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Preferring positivity : age differences in judgments of learning and memory for emotionally-valenced words

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Preferring Positivity: Age Differences in Judgments of Learning and Memory for Emotionally-Valenced Words

by

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Abstract

Many changes occur with age, including changes in emotion regulation and memory. The Socioemotional Selectivity Theory (Carstensen, 2006) posits that older adults tend to be more concerned with emotionally meaningful goals and therefore experience what is called the "positivity effect" with age. The positivity effect results in a bias in attention and memory towards positive stimuli over neutral and negative stimuli. Age-related changes also arise in memory monitoring, specifically in Judgments of Learning (JOLs), when individuals learn emotional words. We examined the presence of the positivity effect in memory and JOLs for positive, negative, and neutral words. Younger and older adults (N=83) viewed words of each valence category and made immediate JOLs, followed by a two-alternative forced choice recognition memory task. The positivity effect was not supported in number correct on the memory task, but it was suggested by the number of positive lures incorrectly identified by older adults relative to that of younger adults. Importantly, JOL ratings suggested a positivity bias in older adults and an emotional salience effect in younger adults. Results of the Positive and Negative Affect Schedule (PANAS) also provided support for the positivity effect in affect scores for older adults relative to younger adults. These results strongly suggest that the positivity effect extends beyond performance on a memory task to metacognition and emotion.

Keywords: older adults, memory, emotion, cognition, aging, positivity, judgments of learning

Preferring Positivity: Age Differences in Judgments of Learning and Memory for Emotionally-Valenced Words

Memory performance is sensitive to different types of memory tests and memory stimuli. For example, the emotional valence of test stimuli is known to play a major role in memory. Previous research has shown that emotional stimuli boost memory performance in both younger and older adults (Kensinger & Corkin, 2003; Mather & Carstenson, 2005). When presented with emotionally-valenced and neutral pictures, younger and older adults remembered emotionally-valenced pictures better than neutral ones (Mather & Carstenson, 2005). This study also revealed that while older adults were less likely to remember the pictures overall, the age difference was greatest for the negative pictures and smallest for the positive pictures, revealing an age by valence interaction driven by emotional content of stimuli. This demonstrates the fact that memory is influenced by the emotional content of stimuli differently for younger and older adults. Specifically, older adults experience a bias of attention and memory for positive stimuli over neutral and negative stimuli (Kensinger, 2008; Reed & Carstensen, 2012), a trend known as the "positivity effect" (Carstensen, 2006).

This effect is explained by the Socioemotional Selectivity Theory (SEST; Carstensen, 2006), which posits that as humans age, and their perceived time left to live shrinks, their goals and motivations change. When time is perceived as plentiful and relatively unlimited, as in younger adulthood, individuals' goals tend to focus on acquiring knowledge and new experiences. When time is perceived as precious and relatively limited, as in older adulthood, individuals tend to focus on goals relating to emotionally meaningful states and experiences. In one study by Fung and Carstensen (2003), older and younger adults were shown advertisements that were related to either gaining knowledge (e.g., "Capture the unexplored world") or an

emotionally meaningful reward (e.g., “Capture those special moments”). Older adults not only preferred the emotionally meaningful advertisement to the knowledge-based advertisement, but they also better remembered its content, demonstrating the impact that emotional goals can have on memory in older adults. The relative shift from seeking all knowledge, which would include both positive and negative information, to seeking emotionally rewarding experiences may represent a regulatory mechanism employed by older adults. As a result, they may attend to and better remember positive information rather than negative in an attempt to create an environment that is less expansive and more emotionally rewarding, resulting in the positivity effect.

This change in emotion regulation is not only due to prioritizing new goals that redirect motivation as suggested by the SEST, but also to cognitive mechanisms that allow older adults to better regulate their emotional states (Mather & Carstensen, 2005). Mather et al. (2004) found that when presented with emotionally positive, neutral, and negative images, younger adults showed significantly increased amygdala activation in response to both positive and negative images, while older adults showed increased activation only in response to positive images. This suggests that older adults avoid or neglect negative material at early stages of processing (e.g., attention and encoding), as well as at recall (Mather et al., 2004). Older adults may process negative information less deeply than positive, demonstrating a cognitive response in older adults that allows them to prioritize positive information and avoid or ignore negative.

These findings from basic research support predictions from a process model of emotional regulation (Gross, 1998). This model can be used to understand age-related differences in attentional and memory processes. The model comprises five strategies deployed in sequence to regulate emotions. The first, situation selection, requires less cognitive resources than subsequent strategies, such as cognitive change or reappraisal, which involves reinterpreting

the situation to change its meaning in a way that alters the following emotional response (Urry & Gross, 2010). These differences in cognitive demands lead to differences in emotion regulation between younger and older adults, specifically in the strategies they utilize. Older adults must select and optimize their emotion regulation resources, as suggested by the selection, optimization, and compensation meta-theory applied to emotion regulation (SOC-ER; Urry & Gross, 2010). For instance, due to reduced processing resources (e.g., working memory), older adults tend to be less successful at certain emotion regulation strategies such as cognitive reappraisal (Opitz, Rauch, Terry, & Urry, 2012). To compensate, older adults rely on their smaller, yet more intimate groups of friends to receive more encouragement and positive social support to cope with stressful situations, relative to younger adults. Consequently, older adults are expected to select and optimize the emotion regulation strategy of situation selection more frequently and successfully than younger adults based on the SOC-ER model (Urry & Gross, 2010). Selecting more positive situations and less negative situations suggests attentional biases for older adults, whereby older adults may attend to positive information and avoid negative information or situations (Isaacowitz, Wadlinger, Goren, & Wilson, 2006).

