test participants are instructed to focus on task accuracy (i.e., generating words that meet certain restrictions), goals to enhance emotional state would not be salient and thus no positivity effect would emerge.

We also compared performance on an autobiographical memory task, using a standard 'cue-word' method (e.g., Conway & Bekerian, 1987; Jansari & Parkin, 1996; Rubin & Schulkind, 1997; Schlagman, Kliegel, Schulz, & Kvavilashvili, 2009), in which participants were first given positive, negative, and neutral cue words and were asked to generate memories that related to each cue word. We predicted that older adults would generate more autobiographical memories classified as positive, than negative or neutral, and that younger adults would generate more autobiographical memories classified as negative, consistent with previous studies of autobiographical memory (e.g., Gallo, Korthauer, McDonough, Teshale, & Johnson, 2011; Kennedy et al., 2004; Serrano, Latorre, & Gatz, 2007). This prediction is also based on the assumption that retrieval of autobiographical memories, in response to cue words, encourages a reflective processing style in which participants' emotional state is more salient as they write out their personal memories. This salience of emotional state may prompt older adults to regulate their emotions by strategically retrieving positive memories.

Additionally we asked participants to rate how they currently felt about the memories they generated. We included ratings of participants' current feeling about autobiographical memories as well as memory classifications by valence to address the idea that, particularly for older adults, there may exist discrepancies between how one would classify an autobiographical memory with respect to valence, and how one currently feels about that memory given that older adults may reappraise their autobiographical memories (e.g., Comblain, D'Argembeau, & Van der Linden, 2005; Levine & Bluck, 1997) in service of emotion regulation goals. Consistent with the logic presented above for classifications of memories, we predicted that older adults would generate

more memories about which they currently felt positive than negative or neutral, particularly those generated in response to negative cue words. Based on our assumptions, instructing participants to think about how negative or positive they currently felt about their memories should in fact be more likely to prompt older adults to regulate their emotional state and rate memories as positive.

As outlined earlier, the cognitive mechanisms that underlie the positivity effect are under debate. Few studies in the memory literature have entertained an alternate explanation to the cognitive control account: that positivity effects may result from an aging-related enhancement in processing fluency for positive items. The current study evaluates this alternate hypothesis by comparing performance on two tasks in which participants must output information in response to verbal cues (phonemic fluency and cue word method autobiographical memory test), so as to allow for a more direct comparison of results than would be possible with retrieval protocols employed in previous studies of autobiographical memory in aging (e.g., Kennedy et al., 2004).

METHOD

Participants

Fifty-five healthy community-dwelling older adults were recruited through the University of Waterloo's Research in Aging Participant pool (WRAP). The WRAP pool distributes recruitment flyers in the Kitchener–Waterloo area and potential participants must complete a phone interview about their demographic characteristics, medical status and history to determine their eligibility to participate in studies. Eligible participants are then entered into the pool and are contacted for individual studies for which they meet study-specific criteria. Fifty-five younger adults were recruited from undergraduate psychology classes into the University of Waterloo's Research Experience Group. Potential participants had to complete a mass testing and pre-screening questionnaire on an online study management system. Students who met the eligibility criteria for specific studies according to their responses on the pre-screen questionnaire could decide to sign up for a study of their choosing. Table 1 displays participant characteristics. Participants came into the laboratory for a study on attention to pictures and completed all of the tasks listed later. Older adults received $10/hour remuneration, and younger adults received course credit for participating. For both age groups inclusion criteria were: fluency in English, normal or corrected-to-normal vision and hearing, no history of neuropsychological impairment, and no previous head injury. This information was obtained through self-report. For older adults, an additional exclusion criterion was a score of less than 26 on the Mini-Mental

TABLE 1. Participant characteristics

	Age group			
	Younger (17–23 years of age; 34 female)		Older (61–87 years of age; 38 female)	
Age in years	19.58	(1.50)	71.73	(6.53)
MMSE score	–	–	28.91	(0.89)
Years of education	14.38	(1.41)	15.58	(3.90)
FSIQ (NART-R)	105.05	(7.73)	116.13	(6.64)
PANAS-X (percent positive)	55.56	(11.11)	63.36	(12.68)
PANAS-X (percent negative)	34.22	(12.27)	29.05	(8.98)
Trails A (time in seconds)	18.32	(5.87)	30.52	(9.28)
Trails B (time in seconds)	36.99	(11.77)	74.09	(32.04)
Digit Span Forward	9.22	(2.10)	8.35	(1.98)
Digit Span Backward	7.53	(1.94)	7.20	(2.21)

Note: Mean values with standard deviation in parentheses.

State Exam (MMSE, Folstein, Folstein, & McHugh, 1975). See Table 1 for neuropsychological test scores.[1]

Materials and Procedure

FAS Test

To examine the contribution of processing fluency to positivity effects, we used the FAS test (Spreen & Strauss, 1998), a standard neuropsychological test of phonemic fluency (executive functioning). On this test participants are given the letters F, A, and S one at a time and are asked to say aloud as many words that begin with each of the target letters as they can. Participants were given 1 minute for generation, per letter, and were instructed to not generate words that are proper names, place names, trademarked names, or the same word with a different ending (e.g., eat and eating). Participant responses were recorded both on paper and with an audio recording device. If a spoken word had multiple meanings (e.g., son and sun, or were homonyms) the experimenter inquired about the intended meaning after the minute had elapsed for the given letter and recorded it on the paper. Words output by participants were later coded as positive, negative, or neutral in one of two ways: (1) words that appeared in the ANEW database

[1] Consistent with literature indicating greater vocabulary with aging (e.g., Verhaeghen, 2003), the older adult group had a higher full scale IQ (FSIQ), $t(108) = -8.06$, $p < .0005$, as estimated by the National Adult Reading Test – Revised (NART-R, Nelson, 1992) than the younger adult group. (In the NART-R, participants are asked to read irregularly spelled words out loud.) Older adults also had a greater number of years of education, $t(63) = -2.08$, $p < .05$ (though years of education data were missing for four older adults).

(Bradley & Lang, 1999; a database with normative ratings of English words by valence and arousal rated on a 1–9 scale) were coded based on their normative valence ratings (ranges were 1–3.66 for negative, 3.67–6.33 for neutral, and 6.34–9 for positive, words), and (2) words not in the ANEW (including different conjugations/pluralizations of words that appeared in the ANEW) were classified by valence by two coders working independently. Coding discrepancies were resolved by a third coder. Coding discrepancies occurred for 27.6 and 20.1% of younger and older adults' word output for words not in the ANEW, respectively. Words that violated test instructions (including nonwords and non-English words) were not coded and these comprised 0.49 and 2.2% of younger and older adults' word output, respectively. Repetitions of words were not included in the analyses. The mean number of errors produced on the FAS test was 0.22 ($SD = 0.50$) for younger adults, and 0.85 ($SD = 1.14$) for older adults.

