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Personal relevance modulates the positivity bias in recall of emotional pictures in older adults

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Some studies have suggested that older adults remember more positive than negative valence information, relative to younger adults, whereas other studies have reported no such difference. We tested whether differences in encoding instructions and in personal relevance could account for these inconsistencies. Younger and older adults were instructed either to passively view positive, negative, and neutral pictures or to actively categorize them by valence. On a subsequent incidental recall test, older adults recalled equal numbers of positive and negative pictures, whereas younger adults recalled negative pictures best. There was no effect of encoding instructions. Crucially, when the pictures were grouped into high and low personal relevance, a positivity bias emerged in older adults only for low-relevance pictures, suggesting that the personal relevance of pictures may be the factor underlying cross-study differences.

There is increasing evidence that older adults experience fewer negative feelings (Gross et al., 1997), dissipate negative affect better (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000), and are better at regulating negative moods (Charles, Reynolds, & Gatz, 2001), as compared with younger adults. This pattern fits well with socioemotional selectivity theory (SST; Carstensen, 1995), which postulates that as people age and perceive their remaining life to be increasingly limited, their goals shift from novelty seeking to emotion regulation, defined as the maintenance of a positive affective state.

Consistent with SST, a growing number of studies have shown that, as compared with young adults, older adults preferentially attend to positive over both negative and neutral information. For example, older adults are slower to localize a dot probe when it is preceded by a face with a negative (e.g., angry) expression and faster when it is preceded by a face with a positive (e.g., happy) expression (Mather & Carstensen, 2003). Older adults also do not sustain attention to negative stimuli (Rösler et al., 2005). These studies suggest that emotional content influences cognitive functions, particularly in older adults.

Studies have also shown that emotion (both positive and negative) can boost memory in younger (Cahill & McGaugh, 1995) and older (Denburg, Buchanan, Tranel, & Adolphs, 2003) adults. Although studies of attention support the possibility of a positivity bias in older adults, evidence for a corresponding bias in memory has been variable. Enhanced memory for positive material has been demonstrated in older adults on tests of autobiographical memories (e.g., Kennedy, Mather, & Carstensen, 2004), working memory for images (Mikels, Larkin, Reuter-Lorenz, & Carstensen, 2005), and memory for choices (Mather & Johnson, 2000). Other work, however, has produced mixed results. Particularly relevant to the present study are the varying results for memory of emotional pictures (scenes). In Charles, Mather, and Carstensen (2003, Experiment 1), emotionality of pictures boosted memory regardless of valence in young adults, whereas the boost was restricted to positive stimuli in older adults (see also Mather & Knight, 2005). However, in other studies in which older and younger adults actively rated positive, negative, and neutral pictures on emotional characteristics during encoding (Denburg et al., 2003; Kensinger, Brierley, Medford, Growdon, & Corkin, 2002), no positivity bias was found.

The goal of the present study was to explain the discrepancy across studies in whether older adults have a positivity bias. The first objective was to determine whether instructions during encoding would influence memory for positive, negative, and neutral pictures in younger and older adults. Studies that have shown a positivity bias for older adults instructed participants to passively view pictures, whereas studies that have failed to show a positivity bias instructed participants to actively rate pictures according to emotional characteristics. Consequently, for the first time, we actually manipulated encoding instructions. If instructional differences are crucial, a positivity bias should emerge for older adults given passive instructions (Charles et al., 2003), but not for those given active instructions (Kensinger et al., 2002).

The second objective was to determine whether personal relevance of to-be-remembered emotional stimuli would influence memory. For this reason, we constructed a scale with which to measure personal relevance, based on the Self-Assessment Manikin (SAM) form from the International Affective Picture System (IAPS; Lang, Brad-

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ley, & Cuthbert, 2001), and conducted analyses to test the possibility that the emergence of a positivity bias for older adults depends on whether study pictures are high or low in personal relevance. Other work has suggested that age differences in memory for highly personally relevant emotional information are not always found. For example, flashbulb memories for the September 11th attack were preserved in both older and younger United States citizens (Davidson, Cook, & Glisky, 2006). Thus, memory for highly negative emotional information that is personally relevant may be preserved in older adults.