The current study sought to examine the positivity effect in the context of Judgments of Learning (JOLs), which assess how much information an individual believes is known (Townsend & Heit, 2011). JOLs are typically presented on a percentage scale to indicate what percentage of information the individual believes has been learned. JOLs are often applied to the context of studying, as it is important to be able to identify what information is known and not known in order to direct further study and improve learning outcomes (Metcalfe & Kornell, 2005; Kornell & Metcalfe, 2006; Kornell & Bjork, 2007). Kornell and Matcalfe (2006), for example, demonstrated that when learners select items for restudy, those whose choices were

honored performed better than those whose choices were dishonored. Metcalfe and Finn (2008) also showed that JOLs have a direct relationship with which material is selected to be restudied. These findings indicate that individuals are seemingly aware of which items could benefit from restudy, and they tend to choose those items in order to improve learning and memory performance.

Generally, research has found that JOLs are somewhat accurate in relation to actual memory performance. Nelson and Dunlosky (1991) found that JOLs are highly accurate in relation to recall when JOLs were delayed for a short period of time after study. While immediate JOLs are much less accurate than delayed JOLs, they still show above-chance accuracy. Research largely shows that this ability to judge learning remains relatively intact with age (Dunlosky, Baker, & Rawson, 2006; Castel, Middlebrooks, & McGillivray, 2016; Hertzog & Dunlosky, 2011), while some research suggests that the ability to judge learning is impaired with age (Daniels, Toth, & Hertzog, 2009; Morson, Moulin & Souchay, 2015; Toth, Daniels, & Solinger, 2011). To further investigate age differences in JOL ratings and accuracy, research has begun to examine the role of emotion.

A study by Tauber and Dunlosky (2012) investigated and found age differences in monitoring of learning for emotional words versus neutral words. Overall, JOLs were higher for emotional words relative to neutral for younger adults, a trend supported by other research (Zimmerman & Kelley, 2010; Nomi, Rhodes, & Cleary, 2013; Hourihan & Bursey, 2015). Tauber and Dunlosky found that for older adults, JOL ratings were higher for negative words relative to neutral, and an age-related monitoring deficit occurred for positive words. Older adults' JOLs did not differ between positive and neutral words. Tauber, Dunlosky, Urry, and Opitz (2017) sought to investigate whether this age difference arises when younger and older

adults study positive and negative pictures, as opposed to words. They found an emotional salience effect on JOLs for both younger and older adults, and did not find support for a monitoring deficit in older adults for learning positive pictures relative to neutral. These results fail to confirm a bias for positive information as demonstrated in the positivity effect, thus further research is warranted.

The purpose of the current study was to test whether the positivity effect is exhibited in JOLs for emotionally valenced words, as in Tauber and Dunlosky (2012). However, the present study's methodology differs in several ways from that used by Tauber and Dunlosky. We used two blocks of 45 words (15 of each valence type) for study in contrast to one block of 30 words (10 of each valence type). By tripling the number of trials, we provide a more reliable measure of memory. Additionally, our participants viewed words for 2.5 sec each whereas participants in Tauber and Dunlosky viewed words for 5 sec each. This reduced encoding time by half, which may influence both JOLs and memory performance. At test, we used a two-alternative forced choice recognition memory test in contrast to the free recall format used by Tauber and Dunlosky. Moreover, we combined each of the three differently valenced target word types with each of the three differently valenced lure types, resulting in nine target-lure test type stimuli that were completely crossed. Finally, our process of selecting word stimuli was different. We selected our word stimuli from a pool of words created by Wolfe, Sanders, Zakrzewski, and Berry (2017). Specifically, younger and older participants rated 398 words on subjective valence and arousal. Words with valence or arousal ratings that differed significantly between age groups were eliminated. Thus, the final database of word stimuli were comprised of words with comparable valence and arousal ratings for each age group. In contrast, Tauber and Dunlosky

chose words from a study by Zimmerman and Kelley (2010) that had been rated on valence and arousal by younger adults, but did not consider ratings from both age groups.

Selecting from the word database created by Wolfe et al. (2017) served the additional purpose of eliminating highly arousing words. Indeed, Tauber and Dunlosky suggested that future studies should use valenced word stimuli with higher levels of arousal to produce a more powerful test of the age-related positivity bias. However, a study by Kensinger (2008) suggests that this strategy may have the opposite effect. Using words that varied by valence and arousal levels, Kensinger found that high arousal diminished the positivity effect. While valence refers to how positive or negative a word is, arousal refers to how exciting or agitating or calming or subduing a word is. Words of the same valence can have different arousal levels, which can influence encoding and recall processes. In the Kensinger study, neutral and either arousing or nonarousing positive and negative words were used. Participants studied 25 words, five each from neutral, positive-arousing, positive-nonarousing, negative-arousing, and negative-nonarousing categories. Participants were instructed to pay careful attention to the words, and then were asked to write down all of the words that they remembered from the list. Results revealed a positivity effect for older adults, characterized by better recall of emotionally positive words rather than emotionally negative words, unless the words are highly arousing. Younger and older adults remembered positive and negative arousing words equally well and more often than neutral. However, younger adults remembered negative nonarousing words better than positive nonarousing words, while older adults remembered positive nonarousing words better than negative nonarousing words. By selecting our word stimuli from the pool created by Wolfe et al. (2017), the current study sought to hold arousal level constant between valence levels and

age groups, thus addressing the limitation encountered by Tauber and Dunlosky, who failed to find a positivity effect in their older adult sample.