Autobiographical Memory Task

Participants were given nine 'cue words' selected from the ANEW database. There were 3 each of negative (Alone, Mistake, Discomfort; $M = 2.49$, $SD = 0.34$), neutral (Teacher, News, Market; $M = 5.55$, $SD = 0.21$), and positive (Home, Bunny, Cake; $M = 7.47$, $SD = 0.38$), words. Cue words were matched as closely as possible on arousal ($M_{\text{negative}} = 4.73$, $SD = 0.51$, $M_{\text{neutral}} = 4.45$, $SD = 0.63$, $M_{\text{positive}} = 4.42$, $SD = 0.51$) and were selected based on presumed ease with which they could be associated with autobiographical memories. Cue words were presented in a random order for each participant on sheets of paper, with 10–13 lines underneath each cue word for the participant to write out their memory (one memory per cue word). Participants were instructed as follows: 'Provide memories of *specific events from your life* that are related to each of the keywords below. You'll have 1 minute (or 2 if you really need it) to write down a brief description of the event. These memories can be from any time in your life (i.e., from childhood or from the recent past). We are interested in your *memories of specific events* that have occurred at a *specific point in time and place*'. Although instructions indicated that participants had 1–2 minutes to retrieve and write down their memories, in practice participants were allowed extra time to record their memories if necessary; this instruction was included to encourage participants to complete the task in a timely manner. After participants wrote down their memories, the experimenter checked to make sure that they were specific (contained detail), and asked participants to provide additional information for productions that were general in nature. For example, if a participant wrote 'I like bunnies' or 'I used to have a bunny' in response to the cue word 'Bunny' the experimenter would ask 'Could you write about a time when you had a specific experience with a bunny or that involved bunnies?'. If after probing a participant could still not generate a specific memory

to the cue word, the memory was still included in the analyses, as we reasoned that such general or semantic memories are based upon the aggregate of a series of episodic memories of the participant's past. Next, participants were asked to 'Please classify each of the events you described earlier as positive, negative, or neutral'; they did so by placing a '+', '–', or '0' in the box on the left of each cue word. Finally, participants rated their memories on a Likert-type scale regarding how they currently felt about each memory. The instructions were: 'For each of the events that you described, please rate how positive or negative you feel each event was, using the scale below (–3 being very negative, 0 being neutral and +3 being very positive). Please make these ratings based on how you feel *right now* about each event. Indicate this score in the box to the right of each description'.

Procedure

Participants were tested individually. Participants completed the NART-R as well as the Trail Making Tests A and B (Reitan & Wolfson, 1985), and Digit Span forward and backward tasks (Wechsler, 1997), which measure executive functioning. Scores on the Trail Making Tests and the Digit Span tasks were used to confirm that older adult participants were within normal range for cognitive functioning (see Table 1), according to published norms (Spreen & Strauss, 1998; Wechsler, 1997). Older adult participants completed the MMSE after the other neuropsychological tasks. To assess mood at time of test, participants also completed the Positive and Negative Affective Schedule – Expanded (PANAS-X, Watson & Clark, 1994). Participants then completed the FAS test and autobiographical memory task.

RESULTS

Mood Measure

Raw PANAS-X scores were converted to percentages (see Table 1 for means). Each age group reported greater positive than negative affect $t_{\text{Younger}}(54) = -9.71$, $p < .0005$; $t_{\text{Older}}(54) = -14.45$, $p < .0005$ at time of test. Older adults reported greater positive $t(108) = -3.43$, $p < .005$ and less negative affect $t(108) = 2.53$, $p < .05$ than did younger adults.

Three mixed ANOVAs were performed. The first was to analyze the number of positive, negative, and neutral words output in the FAS test. The second was to analyze the number of autobiographical memories that participants classified as positive, negative, and neutral. The third was to analyze the number of autobiographical memories that participants rated as 'currently feel positive/negative/neutral about', as there could be a difference in how participants currently felt about their autobiographical memories, and how they would generally classify the memories.

TABLE 2. Mean number of words output in the FAS test by word valence and age group

	Age group			
Word valence	Younger		Older	
Negative	6.75	(3.31)	5.44	(3.58)
Neutral	22.65	(8.48)	28.36	(8.94)
Positive	12.13	(5.41)	6.67	(3.12)

Note: Standard deviations in parentheses.

FAS Test

Number of words output in the FAS test was analyzed using a mixed ANOVA with the between-subjects factor of age group (younger, older) and the within-subjects factor of word valence (negative, neutral, positive). This tested whether older adults would output more positive than negative or neutral words (positivity effect), compared to younger adults.

Total number of words output did not differ between younger ($M = 41.53$, $SD = 9.91$) and older ($M = 40.47$, $SD = 11.47$) adults, $F(1, 108) = 0.27$, $p > .1$, $\eta_p^2 = 0.002$. There was a main effect of valence of words output, $F(2, 216) = 343.90$, $p < .0005$, $\eta_p^2 = .76$. Participants output greater numbers of neutral ($M = 25.51$, $SD = 9.14$) than positive ($M = 9.40$, $SD = 5.18$), $t(109) = -14.80$, $p < .0005$, or negative ($M = 6.09$, $SD = 3.50$), $t(109) = -21.10$, $p < .0005$ words, and greater numbers of positive than negative words, $t(109) = 6.34$, $p < .0005$. This main effect was qualified by a Word Valence × Age Group interaction, $F(2, 216) = 25.37$, $p < .0005$, $\eta_p^2 = .19$ (see Table 2) in which younger adults output a greater number of negative, $t(108) = 1.99$, $p < .05$, and positive words, $t(86) = 6.48$, $p < .0005$, than did older adults, whereas older adults output a greater number of neutral words, $t(108) = -3.44$, $p < .01$, than did young.

Effects of Mood and Years of Education on FAS Test Performance

To examine the effect of negative mood, positive mood, and years of education on the number of words output in the FAS test, the above analyses were conducted using these variables included as covariates; when included, the main effect of word valence became marginal ($p = .07$) and there was a significant main effect of positive mood $F(1, 101) = 7.02$, $p < .01$, $\eta_p^2 = .06$: participants who reported more positive affect output greater numbers of words overall, $r = .23$, $p < .05$. The Word Valence × Age Group interaction remained significant, $F(2, 202) = 16.71$, $p < .0005$, $\eta_p^2 = .14$. No other main effects or interactions reached significance.

Effect of NART-R Reading Test Scores (FSIQ) on FAS Test Performance

As aging-related differences in vocabulary may have affected word output, correlations between raw scores on the NART-R reading test (number of pronunciation errors), and number of words output, were examined for each age group and word valence type. For younger adults, fewer NART-R errors was related to greater output of negative words, $r = –.30$, $p < .05$, and greater total word output, $r = –.31$, $p < .05$. For older adults, fewer NART-R errors was related to greater negative, $r = –.32$, $p < .05$, and neutral, $r = –.38$, $p < .005$, word output, and greater total word output, $r = –.41$, $p < .005$.

