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Social relevance enhances memory for impressions in older adults

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Previous research has demonstrated that older adults have difficulty retrieving contextual material over items alone. Recent research suggests this deficit can be reduced by adding emotional context, allowing for the possibility that memory for social impressions may show less age-related decline than memory for other types of contextual information. Two studies investigated how orienting to social or self-relevant aspects of information contributed to the learning and retrieval of impressions in young and older adults. Participants encoded impressions of others in conditions varying in the use of self-reference (Experiment 1) and interpersonal meaningfulness (Experiment 2), and completed memory tasks requiring the retrieval of specific traits. For both experiments, age groups remembered similar numbers of impressions. In Experiment 1 using more self-relevant encoding contexts increased memory for impressions over orienting to stimuli in a non-social way, regardless of age. In Experiment 2 older adults had enhanced memory for impressions presented in an interpersonally meaningful relative to a personally irrelevant way, whereas young adults were unaffected by this manipulation. The results provide evidence that increasing social relevance ameliorates age differences in memory for impressions, and enhances older adults' ability to successfully retrieve contextual information.

Keywords: Impression formation; Ageing; Memory; Social cognition.

People integrate behavioural information, non-verbal cues, and facial characteristics in a seemingly automatic manner (Willis & Todorov, 2006) to form impressions of others. Although a web search on ''making a strong first impression'' returns over five million results, few studies have probed how these spontaneous impressions are encoded into memory for future use. Interestingly the mechanisms underlying the encoding and retrieval of impressions—i.e., traits inferred from behavioural information and associated with an actor (Todorov & Uleman, 2002, 2003)—may utilise a memory system selective for social information (J. Mitchell, Macrae, & Banaji, 2004) rather than systems engaging the hippocampus. Preservation of this system may illustrate how older adults master social situations with age (Grossman et al., 2010; Hess & Auman, 2001), while having reduced cognitive functions in some domains (Park & Gutchess, 2005), including the ability to correctly identify sources of information.

Source memory refers to the ability to remember the context in which information is conveyed (e.g., a location) (Johnson, Hashtroudi, & Lindsay, 1993), and is particularly impaired with age compared to remembering items alone (Benjamin & Craik, 2001). This suggests a deficit

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in the encoding of information associated with an item, such as the *context* in which information was presented in contrast to remembering *what* was presented (Chalfonte & Johnson, 1996). Much of ageing-related source memory research has utilised stimuli lacking social or emotional context. Emotional context, however, can ameliorate age differences in source memory; although older adults remember perceptual and conceptual contextual source information less well than young adults, this difference disappears with emotional source information (May, Rahhal, Berry, & Leighton, 2005; Rahhal, May, & Hasher, 2002), perhaps because older adults place more emphasis on socio-emotional material over young (Fredrickson & Carstensen, 1990). Even though older adults exhibit difficulty when remembering face–name pairs (Naveh-Benjamin, Guez, Kilb, & Reedy, 2004), this might be because, while socially relevant, a name serves as a label and does not provide emotionally meaningful information. Thus the ability to retrieve contextual information, such as an impression or behaviour, associated with a face, may be affected by ageing less than memory for other types of contextual information.

Recent work (Todorov & Olson, 2008) showed that older adults and an individual with hippocampal damage remember impressions as well as young adults, whereas individuals with amygdala and temporal pole damage exhibit impairments. This suggests that hippocampal activation, which contributes to the retrieval of non-social source information (Cansino, Maquet, Dolan, & Rugg, 2002), does not affect the retrieval of impressions. However, the activation of socially oriented brain regions, potentially preserved with age (Wright, Wedig, Williams, Rauch, & Albert, 2006), is necessary to successfully encode and retrieve impressions. Although Todorov and Olson (2008) suggest older adults maintain the ability to learn and retrieve impressions, this claim is inconclusive due to the size ($N = 11$) and relatively young age ($M = 57$) of the older adult cohort.