Our study investigated the positivity effect for memory and metacognition for words. We hypothesized that overall, older adults would have lower memory performance than younger adults. Additionally, we predicted that younger adults' memory performance would be higher for positive and negative words than for neutral, while older adults' memory performance would be higher for positive words than for negative, and lowest for neutral. Our metacognitive question focused on confidence ratings (JOL responses) for emotionally valenced words. We hypothesized that younger adults would be more confident regarding learning negative and positive words than neutral words, while older adults would be more confident for positive than negative, and least confident for neutral.

Method

Participants

Forty-two younger adults from ages 18 to 23 (33 female, M = 19.36, *SD* = 1.32) were recruited through the University of Richmond Psychology Department and through campus email announcements, and they were either offered course credit for their participation or were recruited as volunteers. Forty-three older adults from ages 65 to 90 (23 female, *M* = 73.81, *SD* = 6.37) were recruited from the Richmond area through newspaper advertisements and received $20 for participation. All of the participants were in good health (M = 8.00, SD = 1.55) and reported no history of Alzheimer's or other memory disorders. The majority of the participants were Caucasian (66 participants), followed by Asian/Asian American (6), African American (3), Hispanic (3), Latino (1), and other (4). English was the first language of the majority of the participants (78 participants). Older adults had higher vocabulary scores (*M* =28.80, *SD* = 3.35)

than did younger adults (M = 24.93, SD = 2.53), $t(83)$=-6.01, p = .001, as measured by the Ekstrom, French, Harman, and Dermen Synonyms Test (1976), a vocabulary test. Younger adults exhibited higher processing speeds (M = 66.69, SD = 10.23) than did older adults (M = 44.84, SD = 11.61), $t(83)$=9.20, p = .001, as shown by the WAIS-R Digit-Symbol Substitution Task (DSST, Wechsler, 1981). Younger adults also exhibited higher memory skills (M = 21.64, SD = 5.60) than did older adults (M = 16.51, SD = 4.68), $t(83) = 4.59$, $p < .001$, as shown by the Wechsler Memory Scale-Revised (WMS-R, Wechsler, 1981). Vocabulary skills, processing speeds, memory scores, and background characteristics of participants are shown in Table 1.

Study Design

The study employed a mixed design with age group (younger, older adults) as a between-subjects factor and valence type (positive, negative, neutral word-pairs) as a within-subjects factor. Three separate mixed ANOVAs were conducted, with number of words correctly recognized, number of words incorrectly recognized in a two-alternative forced choice memory test, and JOL ratings as dependent variables.

Stimuli

Word stimuli were drawn from a pool created by Wolfe and Sanders (2017), whose word stimuli consisted of nouns from the Affective Norms for English Words database (ANEW; Bradley & Lang, 1999) that were rated on valence and arousal by younger and older adults. We initially selected 204 words from the pool, from which 180 words were divided into four lists of 45 words to be randomly assigned as target or lure stimuli. Within each list, 15 words were positively valenced, 15 were neutral, and 15 were negatively valenced. The negative words had the lowest mean valence (M = 2.28), the positive words had the highest mean valence (M = 7.58), with the neutral group falling between the two extremes (M = 5.20), all p's < .001. Mean

arousal scores did not differ between negative (M = 5.47) and positive (M = 5.44) word groups but were both significantly greater than the neutral group (M = 3.84), both p's < .001. The four lists had equivalent valence and arousal levels. Four words were chosen to be practice target words, four to be lures for the practice target words, eight to be buffer targets, and eight to be lures for the buffer words.

Materials

Positive and Negative Affect Schedule (PANAS):

We used the Positive and Negative Affect Schedule (PANAS) to assess current and past affect. Twenty words are presented to participants, who are asked to indicate how well each word describes their experience. Half of the words indicate negative affect (e.g., proud) and half indicate positive affect (e.g., nervous). We asked participants to rate the words based on their feelings in the current moment, and again, based on how they had felt over the previous week.

Prioritizing Positivity:

We used the Prioritizing Positivity Scale (Catalino, Algoe, & Fredrickson, 2014) to assess daily feelings of positive emotions. The 6-item scale is meant to measure "seeking positivity" by focusing on how people "make decisions about how to organize their day-to-day lives." Participants rate each item on a scale ranging from 1 (*strongly disagree*) to 9 (*strongly agree*).

Digit Symbol Substitution Task:

Participants completed the Digit Symbol Substitution Task (Wechsler, 1981) to assess speed of processing.

Vocabulary Task:

Participants completed the Ekstrom, French, Harman, and Dermen Synonyms Test (1976) to assess basic vocabulary skills.

Wechsler Memory Scale-Revised (WMS-R):

We used the Wechsler Memory Scale-Revised (WMS-R; Wechsler, 1981) to assess basic memory skills. Two short stories were read to the participants, and they were then asked to repeat as much of the story as they could remember in as much detail as possible.

Background Information Questionnaire:

Participants completed a background information questionnaire with items assessing basic demographic information, including age, gender, race/ethnicity, education, marital status, and self-rated health, hearing, and vision.