Autobiographical Memory Task

Autobiographical Memories Classified According to Valence

Number of memories classified by the participant according to valence in the Autobiographical Memory Task was analyzed with a mixed ANOVA with the between-subjects factor of age group (younger, older) and the within-subjects factors of memory valence (negative, neutral, positive) and cue word valence (negative, neutral, positive). This tested whether older adults would classify more of their memories as positive, and fewer memories as negative (positivity effect), compared to young.

Because all participants generated nine memories (one for each cue word), there was no main effect of cue word valence, age group, or an Age Group × Cue Word Valence interaction in the analyses reported later. All *p*-values are reported with the Greenhouse–Geisser correction.

There was a main effect of memory valence $F(2, 216) = 94.13$, $p < .0005$, $n_p^2 = 0.47$: participants generated greater numbers of memories classified as positive ($M = 4.24$, $SD = 1.62$), than negative ($M = 3.44$, $SD = 1.41$), $t(109) = –3.02$, $p < .005$, or neutral ($M = 1.31$, $SD = 1.22$), $t(109) = –12.33$, $p < .0005$, and greater numbers of memories classified as negative than neutral, $t(109) = 10.67$, $p < .0005$. This main effect was qualified by 2 two-way interactions. First, there was a Memory Valence × Age Group interaction, $F(2, 216) = 16.32$, $p < .0005$, $\eta_p^2 = .13$ (see Figure 1). Older adults generated greater numbers of memories classified as both negative, $t(54) = 8.07$, $p < .0005$, and positive, $t(54) = –15.36$, $p < .0005$, than neutral, and generated greater numbers of memories classified as positive, than negative, $t(54) = –5.05$, $p < .0005$. Younger adults also generated greater numbers of memories classified as both negative, $t(54) = 7.00$, $p < .0005$, and positive, $t(54) = –5.41$, $p < .0005$, than neutral, but numbers of memories classified as negative and positive did not differ ($p > .1$).

Second, there was a Memory Valence × Cue Word Valence interaction, $F(4, 432) = 120.91$, $p < .0005$, $\eta_p^2 = 0.53$. Note that this interaction serves as a manipulation check that the cue words generally encouraged the generation of memories for which classified valence was congruent with cue

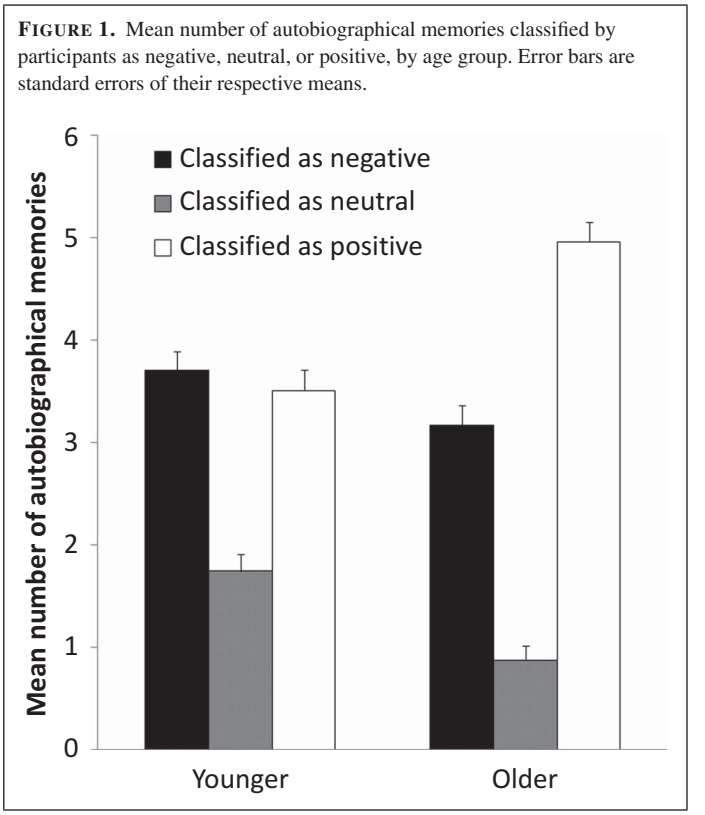


FIGURE 1. Mean number of autobiographical memories classified by participants as negative, neutral, or positive, by age group. Error bars are standard errors of their respective means.

word valence. For negative cues, participants generated greater numbers of memories classified as negative than positive, $t(109) = 13.14$, $p < .0005$, and neutral, $t(109) = 16.81$, $p < .0005$, but numbers of positive and neutral memories did not differ ($p > .05$). For neutral cues, participants generated greater numbers of memories classified as positive than negative, $t(109) = -6.26$, $p < .0005$, and neutral, $t(109) = -8.54$, $p < .0005$, but numbers of negative and neutral memories did not differ ($p > .05$). For positive cues, participants generated greater numbers of memories classified as positive than negative, $t(109) = -11.16$, $p < .0005$, and neutral $t(109) = -13.90$, $p < .0005$, but the difference between number of negative and neutral memories was not significant ($p > .1$).

Effects of Mood and Years of Education on Classification of Autobiographical Memories

To examine whether our reported effects were influenced by Mood at time of test, or by Education variables, the above analyses were run with negative mood, positive mood, and number of years of education as

covariates. When these variables were included, the main effect of memory valence became non-significant ($p > .1$) and there were significant Memory Valence × Positive Mood, $F(2, 202) = 5.46$, $p < .01$, $n_p^2 = .05$, and Memory Valence × Years of Education, $F(2, 202) = 4.34$, $p < .05$, $\eta_p^2 = .04$, interactions. Importantly, the Memory Valence × Age Group interaction remained significant, $F(2, 202) = 8.44$, $p < .0005$, $\eta_p^2 = .08$, as did the Memory Valence × Cue Word Valence interaction, $F(4, 404) = 3.19$, $p < .05$, $\eta_p^2 = .03$. (Greenhouse–Geisser corrected p-values reported.) No other main effects or interactions reached significance.

Ratings of Current Feelings about Autobiographical Memories ('Feel Now' Ratings)

In order to examine how participants currently felt about their autobiographical memories, we tabulated a count of memories that were given a negative, positive, or neutral 'feel now' rating. Memories rated as –1, –2, or –3 were binned into a 'negative-feeling' category and memories rated as +1, +2, or +3 were binned into a 'positive-feeling' category. Memories rated as 0 comprised the 'neutral-feeling' category. The number of memories in each of these three categories was analyzed with a mixed ANOVA with age group as a between–subjects factor and valence of 'feel now' rating (negative, neutral, positive) and cue word valence (negative, neutral, positive) as within-subjects factors. This analysis tested whether older adults would currently feel more positive about memories (i.e., show a positivity effect), than younger adults.