At least one study failed to show differences in the emotional characteristics of older and younger adults' (personal) autobiographical memories (Alea, Bluck, & Semegon, 2004), suggesting that when material is highly relevant, older adults do not selectively attend to positive information. If this is so, recall of pictures that are relatively high in personal relevance should not differ across positive and negative valence conditions, nor should age interact with emotional valence. Recall of pictures that are low in personal relevance, however, should differ across both valence and age groups, and differences in motivation suggested by SST should result in a positivity bias in older adults. That is, when pictures are lower in personal relevance, to maintain a more positive affect, older adults may be motivated more than younger adults to encode and maintain the positive, rather than the negative, pictures in memory.

METHOD

Participants

Seventy-two healthy community-dwelling older adults (61–93 years of age; 49 of them female) recruited through the University of Waterloo's Research in Aging participant pool, and 72 younger adults (18–25 years of age; 50 of them female) recruited from undergraduate psychology classes completed the study. Table 1 displays participant characteristics. For participating, older adults received C$10, and younger adults received course credit. 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 head injury. For older adults, an additional exclusion criterion was a score of less than 26 on the Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975). The older adults had a higher full scale IQ [FSIQ; $F(1,142) = 75.15$, $p < .0005$], as estimated by the National Adult Reading Test–Revised (NART–R; Nelson, 1992), but did not differ from young with respect to years of education ($p > .10$).

Table 1
Participant Characteristics by Age Group

	Age Group			
	Younger		Older	
Characteristic	*M*	*SD*	*M*	*SD*
MMSE score	–	–	28.97	1.20
Years of education	13.92	1.58	14.44	2.97
FSIQ	104.04	7.26	114.55	7.28
PANAS–X percent positive	54.58	14.70	62.20	15.32
PANAS–X percent negative	37.22	14.00	28.58	8.76

Note—Mean age for younger adults was 19.68 years ($SD = 1.56$); mean age for older adults was 72.33 years ($SD = 6.80$). MMSE, Mini-Mental State Exam; FSIQ, full scale IQ, PANAS–X, Positive and Negative Affect Schedule–Expanded Form.

Stimuli

Ninety-six digitized pictures were selected from the IAPS, a collection of pictures normed on valence and arousal, each rated on a scale from 1 (*most negative* or *least arousing*) to 9 (*most positive* or *most arousing*). Of the 96 pictures, 32 were positive, 32 negative, and 32 neutral. Within each valence category, half of the pictures were of medium-low arousal and half were of medium-high arousal; half in each valence and arousal combination contained people, and the other half contained animals, nature scenes, or inanimate objects.

Average normative valence ratings differed (positive $M = 7.22$; negative $M = 2.87$; neutral $M = 5.24$), using Tukey's HSD (all $ps < .001$); average normative arousal ratings did not differ (positive $M = 4.90$; negative $M = 5.12$; neutral $M = 4.73$; all $ps > .10$). Medium-low ($M = 4.12$) and medium-high ($M = 5.71$) arousal pictures differed in average normative arousal rating across valence categories (all $ps < .001$).

The 96 pictures were divided into two lists of 48 pictures, both preserving the characteristics of the original list. The pictures were matched for content between the lists (e.g., both lists contained pictures of dogs) as much as possible. The lists were matched on average normative valence and arousal ratings for each valence type (all $ps > .10$).

The practice phase used six further IAPS pictures, two of medium arousal (one with and one without people) from each valence category. All the pictures were 1,010 × 752 pixels and covered almost the whole screen; a black border filled the remainder.

Design

There were two between-subjects factors, age (younger or older) and instruction (passive or active), and one within-subjects factor, valence (positive, negative, or neutral).

Procedure

The participants were randomly assigned to conditions and tested individually. To assess affect at time of test, the participants completed the Positive and Negative Affect Schedule–Expanded Form (PANAS–X; Watson & Clark, 1994) either before or after completing the experimental tasks (counterbalanced across participants).

The participants were seated 65–78 cm from the computer screen. In the *passive* instruction condition, they were asked to view pictures as they would a television screen, as in Charles et al. (2003). In the *active* instruction condition, they were asked to categorize each picture as positive, negative, or neutral (as in Kensinger et al., 2002), using their dominant hand to press the 1, 2, or 3 key (labeled as P, N, and U) on the numeric keypad.