Procedure

Participants were tested individually by an experimenter in a quiet room. Before beginning the experiment, participants read and completed a consent form.

The study phase, the pattern comparison task (Salthouse & Babcock, 1991) which served as a distractor between the study and test portions, and the test phase were programmed and run on E-Prime version 2.0 (Psychology Software Tools, Pittsburgh, PA).

Participants were given an overview of the experiment and told that they would be studying words and completing ratings of their confidence for remembering those words before being tested on them in a memory task. They completed a practice block to become familiar with the procedure. In the study phase, they viewed four words for 2.5 seconds each, and completed JOLs after each word was presented. They then completed a 15-second distractor task. In the subsequent test phase, they were presented with two words on the screen and asked to indicate

which word they had viewed during study. There were four test trials (one for each word presented during study).

Participants completed two blocks of the study phase, distractor task, and test phase. For each block, participants were randomly assigned one of four lists of 45 words (15 of each valence type) to view in randomized order during the study phase, which followed the same procedure as in the practice block. Two buffer words were presented at the beginning and end of the study phase. After viewing and completing JOLs for each of the 49 words, participants completed the distractor task for 20 seconds before completing the test phase. A second list of 45 words was randomly assigned to serve as lures for each of the 45 target words viewed during study. Five of the positive targets were presented with a positive lure, five with a neutral lure, and five with a negative lure, but the specific target and lure words presented together were randomized. The same pattern applied to neutral and negative targets. Lures were also assigned to the four buffer words. Participants completed 49 trials in randomized order that followed the same test procedure as in the practice block. Across the two blocks, each participant received all four lists of 45 words, two of which were randomly chosen to serve as targets, and two randomly chosen to serve as lures.

After completion of this portion of the experiment, participants completed PANAS ratings for the current moment, the Prioritizing Positivity Scale, the Digit Symbol Substitution Task, a vocabulary task, the Wechsler Memory Scale-Revised, a background and demographic information questionnaire, and last, PANAS ratings for the past week. Participants were then debriefed and reimbursed, unless they had participated on a volunteer basis.

Results

Memory Performance

Number Correct

The number of correct responses (the number of times the participant correctly identified the target word they had viewed during study) was summed for younger and older adults within each target valence category.

A 2 (age group) x 3 (target valence) mixed ANOVA was conducted to examine age differences in number of correct responses across the three target valence categories. Results are displayed in Figure 1. The main effect of age was significant, $F(1, 83) = 26.22$, $p < .001$. Younger adults made a significantly higher number of correct responses ($M = 87.05$, $SD = 2.68$) than older adults did ($M = 80.85$, $SD = 7.37$). The main effect of target valence was marginally significant, $F(2, 166) = 2.56$, $p = .081$. Participants had significantly more correct responses for positive words ($M = 28.17$, $SD = 1.99$) than for neutral ($M = 27.64$, $SD = 2.98$), $p = .037$, and marginally more correct responses for negative words ($M = 28.12$, $SD = 2.51$) than for neutral, $p = .063$. The age group x target valence interaction was marginally significant, $F(2, 166) = 2.87$, $p = .06$. For younger adults, there were no significant differences between any of the valence categories ($ps > .10$). Older adults had significantly more correct responses for positive words ($M = 27.40$, $SD = 2.32$) than for neutral ($M = 26.28$, $SD = 3.51$), $p = .014$, and marginally more correct responses for negative words ($M = 27.19$, $SD = 3.14$) than for neutral, $p = .058$.

Number Incorrect

The number of errors (the number of times the participant selected a lure instead of a target) was summed for younger and older adults within each lure valence category.

A 2 (age group) x 3 (lure valence) mixed ANOVA was conducted to examine age differences in number of errors across the three lure valence categories. Results are displayed in Figure 2. The main effect of age was significant, $F(1,83) = 26.22$, $p < .001$. Younger adults made

significantly fewer errors (M = 2.95, SD = 2.68) than older adults did (M = 9.14, SD = 7.37). The main effect of lure valence was also significant, $F(2, 166) = 6.40$, $p = .002$. Participants made significantly more errors when the lure was positive (M = 2.35, SD = 3.13) than when the lure was neutral (M = 1.50, SD = 1.90), $p = .002$, and significantly more errors when the lure was negative (M = 2.26, SD = 2.42) than when the lure was neutral, $p < .001$. The age group x lure valence interaction was significant, $F(2, 166) = 3.52$, $p = .032$. Younger adults made marginally more errors when the lure was negative (M = 1.21, SD = 1.32) than when the lure was neutral (M = .79, SD = 1.14), p =.060. Older adults made significantly more errors when the lure was positive (M = 3.72, SD = 3.71) than when the lure was neutral (M = 2.19, SD = 2.23), $p = .001$, and significantly more errors when the lure was negative (M = 3.23, SD = 2.82) than when the lure was neutral, $p = .003$.