There was a main effect of valence of 'feel now' rating, $F(2, 216) = 78.31$, $p < .0005$, $\eta_p^2 = .42$. Participants generated greater numbers of memories about which they currently felt positive ($M = 4.61$, $SD = 1.70$), $t(109) = –11.16$, $p < .0005$, and negative ($M = 2.65$, $SD = 1.52$), $t(109) = 4.01$, $p < .0005$, than neutral ($M = 1.71$, $SD = 1.44$), and generated greater numbers of memories about which they currently felt positive than negative, $t(109) = –7.14$, $p < .0005$.

This main effect was qualified by 2 two-way interactions. First, there was a significant Valence of 'feel now' Rating × Age Group interaction, $F(2, 216) = 20.28$, $p < .0005$, $\eta_p^2 = .16$. Younger adults generated greater numbers of memories about which they currently felt negative ($M = 3.07$, $SD = 1.48$), $t(54) = 2.58$, $p < .05$, and positive ($M = 3.73$, $SD = 1.56$), $t(54) = –4.23$, $p < .0005$, than neutral ($M = 2.13$, $SD = 1.64$). Older adults also generated greater numbers of memories about which they currently felt positive ($M = 5.49$, $SD = 1.34$), $t(54) = –16.23$, $p < .0005$, and negative ($M = 2.22$, $SD = 1.46$), $t(54) = 3.18$, $p < .005$, than neutral ($M = 1.29$, $SD = 1.05$), but importantly, they generated greater numbers of memories about which they currently felt positive, than negative, $t(54) = –9.31$, $p < .0005$.

Second, there was a significant Valence of 'feel now' Rating × Cue Valence interaction, $F(4, 432) = 89.20$, $p < .0005$, $n_p^2 = .45$. This interaction serves as a manipulation check that the cue words generally encouraged the generation of memories for which 'feel now' valence was congruent with cue word valence. For negative cues, participants generated greater numbers of memories about which they currently felt negative than positive, $t(109) = 7.38$, $p < .0005$, or neutral, $t(109) = 7.72$, $p < .0005$. For neutral cues, participants generated greater numbers of memories about which they currently felt positive than negative, $t(109) = –9.88$, $p < .0005$, and neutral, $t(109) = –7.85$, $p < .0005$. For positive cues, participants generated greater numbers of memories about which they currently felt positive than negative, $t(109) = –14.09$, $p < .0005$, and neutral $t(109) = –12.72$, $p < .0005$.

These two-way interactions were qualified by the significant three-way Valence of 'feel now' Rating × Age Group × Cue Word Valence interaction, $F(4, 432) = 6.71$, $p < .0005$, $\eta_p^2 = .06$ (see Figure 2). For negative cues, younger adults generated greater numbers of memories about which they currently felt negative, compared to older adults, $t(108) = 4.43$, $p < .0005$, whereas older adults generated greater numbers of memories about which they currently felt positive, compared to young, $t(108) = –4.69$, $p < .0005$. Generation of memories about which participants currently felt neutral did not differ between age groups ($p > .1$).

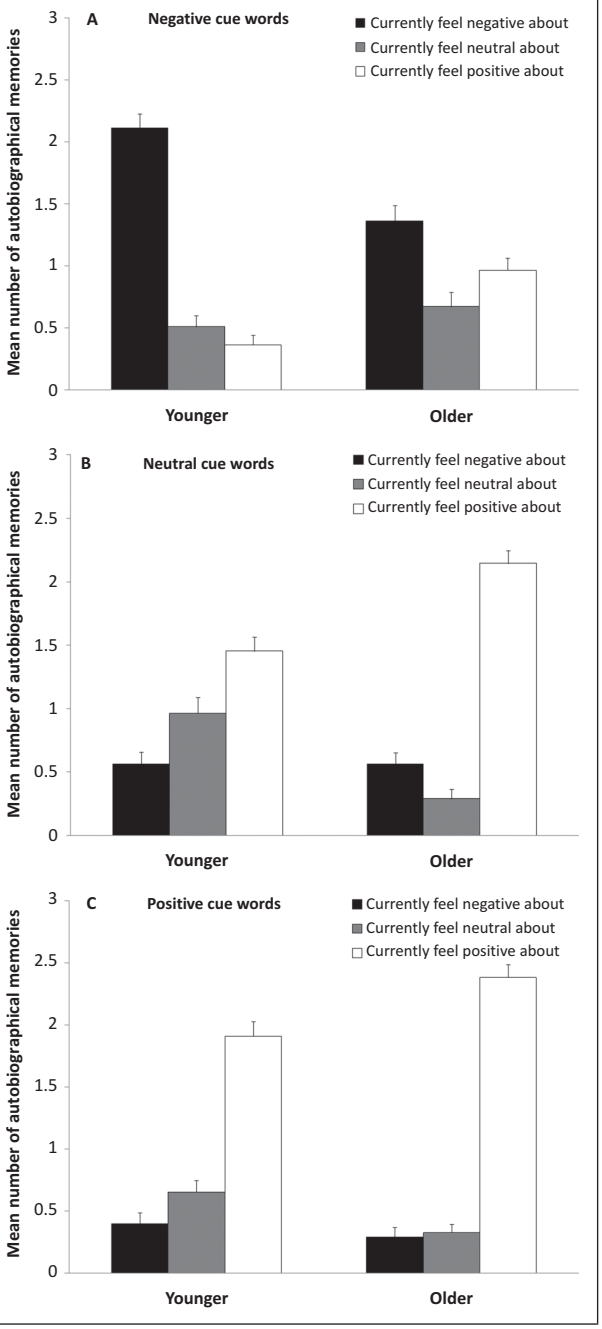
For neutral cue words, older adults generated greater numbers of memories about which they currently felt positive, compared to young, $t(108) = –4.55$, $p < .0005$, whereas younger adults generated greater numbers of memories about which they currently felt neutral, compared to older adults, $t(108) = 4.54$, $p < .0005$. Generation of memories about which participants currently felt negative did not differ between age groups ($p > .1$).

Similarly, for positive cues older adults also generated greater numbers of memories about which they currently felt positive, compared to young, $t(108) = –3.00$, $p < .005$, whereas younger adults generated greater numbers of memories about which they currently felt neutral, compared to older adults, $t(108) = 2.80$, $p < .01$. Generation of memories about which participants currently felt negative did not differ between age groups ($p > .1$).