The participants first viewed the 6 practice pictures individually in random order for 4 sec each. Picture presentation began with a black fixation cross on a white background in the center of the screen for 500 msec, followed by a picture. The participants then completed the study phase under the same instructions and presentation duration as in practice, viewing pictures from either List 1 or 2 (counterbalanced). Afterward, the participants completed the NART–R, which took approximately 5 min; this introduced a delay between study and test. A surprise recall test followed in which the participants were asked to write down descriptions of as many of the pictures as they could remember, taking as long as they wished. A surprise recognition test followed, containing all 48 study pictures and the 48 pictures from the unstudied list (counterbalanced). The participants were asked to indicate whether a picture was *old* or *new*. Specifications for the recognition test were identical to those at study, except that picture offset was determined by participant response or occurred after 30 sec.

After recognition, the participants rated each picture, using a modified SAM form in a paper-and-pencil booklet, on three different scales ranging from to 8. They rated (1) pleasantness (valence), (2) arousal, and (3) our added dimension of personal relevance (ranging from *completely personally irrelevant* to *very personally relevant*) that they felt while viewing each picture. The picture presentation specifications were identical to those in the study phase. The pictures

remained on the screen until all three ratings were complete or for 15 sec. Finally, the older adult participants completed the MMSE.

RESULTS

Memory for Pictures

Two coders independently matched recall responses to the IAPS pictures from study and agreed on 96% of the picture descriptions, resolving coding discrepancies by discussion. Mean number of pictures recalled, shown in Table 2, was analyzed in a mixed ANOVA with valence (positive, negative, or neutral) as a within-subjects factor and age (younger or older) and instruction (passive or active) as between-subjects factors.

There was a main effect of age [$F(1,140) = 10.20$, $p < .01$, $\eta_p^2 = .07$] with the younger adults ($M = 18.15$, $SD = 6.31$) recalling more pictures than did the older adults ($M = 14.96$, $SD = 5.70$). There was also a main effect of valence [$F(2,280) = 26.54$, $p < .001$, $\eta^2 = .16$], with better recall of both negative and positive, relative to neutral, pictures (ps $< .001$). Most important, there was a significant valence × age interaction [$F(2,280) = 5.59$, $p < .01$, $\eta^2 = .04$]. As is shown in Figure 1, the younger adults recalled more negative than both positive [$t(71) = 2.25$, $p < .05$] and neutral [$t(71) = 7.19$, $p < .001$] pictures and more positive than neutral pictures [$t(71) = 4.55$, $p < .001$]. In contrast, the older adults recalled marginally more positive than negative pictures [$t(71) = 1.86$, $p = .07$] and fewer neutral than both positive [$t(71) = 3.97$, $p < .001$] and negative [$t(71) = 2.25$, $p < .05$] pictures. There was no main effect of instruction ($p = .18$), and no other interaction reached significance (all ps $> .36$).

For recognition, there was a main effect of valence: Accuracy for positive pictures ($M = 0.83$, $SD = 0.21$) was equal to that for neutral pictures ($M = 0.84$, $SD = 0.21$), whereas accuracy for negative pictures ($M = 0.80$, $SD = 0.20$) was less than that for both neutral ($p < .001$) and positive ($p < .01$) pictures. There was no main effect of age and no age × valence interaction (ps $> .10$).

Affect measure. Raw PANAS–X scores were converted to percentages (see Table 1 for means). Each age group reported greater positive than negative affect [$t_{Younger}(71) = 6.50$, $p < .0005$; $t_{Older}(71) = 14.58$, $p < .001$]. However, the older adults reported greater positive affect [$F(1,142) = 9.29$, $p < .01$] and less negative affect [$F(1,142) = 19.76$, $p < .001$] than did the younger adults. Linear regression showed no relation between negative or positive affect, recall of pictures of any valence, and age group (all ps $> .10$), except that, for the younger adults, greater positive affect was related to better recall of neutral pictures ($B = .051$, $p < .05$). Further analyses verified that several other factors did not influence the pattern of results.[1]

Participant Ratings of Pictures

Valence. There was a main effect of valence [$F(2,284) = 826.58$, $p < .001$]; ratings for pictures of each valence type were consistent with normative valence ratings (Lang et al., 2001; all ps $< .001$). There was no main effect of age and no valence × age interaction (ps $> .40$).

Arousal. There was a main effect of arousal [$F(2,284) = 18.95$, $p < .001$]. Consistent with normative ratings, positive and negative pictures did not differ in rated arousal ($p = .65$), although both the negative [$F(1,142) = 36.00$, $p < .001$] and the positive [$F(1,142) = 41.95$, $p < .001$] pictures were rated as more arousing than the neutral pictures. There was no interaction with age ($p > .30$), but the main effect of age showed that the older adults rated the pictures as more arousing than did the younger adults [$F(1,142) = 8.08$, $p < .01$].