Judgments of Learning (JOLs)

A 2 (age group) x 3 (valence) mixed ANOVA was conducted to examine age differences in JOL ratings across the three valence categories. Results are displayed in Figure 3. The main effect of age was significant, $F(1, 83) = 6.63$, $p < .012$. Younger adults had significantly lower JOL ratings (M = 3.98, SD = .59) than older adults did (M = 4.42, SD = .94). The main effect of valence was also significant, $F(2, 166) = 31.71$, $p < .001$. Participants made significantly higher JOL ratings for positive words (M = 4.40, SD = .89) than for both negative (M = 4.25, SD = .84), $p = .008$, and neutral (M = 3.95, SD = .89), $p < .001$, and significantly higher JOL ratings for negative words than for neutral $p < .001$. The age group x lure valence interaction was significant, $F(2, 166) = 7.74$, $p < .001$. Younger adults made significantly higher JOL ratings for both positive words (M = 4.16, SD = .72), $p < .001$, and negative words (M = 4.15, SD = .66), $p < .001$, than for neutral (M = 3.62, SD = .64). Younger adults' JOL ratings for positive and

negative words did not differ from each other, $p > .10$. Older adults made significantly higher JOL ratings for positive ($M = 4.63$, $SD = .99$) than for both neutral ($M = 4.27$, $SD = .97$), $p < .001$, and negative ($M = 4.35$, $SD = .99$), $p < .001$. Older adults' JOL ratings for negative and neutral words did not differ from each other $p > .10$.

JOL Accuracy

Gamma coefficients and Pearson's correlation coefficients were calculated for each participant. These measures were used to examine age differences in JOL accuracy.

The magnitude of gamma did not differ by age group: Younger adults' gamma ($M = .15$, $SD = .48$) and older adults' gamma ($M = .12$, $SD = .47$), $t(83) = -0.49$, $p > .10$. Likewise, Pearson correlations were comparable between age groups: Younger adults' r ($M = .03$, $SD = .11$) and older adults' r ($M = .04$, $SD = .09$), $t(83) = .351$, $p > .10$. These results suggest that metacognitive accuracy was similar in younger and older adults.

Positive and Negative Affect Schedule (PANAS)

Half of the words on the PANAS were positive in affective tone, and half were negative. Participants' ratings were summed within the two categories to determine their positive and negative affect scores. A 2 (age group) x 2 (affect) mixed ANOVA was conducted to examine age differences in affect for each version of the PANAS (current and past week). The results for PANAS current are displayed in Figure 4a, and results for PANAS past week are displayed in Figure 4b.

Current

The main effect of age was significant, $F(1, 81) = 11.56$, $p = .001$. Older adults' total PANAS current scores were significantly higher ($M = 46.76$, $SD = 6.79$) than younger adults' total PANAS current scores ($M = 41.22$, $SD = 8.02$). There was a significant main effect of

affect, in which mean positive affect scores were significantly greater (M = 30.67, SD = 7.45) than mean negative affect scores (M = 13.42, SD = 3.74), $F(1, 81) = 538.95$, $p < .001$. Results revealed a significant age group x affect interaction effect, $F(1, 81) = 55.76$, $p < .001$. Younger adults had higher positive affect scores (M = 26.46, SD = 5.83) than negative affect scores (M = 14.76, SD = 4.40), $p < .001$. Older adults also had higher positive affect scores (M = 34.76, SD = 6.55) than negative affect scores (M = 11.98, SD = 2.18), $p < .001$, but this difference was greater than for younger adults.

Past Week

Results for the past week version of the PANAS followed similar trends to those of the current version. There was a significant main effect of age $F(1, 82) = 4.47$, $p = .037$. Younger adults' total PANAS past week scores were significantly higher (M = 53.43, SD = 7.99) than older adults' total PANAS past week scores (M = 49.93, SD = 7.15). There was a significant main effect of affect, in which mean positive affect scores were significantly greater (M = 33.37, SD = 6.72) than mean negative affect scores (M = 18.26, SD = 6.65), $F(1, 82) = 242.78$, $p < .001$. Results revealed a significant age group x affect interaction effect, $F(1, 82) = 44.40$, $p < .001$. Younger adults had higher positive affect scores (M = 31.02, SD = 6.17) than negative affect scores (M = 22.40, SD = 6.67), $p < .001$. Older adults also had higher positive affect scores (M = 35.71, SD = 6.49) than negative affect scores (M = 14.21, SD = 3.38), $p < .001$, but this difference was greater than for younger adults.

Prioritizing Positivity

The six items of the prioritizing positivity measure (α = .86) were averaged to create prioritizing positivity scores for each participant. Prioritizing positivity did not differ between

younger (M = 7.58, SD = 4.84) and older adults (M = 6.88, SD = 1.51), $t(83) = 0.90$, $p = .369$. Table 1 shows age differences for each item of the scale.

Discussion

We investigated the presence of the positivity effect in confidence for remembering words by examining age differences in JOL ratings for positive, negative, and neutral words. We hypothesized that overall, older adults would have lower memory performance than younger adults. Additionally, we predicted that younger adults' memory performance would be higher for positive and negative words than for neutral, while older adults' memory performance would be higher for positive words than for negative, and lowest for neutral. We predicted a similar trend for JOL ratings, in which younger adults would be more confident for negative and positive words than for neutral (demonstrating an emotional salience effect), while older adults would be more confident for positive words than for negative, and least confident for neutral (demonstrating a positivity effect).

As predicted, younger adults performed better on the memory task than older adults. However, our results did not support the predicted emotional salience effect in younger adults or a positivity bias in older adults for the number of correct responses in the memory task. The number of correct responses for younger adults did not differ between valence categories, while older adults' correct responses were significantly higher for both positive and negative words relative to neutral. This suggests that the older adults responded more to emotional stimuli than younger adults did, but does not show support for the positivity effect in memory performance.