Effects of Mood and Years of Education on 'Feel Now' Ratings of Autobiographical Memories

To examine whether our reported effects were influenced by Mood or Education variables, the above analyses were run with negative mood, positive mood, and number of years of education as covariates. With these variables included as covariates, the main effect of valence of 'feel now' rating became non-significant ($p > .1$), and there were marginal interactions of valence of 'feel now' rating with negative mood scores, $F(2, 202) = 2.79$, $p = .06$, $\eta_p^2 = .03$, and with positive mood scores, $F(2, 202) = 2.81$, $p = .06$,

FIGURE 2. Mean number of autobiographical memories about which participants currently felt negative, neutral, or positive, by age group and for each cue word valence. Panel A: memories generated for negative cue words. Panel B: memories generated for neutral cue words. Panel C: memories generated for positive cue words. Error bars are standard errors of their respective means.



$\eta_p^2 = .03$. Importantly, the Valence of 'feel now' Rating × Age Group interaction remained significant, $F(2, 202) = 11.15$, $p < .0005$, $\eta_p^2 = .1$, and the Valence of 'feel now' Rating × Cue Valence interaction was also significant, $F(4, 404) = 2.38$, $p = .05$, $\eta_p^2 = .02$. Furthermore, the Valence of 'feel now' Rating × Age Group × Cue Word Valence interaction remained significant, $F(4, 404) = 3.82$, $p < .01$, $\eta_p^2 = .04$. No other main effects or interactions reached significance.

DISCUSSION

In the current study we compared retrieval of words on a phonemic fluency task, and of events on an autobiographical task, in younger and older adults. When asked to generate words that began with the letters F, A, and S, no positivity effect in output was found, though older adults output more neutral words. For our autobiographical task, older adults output more autobiographical memories classified as positive, and rated their memories more positively than did younger adults. We suggest that the positivity effect in older adults is primarily observed when the cognitive task allows for personal evaluation and/or engages a reflective style of processing, as on an autobiographical but not a fluency task.

Phonemic Fluency Test (FAS)

To the best of our knowledge, only one study to date has examined the processing fluency account of aging-related differences in memory for emotional and neutral information. Although the study (Yang & Hasher, 2011) used an implicit and semantic memory task (speeded word fragment completion), our results are similar to theirs even though we used an explicit and phonemic-based fluency task, and performance on the FAS test likely relied on self-initiated retrieval of words to a greater extent. In both Yang and Hasher's study and in ours, older adults generated more neutral than negative, or positive, information. These convergent findings provide support for Yang and Hasher's assertion that neutral information may be more accessible to older adults relative to information with emotional content. Also similar to the current study, Yang and Hasher found that younger adults generated more neutral than positive words. Thus, information of a neutral valence appears to be more accessible for both older and younger adults relative to emotional information, but this pattern of results may simply reflect the numbers of neutral and emotional words in the English lexicon.

One might argue that older adults in this sample scored higher on the NART-R (reading test), and that this difference in vocabulary may have affected number, or valence type, of words output in the FAS test. However, consistent with previous studies (e.g., Bolla, Lindgren, Bonaccorsy, & Bleecker, 1990; Troyer, Moscovitch, & Winocur, 1997), number of words

output did not differ between age groups; also, both age groups output greater numbers of neutral compared to negative, or positive, words. Furthermore, as fewer errors on the NART-R was related to greater output of negative words and greater total word output in both age groups, it is unclear how vocabulary size *per se* might have affected the Age × Valence interaction.

Autobiographical Memory Task

We turn next to the results for the autobiographical memory task. Older adults classified greater numbers of their autobiographical memories as positive, than negative or neutral, and classified greater numbers of memories as negative, than neutral. Younger adults, on the other hand, classified greater numbers of their autobiographical memories as positive or negative compared to neutral, with no significant differences between numbers of positive and negative memories generated. Thus, when older adults are asked to retrieve autobiographical memories they preferentially recall events that they classify as positive, whereas younger adults retrieve memories that they classify as being positively and negatively valenced, relative to neutral.

Participant ratings of how they currently felt about their autobiographical memories replicated the pattern found for classifications of memories. Again, older adults showed a positivity effect; they generated greater numbers of autobiographical memories about which they currently felt positive, than negative or neutral. Younger adults generated greater numbers of autobiographical memories about which they currently felt positive and negative, than neutral. Thus, older adults appear to preferentially recall events that they not only evaluate as being positive in nature, but also about which they currently feel positively about, whereas younger adults recall events about which they currently feel positive and negative.

What is especially interesting is the Valence of 'feel now' Rating × Age Group × Cue Word Valence interaction. Here we find evidence of both a positivity effect and negativity reduction for older adults. Given negative cue words, older adults generated greater numbers of autobiographical memories about which they currently felt positive, and fewer autobiographical memories about which they currently felt negative, relative to younger adults. Also, given either neutral or positive cues, older adults again generated greater numbers of memories about which they currently felt positive, relative to younger adults. These findings suggest that older adults may not only preferentially recall life events about which they currently feel positive, but may also be inclined to avoid recalling life events about which they currently feel negative, even when prompted with negative cues.

It is important to note that the cue word valence interactions, with memory valence and with valence of 'feel now' rating, indicate that participants did indeed generate memories with valence concordant with that of the cue

word. That is, participants generated greater numbers of positive and negative memories to positive and negative cue words, respectively. The only exception was for neutral cue words, for which participants generated greater numbers of positive, compared to negative and neutral memories. This is in line with experience sampling studies that show that both younger and older adults report a higher frequency of positive, than negative, affect in their day-to-day lives (e.g., Carstensen, Pasupathi, Mayr, & Nesselroade, 2000).

Our autobiographical memory results are also largely in line with previous literature. A number of studies have investigated aging-related changes in autobiographical memory for emotional and neutral events. For instance, Kennedy et al. (2004) asked a sample of middle-aged and older nuns to recall aspects of their past physical and emotional health on which they had previously given reports 14 years earlier. They found that older nuns recalled their past in a more positive light than was originally reported, compared with middle-aged nuns. In line with this, Comblain et al. (2005) asked younger and older adults to generate negative, neutral, and positive autobiographical memories from the past two years and found that older adults rated their negative memories as having been more positive, compared to younger adults. These results suggest that older adults may have reappraised their negative memories to be more positive, as reported in our study. Fernandes, Ross, Weigand, and Schryer (2008) also found a positivity effect in number of reports of positive autobiographical events. Interestingly, later recall of those initially retrieved events did not show a positivity effect, perhaps because the task instructions focused on accuracy of recall of events reported in the previous session. Notably, they did find a positivity effect in older adults' false memories about recent events, in line with our report of a biased output of positive events on autobiographical tests. Moreover, one recent study that also used the cue-word method to probe autobiographical memory found that older adults, especially older men, retrieved fewer negative memories in response to negative cue words compared with younger adults (Ros & Latorre, 2010).