The current studies extended previous work by assessing the extent to which self-relevance and interpersonal meaningfulness affect memory for impressions across younger and older adults. Experiment 1 assessed whether self-referencing improves memory for impressions. Previous research (Gutchess, Kensinger, Yoon, & Schacter, 2007; Hamami, Serbun, & Gutchess, 2011) demonstrated that self-referencing enhances memory for older adults, although it fails to restore their memory to the level of young. We hypothesised that if self-reference affects memory for impressions, then increasing self-relevance at encoding should enhance retrieval of impressions in both young and older adults.

We also explored how interpersonal meaningfulness affects memory for impressions in Experiment 2. Interpersonal meaningfulness differs from self-reference by emphasising one's relationships with other individuals, rather than focusing solely on the self as an individual entity. We tested whether an interpersonally meaningful context improved memory for impressions compared with a personally irrelevant condition. Meaningful goals increase cognitive engagement in older adults to a greater extent than young (Hess, Follett, & McGee, 1998). For instance, Fung and Carstensen (2003) demonstrated that older adults remember more advertisements with emotionally meaningful messages over knowledge-related messages, whereas young adults do not display this bias. Social, interpersonally meaningful contexts may enhance memory much like emotion-rich contexts. We predicted that interpersonally meaningful goals would capture older adults' attention, improving encoding over a less-meaningful task (Hess, Germain, Swaim, & Osowski, 2009). Young adults should be less affected by this manipulation, given their overall information-seeking framework (Carstensen & Mikels, 2005; Fung & Carstensen, 2003).

In both experiments we predicted behavioural content could modulate memory for impressions. Both intention and consequence influence trait inferences of an actor (Newman & Uleman, 1993). We hypothesised that if a behaviour's consequences affected many people (e.g., not reporting a fire in an apartment building), this behaviour would be more memorable than if only affecting the actor (e.g., running every morning for marathon training).

Moreover, we addressed how valence contributed to age differences in memory for impressions. Socio-emotional selectivity theory (SST) posits that, with age, adults focus on and remember positive over negative information (Carstensen, Isaacowitz, & Charles, 1999). Although some work has found negativity biases in memory (Rozin & Royzman, 2001), these may only emerge for extremely valenced, arousing behaviours, with positivity effects present for less arousing material (Wojciszke, Brycz, & Borkenau, 1993). Given the low-arousal nature

of the impression formation task, we predicted a positivity bias for young and older adults in remembering impressions in both experiments.

Two studies examined the effects of self-referencing and interpersonally meaningful goals on memory for impressions in young and older adults. We hypothesised that older adults would be more influenced by goals than young due to the prioritisation of interpersonal goals with age.

EXPERIMENT 1

Method

Participants. A total of 24 older adults (64 to 83 years old, 5 males; $M = 73.83$, $SD = 5.91$) and 24 undergraduates (17 to 22 years old, 7 males; $M = 18.96$, $SD = 1.40$) recruited from Brandeis University and the surrounding community participated. Older adults had Mini-Mental State Examination (MMSE) scores > 26 (Folstein, Folstein, & McHugh, 1975) ($M = 28.75$, $SD = 1.07$), and were characterised on cognitive measures to ensure comparability to other samples in the literature. Older adults had more years of education ($M = 16.54$, $SD = 1.89$) than the young adults ($M = 12.92$, $SD = 1.07$), $t(46) = 8.18$, $p < .001$, and higher vocabulary scores (Shipley, 1986) ($M = 36.42$, $SD = 2.64$) than the young adults ($M = 32.71$, $SD = 3.83$), $t(46) = 3.91$, $p < .001$. Young adults exhibited faster processing speed ($M = 75.17$, $SD = 14.67$) than old ($M = 59.46$, $SD = 13.91$), $t(46) = 3.81$, $p < .001$, using a digit-comparison measure (Hedden et al., 2002) and higher letter-number sequencing scores (Wechsler, 1997) ($M = 11.92$, $SD = 2.41$) than old ($M = 10.04$, $SD = 2.68$), $t(46) = 2.55$, $p < .05$.