The impact of valence on memory was also examined in incorrect responses across the three lure valence categories. Younger adults made marginally more errors when the lure was negative than when the lure was positive or neutral. Older adults made more errors when the lure

was positive or negative than when the lure was neutral. This again demonstrates that older adults may be more drawn to emotional stimuli than younger adults are. Additionally, evidence of a positivity bias relative to younger adults is suggested by the significant difference between positive and neutral found in older adults' error types but not in younger adults' errors types.

The results of JOL analyses supported our hypothesis that there is an emotional salience effect for younger adults' confidence for remembering words and a positivity bias for older adults' confidence. Younger adults were significantly more confidence for positive and negative words relative to neutral, while their confidence ratings for positive and negative words did not differ. In contrast, older adults were significantly more confident for positive words than for negative and neutral, while their confidence ratings for negative and neutral did not differ, demonstrating a positivity bias in JOL ratings for older adults. Our results for JOL ratings are consistent with Tauber and Dunlosky's (2012) results, except that we found evidence of the positivity effect that their results failed to support. This key difference may be due to the differences in methodology, such as including valence and arousal ratings from both age groups when selecting word stimuli and the use of a two-alternative forced choice recognition memory task as opposed to free recall.

Evidence of the positivity effect was further supported by the interaction effect found in the PANAS scores. While younger and older adults both had higher positive affect scores than negative, for both current and past affect, this difference was significantly greater for older adults, demonstrating an increase in positive affect and a decrease in negative affect with age. This effect, along with the positivity bias found in JOL ratings for older adults, strongly suggests that the positivity effect extends beyond performance on a memory task to metacognition and emotion.

A limitation of this study was that the memory task did not appear to be difficult enough. Although participants had only 2.5 seconds to view each word during the study phase, the mean number of correct responses for younger adults was 87.05 (*SD* = 2.68) out of 90, suggesting a ceiling effect. This limited us from being able to thoroughly examine effects of valence on younger adults' performance. The mean number of correct responses for older adults was 80.85 (*SD* = 7.37), which was not at ceiling but still suggested that the task may have been too easy. Future studies should make the memory task more difficult by using more words, using more challenging words, or having a shorter view time. It is also possible that the two-alternative forced choice paradigm was easier for participants than other memory tests such as cued-recall or free recall, but the use of lures presented alongside the targets allowed us to investigate the effects of lure valence. Furthermore, it is also a possibility that the act of completing judgments of learning strengthens memory for the words being studied. Time spent completing these judgments, as well as their range, should be analyzed to examine whether certain participants are potentially more invested in this task, and how that informs performance on the memory test.

Additionally, our results showed very low levels of JOL accuracy for younger and older adults, contradicting the general finding that younger and older adults are relatively accurate at making these judgments (Nelson & Dunlosky, 1991; Dunlosky, Baker, & Rawson, 2006; Castel, Middlebrooks, & McGillivray, 2016; Hertzog & Dunlosky, 2011). We had hoped to examine effects of valence on JOL accuracy for younger and older adults, but that was not possible with such low accuracy levels overall. This trend should be explored in future studies.

Overall, the presence of the positivity effect in confidence for remembering words is a novel finding, and along with the need to address the limitations of this study, it warrants further investigation.

Tables & Figures

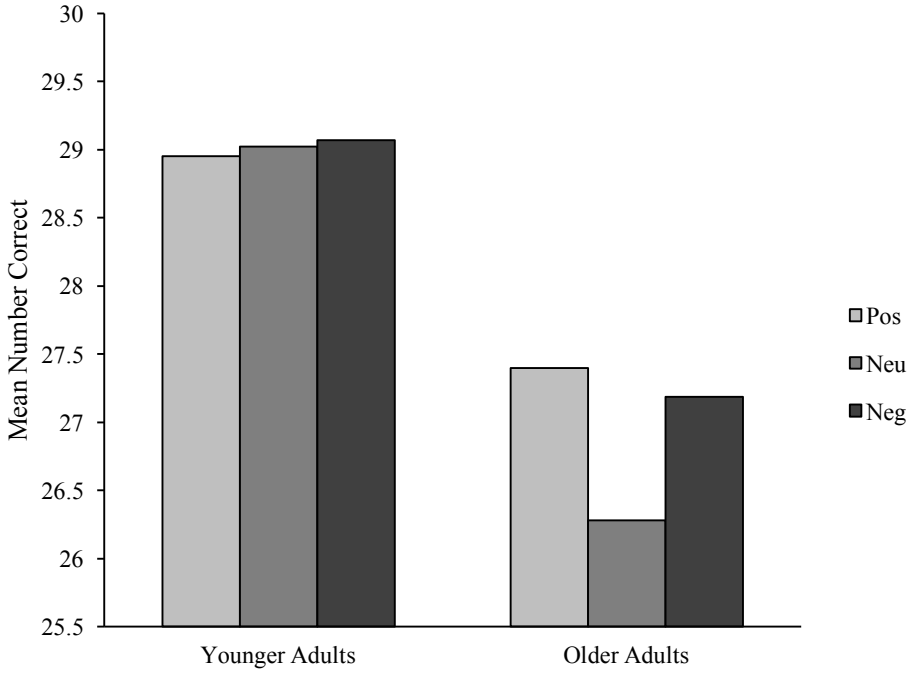

Figure 1. Mean number correct for each target valence by age group.