Despite using a very similar methodology to the current study, however, Schlagman et al. (2009) did not find a positivity effect in older adults' voluntary autobiographical memories. Schlagman et al. (2009) examined 'involuntary' (spontaneous) and 'voluntary' (generated in response to word or phrase cues) autobiographical memories of younger and older adults. While they did not find a positivity effect in older adults' voluntary memories, they did find that older adults rated their involuntary memories more positively compared to younger adults. One difference between Schlagman et al.'s (2009) procedure and ours is that they used phrases which described specific situations, as well as single words, as retrieval cues for voluntary autobiographical memories, whereas we exclusively used single words as cues. To illustrate, Schlagman et al.'s (2009) phrase cues 'having a row'

(negative phrase), 'first date' (positive phrase), and 'giving directions' (neutral phrase) might be perceived as stronger cues to generate autobiographical memories with a negative, positive, and neutral valence, respectively, compared to our word cues, which afforded more scope for emotional regulation goals to become evident. Moreover, Schlagman et al. (2009) did not analyze the number of memories that participants rated as being negative, neutral, and positive in valence, for each word cue valence as we did. Rather, mean valence ratings were analyzed by word cue type (negative, neutral, positive). It is perhaps not surprising, then, that both younger and older adults rated the memories that they generated in response to negative, neutral, and positive phrase cues as negative, neutral, and positive, respectively. This pattern is very similar to the pattern found in our Memory Valence × Cue Word Valence interaction for classifications of autobiographical memories, which suggests that participants generated memories for which valence was concordant with cue word valence.

In line with the cognitive control account, and with the predictions of SST more generally, we suggest that it is primarily when tasks engage participants in a reflective processing style, or when the cognitive task in question allows emotional goals to be more salient, that positivity effects are most likely to be found. We propose that tasks which engage participants in strategic and reflective processing allow greater focus on one's emotional state, and may be more likely to show a positivity effect in aging.

We note that the cognitive control and processing fluency accounts are not necessarily mutually exclusive and it is likely that many of the cognitive tasks that have been used in the literature to assess aging-related positivity effects can be carried out through reliance on processing fluency of study materials and/or through use of strategic processes. Moreover, it is entirely possible that there may be individual differences in the extent to which these cognitive processes are used to carry out a given task. In light of these considerations, we acknowledge that both our fluency and 'reflective' tasks likely tap into processing fluency and cognitive control mechanisms. We argue, however, that the autobiographical memory task lends itself much more readily to a reflective processing style as participants must contemplate events from their lives and in doing so may become focused on their emotional state, which would allow for use of cognitive control to be used in service of emotion regulation goals. This view is in accordance with recent research which shows that retrieval of specific autobiographical memories (as in our task) depends, in part, upon executive control processes (e.g., Dalgleish et al., 2007; Neshat-Doost, Dalgleish, & Golden, 2008; Piolino et al., 2010). This is in contrast to our fluency task, which discourages a reflective processing style by requiring participants to output as many words as possible in a short time period, with an emphasis on task accuracy (first letter of output, and generating words within specific test restrictions).

As mentioned in the Introduction, recent studies have shown that positivity effects in cognitive tasks can be influenced by instructions to focus on task accuracy or emotional state; when both younger and older participants focus on their emotional state, positivity effects tend to emerge, whereas positivity effects disappear when participants focus on task accuracy (e.g., Kennedy et al., 2004; Löckenhoff & Carstensen, 2007). This effect may even occur more strongly on intentional memory tasks that require controlled processing (Yang & Ornstein, 2011), as on our autobiographical task.

There is also evidence from neuroimaging studies that the brain basis for the positivity effect lies in control processes mediated by the prefrontal cortex. A number of studies have shown that when participants engage in emotion regulation strategies, such as reappraisal of emotion-eliciting events, activation increases in the dorsolateral prefrontal cortex, lateral prefrontal cortex, and medial prefrontal cortex, whereas activation in limbic structures such as the amygdalae decreases (for reviews see Green & Malhi, 2006 and Ochsner & Gross, 2005). In the context of the positivity effect literature, it is assumed that older adults' chronically activated goal to regulate their affective state motivates them to use cognitive control processes to engage in emotion regulation. Indeed, there is mounting evidence of the role of the prefrontal cortex in the involvement of positivity effects in a variety of cognitive tasks (e.g., Addis, Leclerc, Muscatell, & Kensinger, 2010; Kensinger & Schacter, 2008; Leclerc & Kensinger, 2008, 2010; St. Jacques, Dolcos, & Cabeza, 2010). Our results and interpretation fall in line with this literature.

Finally, our results are in line with neuroimaging studies which show that when processing positive stimuli during tasks which induce a deep level of processing, older adults recruit the prefrontal cortex to a greater extent than younger adults, perhaps as a result of attempting to regulate emotional response to those stimuli (for a review see Nashiro, Sakaki, & Mather, 2011). Specifically, this effect appears in tasks in which participants make semantic (Ritchey, Bessette-Symons, Hayes, & Cabeza, 2011), and self-referential, judgments (Gutchess, Kensinger, & Schacter, 2007). Because our autobiographical memory task required participants to reflect upon how cue words could be related to events from their own lives, this task likely tapped into memories that were more deeply processed relative to the phonemic fluency task, and so may have been more likely to make emotion regulation goals more salient to older adults.

Limitations

It is possible that differences between our phonemic fluency and autobiographical tasks other than the extent to which they engaged in a reflective processing style and use of cognitive control mechanisms could have contributed to the observed differences. First, words generated in the FAS test

were coded for valence by independent coders and through use of the ANEW, whereas valence of memories in the autobiographical task was rated by participants themselves. If participants had coded valence of words generated in the FAS test themselves, it is possible that they would classify words differently. It seems unlikely, however, that the majority of participants' classifications would differ greatly from those of independent coders. Furthermore, the emotional tone of a participant's autobiographical memory may not be as obvious to an objective observer as it would to the participant, and so we felt that participants' classifications of the valence of their autobiographical memories would be more valid than those of objective coders. Moreover, Fernandes et al. (2008) had both younger and older adult external coders rate the autobiographical memories generated by younger and older adult participants, and found the same results regardless of coder status.

Nevertheless, we discuss a number of ways in which the limitations of this study could be addressed in future research. To address the limitation that our tasks may have differed on variables other than a reflective processing style, future work can manipulate instructions given for the FAS test to either focus on accuracy (adherence to test restrictions) or emotional state, and examine valence of words output. These two instruction conditions could also be used to compare the valence of memories generated in the autobiographical memory task. Furthermore, it would be interesting to examine age differences in performance on other types of fluency tasks to determine whether the results of the FAS test are generalizable.