Personal relevance. Mean rated personal relevance of pictures was analyzed with a mixed ANOVA, with valence (positive, negative, or neutral) and memory status (recalled or not recalled) as within-subjects factors, and age (younger or older) as a between-subjects factor (see Figure 2 for means). There was a main effect of valence [$F(2,276) = 120.35$, $p < .001$, $\eta^2 = .47$]: Positive pictures were rated as more personally relevant than were negative [$F(1,138) = 98.50$, $p < .001$] or neutral [$F(1,138) = 244.42$, $p < .0005$] pictures, and negative pictures were rated as more personally relevant than were neutral pictures [$F(1,138) = 20.60$, $p < .0005$]. There was also a main effect of recall status: Recalled pictures were rated as more personally relevant than were nonrecalled pictures [$F(1,138) = 5.32$, $p < .05$, $\eta^2 = .04$]. No other main effects or interactions were significant (all ps $> .12$).

Personal Relevance: High/Low Split

The second goal of this study was to determine how personal relevance of pictures would affect recall. A mean split based on average ratings of personal relevance for older and for younger adults for positive ($M_{Younger} = 4.31$, $M_{Older} = 4.30$), negative ($M_{Younger} = 2.72$, $M_{Older} = 3.18$), and neutral ($M_{Younger} = 2.44$, $M_{Older} = 2.93$) pictures was used to classify recalled pictures as either high or low in personal relevance. These data were then analyzed in the same manner as the recall data (see Figure 3 for means).

It is possible that the mean split resulted in unequal numbers of pictures of each valence type being classified as low

Table 2
Mean Number of Pictures Recalled for Each Age Group As a Function of Valence Type and Instruction Condition (With Standard Deviations)

	Age Group											
	Younger						Older					
	Positive		Negative		Neutral		Positive		Negative		Neutral	
Instruction Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Passive	5.81	2.19	6.58	2.25	4.64	2.44	5.53	2.24	5.17	2.41	4.06	1.93
Active	6.72	2.39	7.19	2.87	5.36	2.68	5.56	2.29	4.94	2.65	4.67	2.69

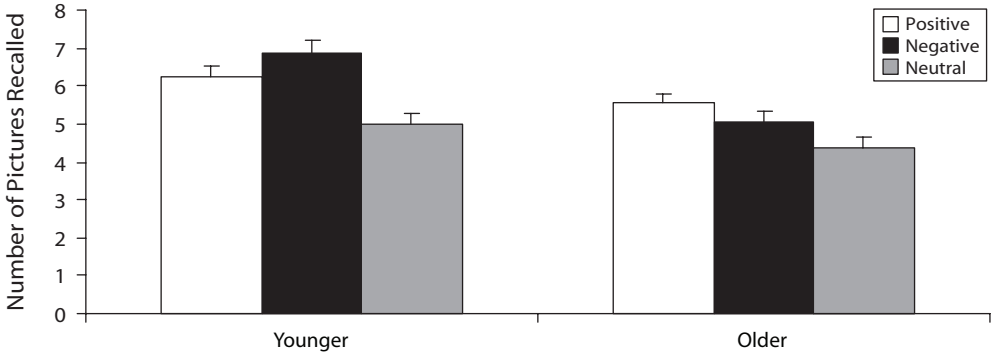

Figure 1. Mean number of pictures (maximum of 16) of each valence type recalled as a function of age group. Error bars are standard errors of their respective means.

and as high in personal relevance and that this could account for the patterns of the age × valence interactions observed. For example, if older participants rated more positive than negative pictures as low in personal relevance, this could increase their likelihood of recalling more positive than negative pictures low in personal relevance. To address this, the number of pictures recalled for each valence type and personal relevance level (low or high) was expressed as a percentage of the total number of pictures of each valence type classified as low or high in personal relevance.

For pictures high in personal relevance, there was a main effect of valence [$F(2,272) = 5.38$, $p < .01$, $\eta^2 = .04$]. More positive [$F(1,136) = 9.15$, $p < .01$] and negative [$F(1,136) = 5.16$, $p < .05$] pictures were recalled than neutral pictures, but there was no difference in recall of positive and negative pictures ($p = .36$). There was a main effect of age [$F(1,136) = 5.31$, $p < .05$, $\eta^2 = .04$], with the younger adults recalling more pictures than did the older adults, and no age × valence interaction ($p = .15$).