Stimuli. The full face dataset consisted of 96 pictures of Caucasian faces (evenly distributed across young/old and male/female) with neutral expressions, drawn from the PAL database (Minear & Park, 2004). Faces were equated for attractiveness, distinctiveness, and trustworthiness (Gilron & Gutchess, 2012). The full sentence dataset consisted of 96 behavioural sentences (distributed equally among positive and negative inferred traits) drawn from a dataset normed for trait convergence (Uleman, 1988). Ratings from 10 young (M age $= 18.80$, $SD = 0.63$) and 9 older adults (M age $= 79.00$, $SD = 3.77$) confirmed the reliability of impressions. For these sentences, young and older adults similarly rated the sentence as inferring the trait (i.e., averages at the extreme end of a 7-point scale), and average ratings for each sentence did not differ by age group. In Experiment 1 a subset of 48 Caucasian faces (evenly distributed across young/old and male/female) was randomly paired with unique behavioural sentences (equally divided between positive and negative valence across the four age/gender face groups). For each age–gender group, 12 were chosen at random from the full set of 96 faces for this subset. The same subset of 48 faces was used for all participants, and was equated for attractiveness, distinctiveness, and trustworthiness.

To characterise the stimuli, 10 different young (M age $= 18.80$, $SD = 0.63$) and 10 older (M age $= 78.70$, $SD = 3.68$) adults rated sentences for arousal and valence on a 9-point scale. Older adults ($M = 5.42$, $SD = 1.18$) rated sentences as more arousing than young ($M = 5.09$, $SD = 0.83$), $F(1, 188) = 5.17$, $p < .05$, $\eta_p^2 = .03$, and negative sentences ($M = 5.40$, $SD = 1.14$) were marginally more arousing than positive sentences ($M = 5.11$, $SD = 0.89$), $F(1, 188) = 3.78$, $p = .053$, $\eta_p^2 = .02$. No other effects approached significance. We assessed whether young and older participants agreed on the extent to which a behaviour was positive or negative by calculating the absolute value of each sentence valence rating from the scale's neutral point. Older adults ($M = 1.99$, $SD = 1.24$), rated sentences more extremely than young adults ($M = 1.55$, $SD = 0.88$), $F(1, 188) = 8.03$, $p < .01$, $\eta_p^2 = .04$. No other effects approached significance. Sentences were additionally rated for interpersonal consequences (i.e., the extent to which behaviours affect other people), which did not differ with age, $F(1, 888) < 1$, *ns*, or vary by valence, $F(1, 888) < 1$, *ns*.

To select sentences for low (e.g., "She usually studied until 2 am") and high (e.g., "He asked everyone which movie they wanted to see") interpersonal consequences, we chose 24 positive and 24 negative sentences that were extremely rated on the interpersonal consequences dimension and did not have large differences in arousal or valence extremity ratings between the age groups. We confirmed that there were no significant age differences in arousal, valence extremity, and interpersonal consequences ratings for this 48-sentence subset.

Procedure. Participants were told they would be forming impressions of others, and were unaware of the memory test. After providing

informed consent, participants practised the encoding task. Stimuli were presented via E-Prime (Psychology Software Tools, Pittsburgh, PA).

At encoding, participants viewed a face–behaviour pair, and were instructed to form a one-word behaviour-based impression for 5000 ms. Immediately afterwards participants viewed the same face coupled with one of three prompts indicating encoding context for 5000 ms. The prompt was non-social (''Did the sentence contain any three-syllable words?''), social but not explicitly self-related (''Is this behaviour common?''), or social and self-related (''Would I do this behaviour?'') (Figure 1A). Participants indicated yes or no via button press.