SUMMARY AND CONCLUSIONS

The current study shows an aging-related positivity effect and a negativity reduction on an autobiographical memory task, but no evidence of such effects on a phonemic fluency task in the same sample of younger and older participants. In keeping with Mather and Carstensen's (2005) idea that aging-related positivity effects may be most likely to arise on memory tasks in which the to-be-remembered material is personally relevant, the most obvious difference between our fluency and autobiographical tasks is the degree to which the tasks engage participants in a self-reflective processing style. This likely includes aspects of cognitive control (e.g., Mather & Knight, 2005). Although the FAS test is traditionally used to measure verbal fluency (executive function), this task by its nature does not clearly lend itself to a reflective processing style – participants may not have sufficient motivation to preferentially retrieve positive information when the goal is to quickly generate words that begin with a certain letter, and is unlikely to activate goals to maintain positive well-being. Such a result is in line with Kennedy et al.'s (2004) claim that motivation to maintain positive well-being influences whether or not a positivity effect is obtained.

Our results also speak to the current debate regarding another theoretical account of aging-related positivity effects, which postulates that these effects arise from age-related decline in the amygdala's ability to process negative information (Cacioppo, Berntson, Bechara, & Tranel, 2011). It is argued that if positivity effects stem from biological decline, then they should be more consistent across tasks and less susceptible to experimental manipulations of motivational state (e.g., Charles & Carstensen, 2009; Scheibe & Carstensen, 2010). The fact that our study did not find a consistent positivity effects across two tasks, in the same sample of participants, and that our phonemic fluency task did not provide evidence of a selective decrement in the processing of negative information in older adults, relative to positive information, goes against this theoretical account.

To conclude, we found no evidence of a positivity effect or negativity reduction in the valence of words output on a phonemic retrieval fluency task. We did, however, find evidence of a negativity reduction and a positivity effect on our episodic autobiographical memory task, and in appraisal of those memories, in older relative to younger adults. The results of our study are not readily accommodated by a processing fluency account. By this account, the fluency task should have revealed a bias in output, but it did not. Whether a positivity effect in older adults is observed seems to depend, at least in part, on whether or not the task is one which engages a self-reflective style of processing, and in so doing, primes emotional regulation goals.

Original manuscript received 6 July 2011
Revised manuscript accepted 26 November 2011
First published online 23 January 2012

REFERENCES

Addis, D. R., Leclerc, C. M., Muscatell, K. A., & Kensinger, E. A. (2010). There are age-related changes in neural connectivity during the encoding of positive, but not negative, information. *Cortex*, *46*, 425–433.

Bolla, K. I., Lindgren, K. N., Bonaccorsy, C., & Bleecker, M. L. (1990). Predictors of verbal fluency (FAS) in the healthy elderly. *Journal of Clinical Psychology*, *46*, 623–628.

Bradley, M. M., & Lang, P. J. (1999). *Affective norms for English words (ANEW): Stimuli, instruction manual and affective ratings*. Technical Report C-1, Gainesville, FL. The Center for Research in Psychophysiology, University of Florida.

Cacioppo, J. T., Berntson, G. G., Bechara, A., Tranel, D., & Hawkley, L. C. (2011). Could an aging brain contribute to subjective well-being? The value added by a social neuroscience perspective. In A. Tadorov, S. T. Fisk & D. Prentice (Eds.), *Social neuroscience: Toward understanding the underpinnings of the social mind* (pp. 249–263). New York, NY: Oxford University Press.

Carstensen, L. L. (1995). Evidence for a life-span theory of socioemotional selectivity. *Current Directions in Psychological Science*, *4*, 151–156.

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, *54*, 165–181.

Carstensen, L. L., Pasupathi, M., Mayr, U., Nesselroade, J. R. (2000). Emotional experience in everyday life across the adult life span. *Journal of Personality & Social Psychology*, *79*, 644–655.

Charles, S. T., & Carstensen, L. L. (2009). Social and emotional aging. *Annual Review of Psychology*, *61*, 383–409.

Charles, S. T., Mather, M., & Carstensen, L. L. (2003). Aging and emotional memory: The forgettable nature of negative images for older adults. *Journal of Experimental Psychology: General*, *132*, 310–324.

Comblain, C., D'Argembeau, A., & Van der Linder, M. (2005). Phenomenal characteristics of autobiographical memories for emotional and neutral events in older and younger adults. *Experimental Aging Research*, *31*, 173–189.

Conway, M. A., & Bekerian, D. A. (1987). Organization in autobiographical memory. *Memory & Cognition*, *15*, 119–132.

Dalgleish, T., Golden, A. J., Barrett, L. F., Yeung, C. A., Murphy, V., Tchanturia, K., Williams, J. M. G., Perkins, N., Barnard, P. J., Elward, R., & Watkins, E. (2007). Reduced specificity of autobiographical memory and depression: The role of executive control. *Journal of Experimental Psychology: General*, *136*, 23–42.

Fernandes, M., Ross, M., Wiegand, M., & Schryer, E. (2008). Are the memories of older adults positively biased? *Psychology and Aging*, *23*, 297–306.

Folstein, M. F., Folstein, S. F., & McHugh, P. R. (1975). Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*, 189–198.

Gallo, D. A., Korthauer, L. E., McDonough, I., Teshale, S., & Johnson, E. L. (2011). Age-related positivity effects and autobiographical memory detail: Evidence from a past/future source memory task. *Memory*, *19*, 641–52.

Grady, C. L., Hongwanishkul, D., Keightley, M., Lee, W., & Hasher, L. (2007). The effect of age on memory for emotional faces. *Neuropsychology*, *21*, 371–380.

Green, M. J., & Malhi, G. S. (2006). Neural mechanisms of the cognitive control of emotion. *Acta Neuropsychiatrica*, *18*, 144–153.

Grühn, D., Smith, J., & Baltes, P. B. (2005). No aging bias favoring memory for positive material: Evidence from a heterogeneity-homogeneity list paradigm using emotionally toned words. *Psychology and Aging*, *20*, 579–588.

Gutchess, A. H., Kensinger, E. A., & Schacter, D. L. (2007). Aging, self-referencing, and medial prefrontal cortex. *Social Neuroscience*, *2*, 117–133.

Holland, A. C., Tamir, M., & Kensinger, E. (2010). The effect of regulation goals on emotional event-specific knowledge. *Memory*, *18*, 504–521.

Isaacowitz, D. M., Wadlinger, H. A., Goren, D., & Wilson, H. R. (2006). Selective preference in visual fixation away from negative images in old age? An eye-tracking study. *Psychology and Aging*, *21*, 40–48.

Isaacowitz, D. M., Toner, K., Goren, D., & Wilson, H. R. (2008). Looking while unhappy: Mood-congruent gaze in young adults, positive gaze in older adults. *Psychological Science*, *19*, 848–853.

Isaacowitz, D. M., Toner, K., & Neupert, S. D. (2009). Use of gaze for real-time mood regulation: Effects of age and attentional functioning. *Psychology and Aging*, *24*, 989–994.