For pictures low in personal relevance, the main effects of age [$F(1,136) = 5.67$, $p < .05$, $\eta^2 = .04$] and valence [$F(2,272) = 8.77$, $p < .001$, $\eta^2 = .06$] were qualified by an age × valence interaction [$F(2,272) = 6.17$, $p < .01$, $\eta^2 = .04$]. The younger adults recalled more negative than positive pictures [$t(67) = 2.57$, $p < .05$] or neutral pictures [$t(69) = 4.58$, $p < .001$], but their recall of positive and neutral pictures did not differ [$t(68) = 1.67$, $p = .10$]. In contrast, the older adults recalled more positive than negative pictures [$t(69) = 2.12$, $p < .05$] or neutral pictures [$t(70) = 3.37$, $p < .001$], but their recall of negative and neutral pictures did not differ ($p = .09$).[2]

Affect measure. Regression analyses showed no relation between positive or negative affect and recall of high- or low-relevance pictures for any age group (all ps $> .05$), except that, for the younger adults, greater negative affect was related to recall of fewer neutral pictures high in personal relevance and greater positive affect was related to better recall of negative and neutral pictures low in personal relevance.

Arousal and valence. A mixed ANOVA was conducted on average rated arousal for recalled pictures with age as a between-subjects factor and valence and personal relevance as within-subjects factors. There was a main effect of personal relevance [$F(1,59) = 22.69$, $p < .001$, $\eta^2 = .28$]: Pictures high in personal relevance were rated higher in arousal ($M = 4.67$, $SD = 1.09$) than were pictures low in personal relevance ($M = 3.86$, $SD = 1.12$). No other main effects of interactions were significant (all ps $> .20$).

The same mixed ANOVA was conducted on average rated valence for recalled pictures. The main effects of personal relevance [$F(1,59) = 31.29$, $p < .001$, $\eta^2 = .35$] and valence [$F(2,118) = 394.65$, $p < .001$, $\eta^2 = .87$]

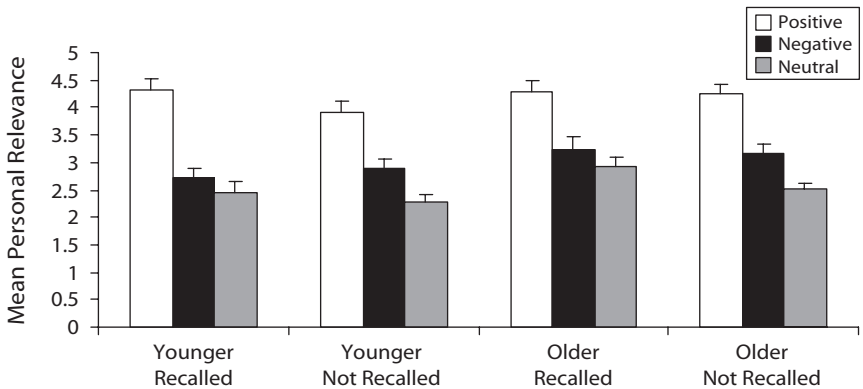

Figure 2. Mean personal relevance of pictures of each valence type as a function of age group and memory status. Error bars are standard errors of their respective means.