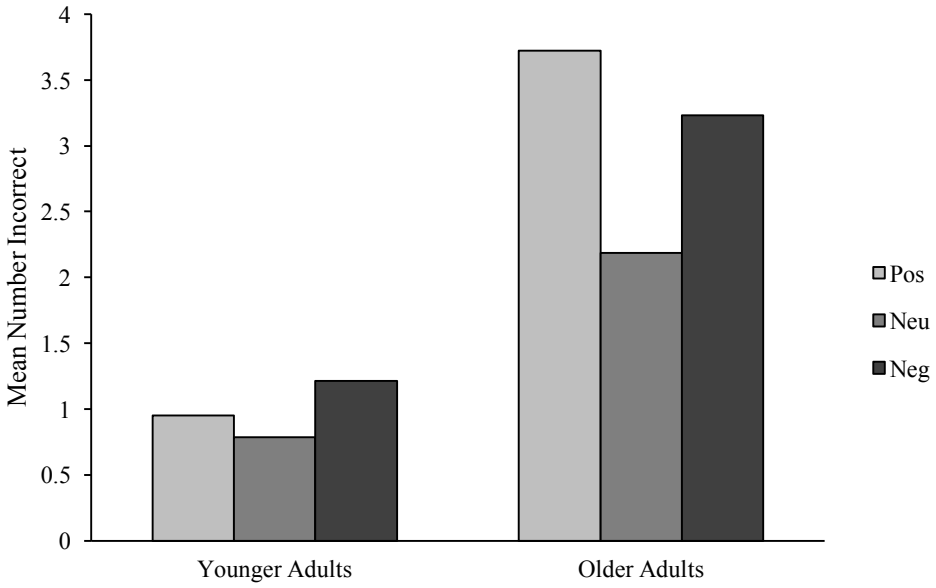

Figure 2. Mean number incorrect for each lure valence by age group.

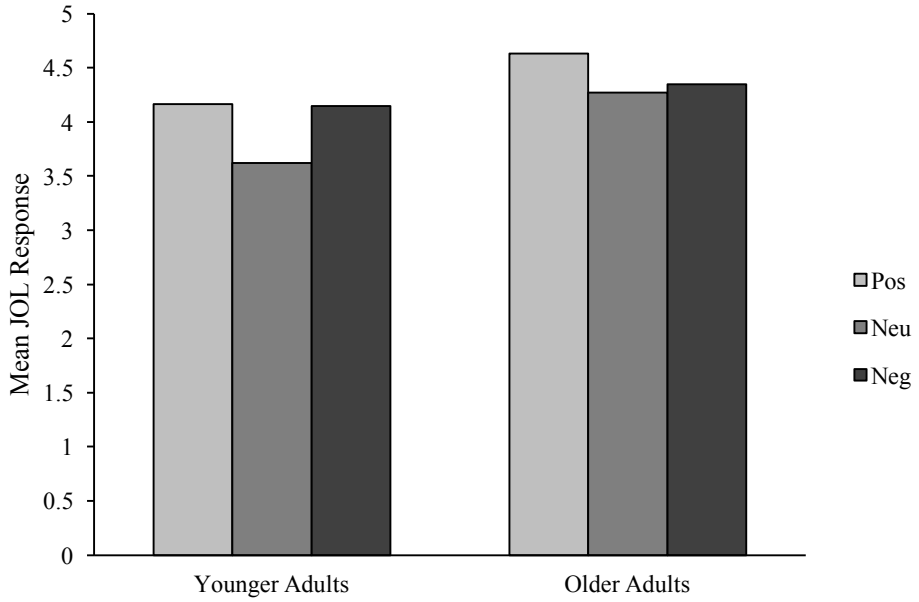

Figure 3. Mean JOL responses for each target valence by age group.

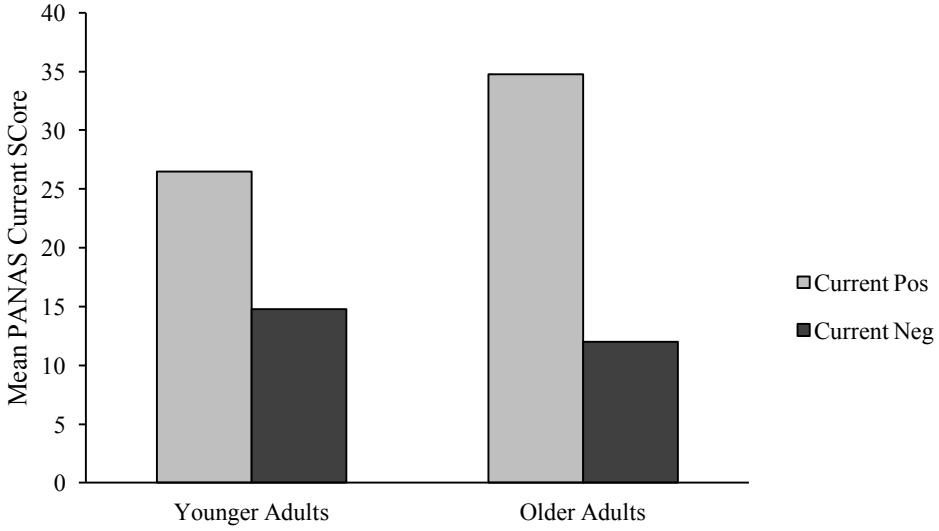

Figure 4a. Mean PANAS current scores for each affect category by age group.