There were three task versions, with subsets of sentences matched for valence (positive, negative) and interpersonal consequences (low, high), to counterbalance face-sentence across the three prompts. To improve performance, each face–behaviour pair appeared twice with the same encoding context, once per run in a random order. Participants were not told why each face–behaviour pair appeared twice. Trials of each encoding context were evenly and randomly distributed within four 12-trial blocks, with a 6000-ms delay between blocks.

After encoding, participants counted back by sevens for 60 seconds to reduce recency effects. Next participants completed a self-paced retrieval task, where all viewed faces were presented in one block, one at a time in a random order. Two trait adjectives were listed below each face. One was the correct response, inferred from the encoding behaviour, and the other was a non-inferred lure unrelated to the inferred trait. Target traits were the most commonly generated impressions from norms (Uleman, 1988). Lure traits were experimenter-generated. Participants indicated which trait they remembered as associated with the face. Half of the presented lure traits had matching valence of the inferred trait without being synonyms (e.g., friendly vs generous), and half had unmatched valence of the inferred trait, but were not antonyms (e.g., friendly vs dull). Participants then completed additional cognitive measures.

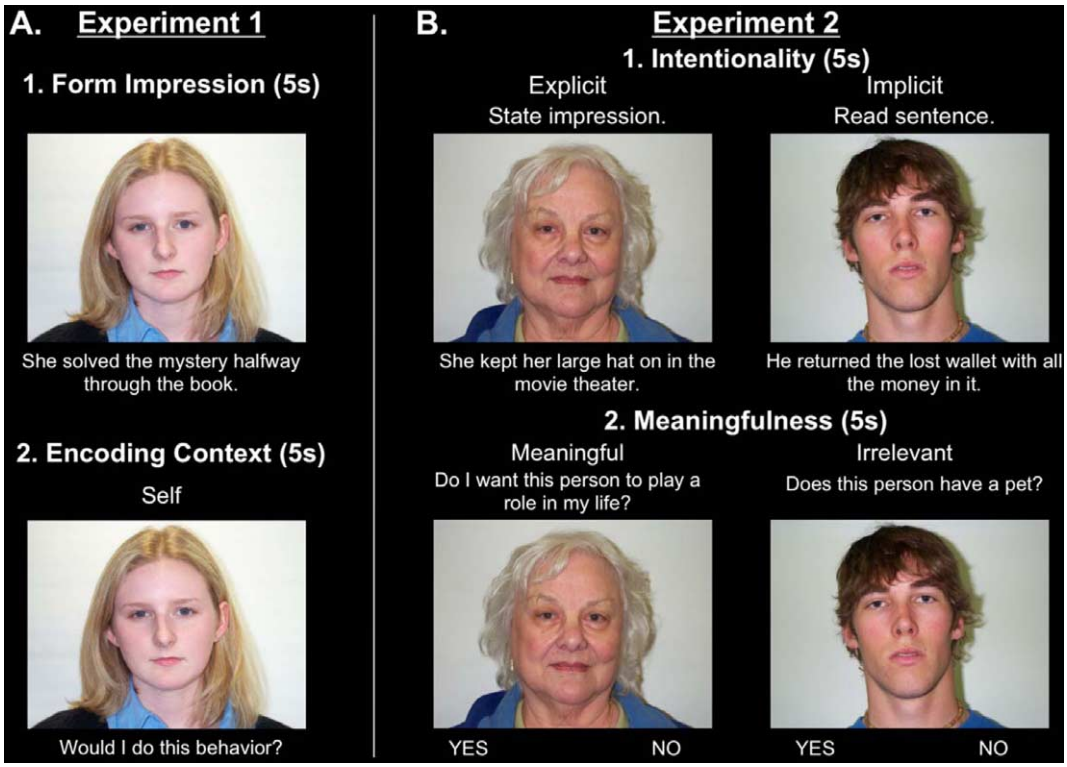

Figure 1. (A) Example encoding stimuli for Experiment 1: The impression formation stage, followed by the second stage (one of three encoding contexts (self [shown], common, or word). (B) Example encoding stimuli for Experiment 2: Each level of the intentionality (explicit, implicit) and interpersonal meaningfulness (meaningful, irrelevant) conditions.