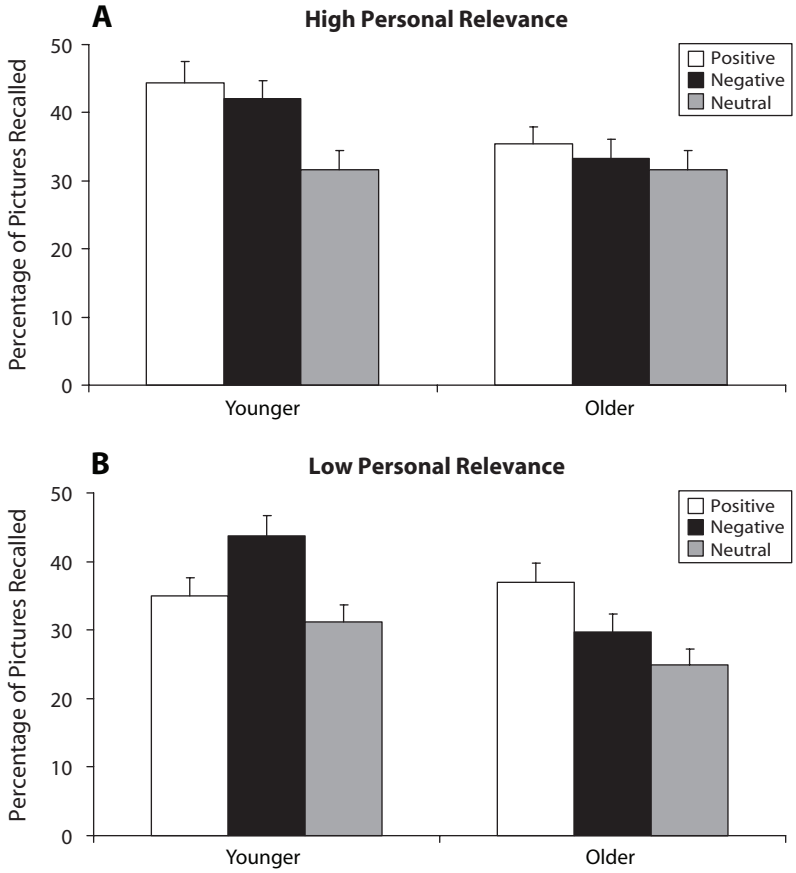

Figure 3. Mean percentages of pictures recalled of each valence type for pictures rated as high in personal relevance (top panel) versus low in personal relevance (bottom panel). Error bars are standard errors of their respective means.

were qualified by a personal relevance × valence interaction [$F(2,199) = 8.23$, $p < .001$, $\eta^2 = .12$]: Positive high-relevance pictures were rated as more positive ($M = 7.09$, $SD = 1.03$) than were positive low-relevance pictures ($M = 5.66$, $SD = 1.39$) [$t(111) = 9.73$, $p < .001$], and neutral high-relevance pictures were rated as more positive ($M = 4.09$, $SD = 2.04$) than were neutral low-relevance pictures ($M = 2.94$, $SD = 1.54$) [$t(97) = 4.88$, $p < .001$], but valence ratings for negative high- and low-relevance pictures did not differ ($p = .24$). No other main effects or interactions were significant (all ps $> .20$).

DISCUSSION

Consistent with the studies of both Charles et al. (2003) and Mather and Knight (2005), we observed a significant age × valence interaction in recall of emotional and neutral pictures. Specifically, younger adults displayed a negativity bias, in accord with a number of other studies of various cognitive processes (see Rozin & Royzman, 2001, for a review). Younger adults recalled more negative pictures, relative to positive and neutral pictures, whereas older adults showed a boost in recall for both positive and negative pictures, relative to neutral ones. The literature has been unclear whether the positivity bias in older adults' memory represents an increase in memory for positive, as compared with negative and neutral, material (e.g., Charles et al., 2003, Experiment 1) or a decrease in memory for negative material (e.g., Charles et al., 2003, Experiment 2), relative to younger adults. Our results are in line with the latter.

Our manipulation of instructions—either to passively view or to actively rate study pictures—did not influence recall for positive, negative, and neutral pictures in younger and older adults. Thus, this difference between the studies of Charles et al. (2003) and Kensinger et al. (2002) does not explain why one found and the other did not find a positivity bias in memory for older adults.

What is novel in our study and particularly relevant to the current debate about whether a positivity bias exists in older, as compared with younger, adults is our finding that personal relevance of the pictures did determine whether an age × valence interaction was found. When recalled pictures were classified as either high or low in personal relevance, an age × valence interaction emerged only for pictures rated as low in personal relevance. There was a negativity bias in recall of pictures in younger adults, but a positivity bias emerged in older adults: They recalled more positive than both negative and neutral pictures. We interpret this as meaning that when to-be-remembered

pictures are more personally relevant, older and younger adults incidentally encode both positive and negative pictures to a greater extent than neutral pictures, resulting in the typically seen boost in recall for emotional, relative to neutral, items (e.g., Cahill & McGaugh, 1995). In contrast, when pictures are lower in personal relevance, older adults engage in emotional regulation and preferentially encode only positive, relative to negative and neutral, pictures, resulting in better recall of positive pictures.

Although older adults reported greater positive, and less negative, affect on the PANAS–X, as compared with younger adults, regression analyses indicated that affect was not related to recall for any valence type. Also, both younger and older adults reported more positive than negative affect when each age group was considered separately, which argues against a mood congruency explanation of the age × valence interaction. The participants also rated positive pictures as being most personally relevant, followed by negative and neutral pictures.