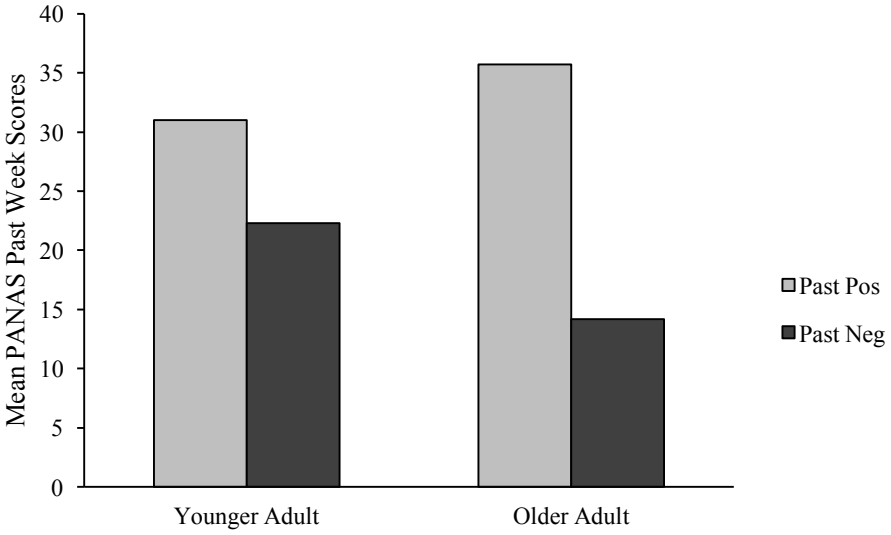

Figure 4b. Mean PANAS past week scores for each affect category by age group.

Table 1

Background Characteristics of Younger and Older Adult Participants

Measure	Younger Mean (SD)	Older Mean (SD)	*p and Cohen's d*
Years of Education	13.24 (1.32)	17.19 (3.05)	$p < .001$, $d = -1.69$
Digit Symbol Substitution task	66.69 (10.23)	44.84 (11.61)	$p < .001$, $d = 2.02$
Ekstrom vocabulary task	24.93 (2.53)	28.80 (3.35)	$p < .001$, $d = -1.32$
Wechsler Memory Scale-Revised	21.64 (5.60)	16.51 (4.68)	$p < .001$, $d = 1.07$
Self-Rated Health	8.26 (1.36)	7.74 (1.69)	*ns*
Self-Rated Vision	8.93 (1.57)	7.93 (1.64)	$p = .005$, $d = 0.63$

Self-Rated Hearing	9.12 (1.42)	7.70 (2.06)	$p < .001$, $d = .81$

Table 2

Means, Standard Deviations, and Significance for Prioritizing Positivity Items by Age Groups

Items	Younger Mean (SD)	Older Mean (SD)	*p and Cohen's d*
1) A priority for me is experiencing happiness in everyday life.	7.62 (1.41)	7.26 (1.79)	*ns*
2) I look for and nurture my positive emotions.	6.62 (1.72)	7.30 (1.61)	$p = .063$, $d = -.41$
3) What I decide to do with my time outside of work is influenced by how much I might experience positive emotions.	7.10 (1.45)	6.79 (2.10)	*ns*
4) I structure my day to maximize my happiness.	5.38 (1.65)	6.74 (1.56)	$p = .001$, $d = -.86$
5) My major decisions in life are influenced by how much I might experience positive emotions.	7.29 (1.11)	7.05 (1.81)	*ns*
6) I admire people who make their decisions based on the happiness they will gain.	7.49 (1.57)	6.40 (2.07)	$p = .008$, $d = .60$

Stimuli Lists

List 1	List 2	List 3	List 4
trauma	neglect	poison	obesity
scorn	fever	paralysis	scum
stench	vandal	lie	maggot
failure	abduction	fraud	misery
execution	burn	divorce	ache
pus	accident	death	victim
prison	lice	fear	tumor
wounds	coward	jail	agony
hatred	gloom	nightmare	massacre
cockroach	rotten	insult	corpse
pain	hostage	grief	trouble
abuse	danger	mosquito	malice
blackmail	crash	injury	crisis
waste	disaster	jealousy	debt
discomfort	loneliness	headache	mistake
seat	inhabitant	hammer	ankle
manner	quart	body	stomach
taxi	arm	pencil	lightbulb
lamp	hydrant	kerchief	cord
pig	part	cow	phase
jug	foot	bathroom	ink
iron	engine	bowl	scissors
runner	trunk	cannon	corridor
hairpin	machine	vest	lion
elbow	owl	key	industry
moment	cork	umbrella	appliance
finger	boxer	clock	lantern
locker	table	hand	unit
rock	chin	passage	cabinet
hairdryer	curtains	utensil	barrel
gift	knowledge	acceptance	family
beauty	success	life	gold
friend	liberty	trophy	triumph
victory	enjoyment	diamond	blossom
pleasure	valentine	kindness	comfort
freedom	rainbow	sunlight	cash
refreshment	home	champion	politeness
laughter	delight	kiss	glory
nature	angel	heaven	beach
wish	comedy	sweetheart	fun
cuddle	vacation	affection	music
justice	honor	joke	millionaire
mother	song	peace	passion
respect	cheer	perfection	treat
ambition	applause	holiday	hug

Buffer Targets	**Buffer Lures**
tool	window
kettle	medicine
tower	material
metal	sphere
building	wagon
tank	headlight
avenue	basket
banner	paper

Practice Targets	**Practice Lures**
slap	riot
dog	sunrise
highway	item
detail	ship

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