Jansari, A., & Parkin, A. J. (1996). Things that go bump in your life: Explaining the reminiscence bump in autobiographical memory. *Psychology and Aging*, *11*, 85–91.

Kennedy, Q., Mather, M., & Carstensen, L. L. (2004). The role of motivation in the age-related positivity effect in autobiographical memory. *Psychological Science*, *15*, 208–214.

Kensinger, E. A., & Schacter, D. L. (2008). Neural processes supporting young and older adults' emotional memories. *Journal of Cognitive Neuroscience*, *20*, 1161–1173.

Kensinger, E. A., Growdon, J. H., Brierley, B., Medford, N., & Corkin, S. (2002). Effects of normal aging and Alzheimer's disease on emotional memory. *Emotion*, *2*, 118–134.

Knight, M., Seymour, T. L., Gaunt, J. L., Baker, C., Nesmith, K., & Mather, M. (2007). Aging and goal-directed emotional attention: Distraction reverses emotional biases. *Emotion*, *7*, 705–714.

Leclerc, C. M., & Kensinger, E. A. (2008). Age-related differences in medial prefrontal activation in response to emotional images. *Cognitive, Affective, & Behavioral Neuroscience*, *8*, 153–164.

Leclerc, C. M., & Kensinger, E. A. (2010). Age-related valenced-based reversal in recruitment of medial prefrontal cortex on a visual search task. *Social Neuroscience*, *5*, 560–576.

Levine, L. J., & Bluck, S. (1997). Experienced and remembered emotional intensity in older adults. *Psychology and Aging*, *12*, 514–523.

Löckenhoff, C. E., & Carstensen, L. L. (2007). Aging, emotion, and health-related decision strategies: Motivational manipulations can reduce age differences. *Psychology and Aging*, *22*, 134–146.

Mather, M., & Carstensen, L. L. (2003). Aging and attentional biases for emotional faces. *Psychological Science*, *14*, 409–415.

Mather, M., & Carstensen, L. L. (2005). Aging and motivated cognition: The positivity effect in attention and memory. *Trends in Cognitive Sciences*, *9*, 496–502.

Mather, M., & Knight, M. (2005). Goal-directed memory: The role of cognitive control in older adults' emotional memory. *Psychology and Aging*, *20*, 554–570.

Mikels, J. A., Larkin, G. R., Reuter-Lorenz, P. A., & Carstensen, L. L. (2005). Divergent trajectories in the aging mind: Changes in working memory for affective versus visual information with age. *Psychology and Aging*, *20*, 542–553.

Miller, E. K. (2000). The prefrontal cortex and cognitive control. *Nature Reviews Neuroscience*, *1*, 59–65.

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.

Nashiro, K., Sakaki, M., & Mather, M. (2011). Age differences in brain activity during emotion processing: Reflections of age-related decline or increased emotion regulation? *Gerontology*. Advance online publication. doi:10.1159/000328465

Nelson, H. E. (1992). *The National Adult Reading test (NART-R): Test manual*. Windsor, UK: NFER.

Neshat-Doost, H. T., Dalgleish, T., & Golden, A. J. (2008). Reduced specificity of emotional autobiographical memories following self-regulation depletion. *Emotion*, *8*, 731–736.

Ochsner, K. N., & Gross, J. J. (2005). The cognitive control of emotion. *Trends in Cognitive Sciences*, *9*, 242–249.

Petrican, R., Moscovitch, M., & Schimmack, U. (2008). Cognitive resources, valence, and memory retrieval of emotional events in older adults. *Psychology and Aging*, *23*, 585–594.

Piolino, P., Coste, C., Martinello, P., Mace, A., Quinette, P., Guillery-Girard, B., & Belleville, S. (2010). Reduced specificity of autobiographical memory and aging: Do the executive and feature binding functions of working memory have a role? *Neuropsychologia*, *48*, 429–440.

Reitan, R. M., & Wolfson, D. (1985). *The Halstead-Reitan Neuropsychological Test Battery: Therapy and clinical interpretation*. Tucson, AZ: Neuropsychological Press.

Ritchey, M., Bessette-Symons, B., Hayes, S. M. Cabeza, R. (2011). Emotion processing in the aging brain is modulated by semantic elaboration. *Neuropsychologia*, *49*, 640–650.

Ros, L., & Latorre, J. M. (2010). Gender and age differences in the recall of affective autobiographical memories using the autobiographical memory test. *Personality and Individual Differences*, *49*, 950–954.

Rubin, D. C., & Schulkind, M. D. (1997). Distribution of important and word-cued autobiographical memories in 20-, 35-, and 70-year-old adults. *Psychology and Aging*, *12*, 524–535.

Scheibe, S., & Carstensen, L. L. (2010). Emotional aging: Recent findings and future trends. *Journal of Gerontology: Psychological Sciences*, *65B*, 135–144.

Schlagman, S., Kliegel, M., Schulz, J., & Kvavilashvili, L. (2009). Differential effects of age on involuntary and voluntary autobiographical memory. *Psychology and Aging*, *24*, 397–411.

Serrano, J. P., Latorre. J. M., & Gatz, M. (2007). Autobiographical memory in older adults with and without depressive symptoms. *International Journal of Clinical and Health Psychology*, *7*, 41–57.

Spreen, O., & Strauss, E. (1998). *A compendium of neuropsychological tests*. New York, NY: Oxford University Press.

St. Jacques, P., Dolcos, F., & Cabeza, R. (2010). Effects of aging on functional connectivity of the amygdala during negative evaluation: A network analysis of fMRI data. *Neurobiology of Aging*, *31*, 315–327.

Tomaszczyk, J. C., Fernandes, M. A., & MacLeod, C. M. (2008). Personal relevance modulates the positivity bias in recall of emotional pictures in older adults. *Psychonomic Bulletin & Review*, *15*, 191–196.

Troyer, A. K., Moscovitch, M., & Winocur, G. (1997). Clustering and switching as two components of verbal fluency: Evidence from younger and older healthy adults. *Neuropsychology*, *11*, 138–146.

Verhaeghen, P. (2003). Aging and vocabulary scores: A meta-analysis. *Psychology and Aging*, *18*, 332–339.

Watson, D., & Clark, L. A. (1994). *The PANAS-X: Manual for the Positive and Negative Affect Schedule-Expanded form*. Unpublished manuscript, University of Iowa.

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale-III*. San Antonio, TX: The Psychological Corporation.

Yang, L., & Hasher, L. (2011). Age differences in the automatic accessibility of emotional words from semantic memory. *Cognition and Emotion*, *25*, 3–9.

Yang, L, & Ornstein, T. J. (2011). The effect of emotion-focused orientation at retrieval on emotional memory in young and older adults. *Memory*, *19*, 305–313.