Results

Retrieval accuracy. We analysed participants' accuracy (proportion of correct responses in remembering trait associations) in the retrieval task using a $2 \times 3 \times 2 \times 2$ ANOVA with Age Group (young, old) as a between-groups factor and Encoding Context (word, common, self), Interpersonal Consequences (low, high), and Inferred Trait Valence (negative, positive) as within-group factors (see Table 1A).

Older ($M = 71.86\%$, $SD = 10.53\%$) and younger ($M = 75.95\%$, $SD = 9.85\%$) adults similarly remembered trait associations, $F(1, 46) = 2.30$, $p > .10$, $\eta_p^2 = 0.05$. There was a main effect of Encoding Context, $F(2, 92) = 7.54$, $p < .001$, $\eta_p^2 = 0.14$ (Figure 2A). Contrasts showed that performance in the word context ($M = 69.50\%$, $SD = 13.80\%$) was worse than performance in both the common ($M = 74.70$, $SD = 15.03\%$), $F(1, 47) = 4.98$, $p < .05$, $\eta_p^2 = 0.10$, and self ($M = 78.00$, $SD = 11.14\%$) contexts, $F(1, 47) = 15.97$, $p < .001$, $\eta_p^2 = 0.25$. Performance in common and self-encoding contexts did not differ, $F(1, 47) = 2.37$, *ns*. No interactions with Age Group approached significance.

There were no main effects of Inferred Trait Valence, $F(1, 46) = 2.23$, *ns*, or Interpersonal Consequences, $F(1, 46) = 1.92$, *ns*. However, analyses revealed a marginally significant interaction between Interpersonal Consequences and Inferred Trait Valence, $F(1, 46) = 3.75$, $p = .06$, $\eta_p^2 = 0.08$ (Figure 2B). Participants remembered more positive ($M = 78.0\%$, $SD = 12.47\%$) than negative ($M = 72.20\%$, $SD = 13.86\%$) associations when behaviours had high, $F(1, 47) = 5.23$, $p < .05$, $\eta_p^2 = 0.10$, but not low, interpersonal consequences, $F(1, 47) < 1$, *ns*.

Discussion

Memory for impressions was stable with age. Across age groups, self-referencing affected memory for impressions. Performance was enhanced in the self and common encoding contexts relative to the word context, consistent with self-referencing literature (Symons & Johnson, 1997).

The similar performance in the self and common encoding contexts suggests that participants may have utilised similar mechanisms in these conditions. In a post-task questionnaire a majority of participants responded that they considered whether they or close others performed the behaviour to decide whether it was common. Thus a self-reference effect may have extended into the common encoding context, reducing or eliminating potential differences across the two conditions. Because the prompts appeared after participants viewed face–behaviour pairs,

TABLE 1
Proportions of correctly retrieved impressions (means and *SD*) for Experiments 1 and 2

	Low interpersonal consequences			*High interpersonal consequences*		
(A) Experiment 1	*Word*	*Common*	*Self*	*Word*	*Common*	*Self*
Young Adults						
Negative	0.74 (0.21)	0.76 (0.24)	0.82 (0.20)	0.74 (0.24)	0.72 (0.29)	0.79 (0.20)
Positive	0.69 (0.24)	0.75 (0.22)	0.80 (0.18)	0.72 (0.23)	0.79(0.20)	0.83 (0.20)
Older Adults						
Negative	0.67 (0.26)	0.73 (0.23)	0.67 (0.23)	0.65 (0.28)	0.72 (0.26)	0.72 (0.20)
Positive	0.66 (0.22)	0.71 (0.25)	0.78 (0.22)	0.71 (0.25)	0.80 (0.16)	0.82 (0.19)