We conclude that differences in the personal relevance of picture sets used across studies may well account for whether a positivity bias is or is not observed in older adults' memory. Studies that have shown a positivity bias may have used pictures that were relatively low in personal relevance to older adult participants, whereas studies that have not shown a positivity bias may have used pictures that older adults found to be high in personal relevance. Our results suggest that a variable previously not considered—personal relevance—may be the "active ingredient" in the emergence of this age difference in memory.

AUTHOR NOTE

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REFERENCES

ALEA, N., BLUCK, S., & SEMEGON, A. B. (2004). Young and older adults' expression of emotional experience: Do autobiographical narratives tell a different story? *Journal of Adult Development*, **11**, 235-250.

CAHILL, L., & MCGAUGH, J. L. (1995). A novel demonstration of enhanced memory associated with emotional arousal. *Consciousness & Cognition*, **4**, 410-421.

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

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., 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.

CHARLES, S. T., REYNOLDS, C. A., & GATZ, M. (2001). Age-related differences and change in positive and negative affect over 23 years. *Journal of Personality & Social Psychology*, **80**, 136-151.

DAVIDSON, P. S. R., COOK, S. P., & GLISKY, E. L. (2006). Flashbulb memories for September 11th can be preserved in older adults. *Aging, Neuropsychology, & Cognition*, **13**, 196-206.

DENBURG, N. L., BUCHANAN, T. W., TRANEL, D., & ADOLPHS, R. (2003). Evidence for preserved emotional memory in normal older persons. *Emotion*, **3**, 239-253.

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.

GROSS, J. J., CARSTENSEN, L. L., PASUPATHI, M., TSAI, J., GÖTESTAM SKORPEN, C., & HSU, A. Y. C. (1997). Emotion and aging: Experience, expression, and control. *Psychology & Aging*, **12**, 590-599.

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., BRIERLEY, B., MEDFORD, N., GROWDON, J. H., & CORKIN, S. (2002). Effects of normal aging and Alzheimer's disease on emotional memory. *Emotion*, **2**, 118-134.

LANG, P. J., BRADLEY, M. M., & CUTHBERT, B. N. (2001). *International affective picture system (IAPS): Instruction manual and affective ratings* (Tech. Rep. A-5). Gainesville: University of Florida, Center for Research in Psychophysiology.

MATHER, M., & CARSTENSEN, L. L. (2003). Aging and attentional biases for emotional faces. *Psychological Science*, **14**, 409-415.

MATHER, M., & JOHNSON, M. K. (2000). Choice-supportive source monitoring: Do our decisions seem better to us as we age? *Psychology & Aging*, **15**, 596-606.

MATHER, M., & KNIGHT, M. (2005). Goal-directed memory: The role of cognitive control in older adults' emotional memory. *Psychology & 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 & Aging*, **20**, 542-553.

NELSON, H. E. (1992). *The National Adult Reading Test (NART–R): Test manual*. Windsor, U.K.: NFER.

RÖSLER, A., ULRICH, C., BILLINO, J., STERZER, P., WEIDAUER, S., BERNHARDT, T., ET AL. (2005). Effects of arousing emotional scenes on the distribution of visuospatial attention: Changes with aging and early subcortical vascular dementia. *Journal of the Neurological Sciences*, **229-230**, 109-116.

ROZIN, P., & ROYZMAN, E. B. (2001). Negativity bias, negativity dominance, and contagion. *Personality & Social Psychology Review*, **5**, 296-320.

WATSON, D., & CLARK, L. A. (1994). *The PANAS–X: Manual for the Positive and Negative Affect Schedule–Expanded Form*. Unpublished manuscript, University of Iowa.

NOTES

1. FSIQ was not related to recall for any valence, and there was no effect of order of PANAS–X administration or of picture list on recall (all $ps > .05$). The participants recalled more medium-high ($M = 8.64$, $SD = 3.45$) than medium-low ($M = 7.92$, $SD = 3.37$) arousal pictures [$F(1,142) = 9.45$, $p < .01$, $\eta^2 = .06$]. Arousal and age did not interact.

2. When a median split was used, the pattern of data was virtually identical to that obtained when the mean split was used, except that for low-relevance pictures, the main effect of age was marginally significant ($p = .063$) and younger adults reliably recalled more positive than neutral pictures ($p = .004$).

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