	Explicit		*Implicit*	
(B) Experiment 2	*Meaningful*	*Irrelevant*	*Meaningful*	*Irrelevant*
Young Adults				
Negative	0.71 (0.18)	0.74 (0.13)	0.66 (0.12)	0.70 (0.13)
Positive	0.72 (0.12)	0.74 (0.15)	0.75 (0.13)	0.75 (0.12)
Older Adults				
Negative	0.72 (0.14)	0.66 (0.14)	0.67 (0.15)	0.61 (0.15)
Positive	0.69 (0.14)	0.66 (0.16)	0.75 (0.15)	0.73 (0.11)

Standard deviations are in parentheses.

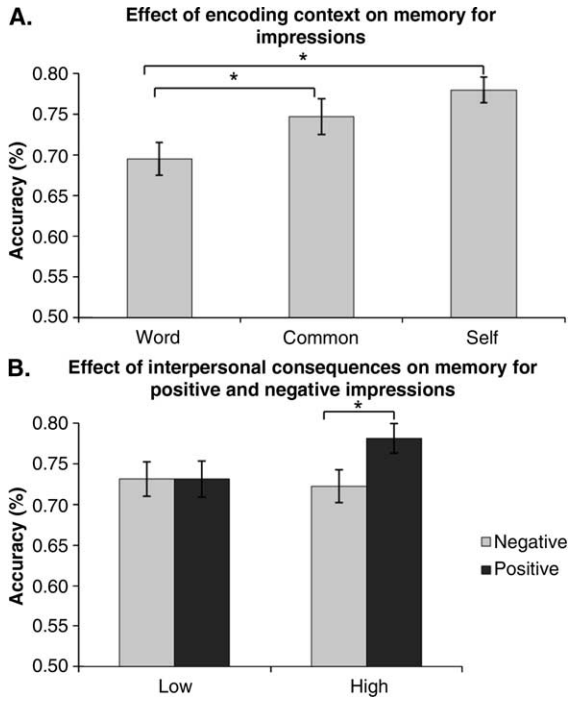

Figure 2. Accuracy in Experiment 1: (A) The self and common encoding contexts produced enhanced memory for impressions relative to the word context. (B) When behaviours were low in interpersonal consequences, participants remembered similar numbers of impressions, whereas when interpersonal consequences were high, participants remembered more positive than negative impressions. *$p < .05$

participants may have also utilised a general encoding strategy in preparation to answer any of the prompts. However, given the differential retrieval accuracy between the self and common relative to the word context, the data still suggest that self-relevance improves memory for impressions. If anything, a general encoding strategy would result in underestimating differences across conditions in the present study.

Alternatively, these data may indicate a general mnemonic enhancement from the two social conditions, or a level of processing (LOP) effect. This experiment was designed to test the effects of self-reference on memory for impressions, which seems to engage separate mechanisms than LOP (Kelley et al., 2002). However, the word prompt may function as a shallow condition in LOP paradigms (Lockhart & Craik, 1990), whereas the self and common prompts are more semantic-based, potentially enhancing performance due to a LOP manipulation. The conditions of our self-referencing manipulation were similar to those used in fMRI studies that implicate midline cortical activity (Northoff et al., 2006), rather than the lateral prefrontal activity indicative of LOP effects in memory (Kapur et al., 1994). This suggests that self-referencing, rather than LOP, caused improvements in memory, although we cannot conclusively rule out a contribution from LOP effects.

Because the stimuli were inherently social, they differ from other work showing age-related source memory impairments (Benjamin & Craik, 2001). While memory for impressions framed with the non-social prompt may be decreased relative to the self and common conditions, the social nature of the stimuli themselves, through the use of faces and behaviours, may enhance older adults' memory for impressions to be comparable to young adults' memory, even when framed with the non-social prompt. The prompt may help participants to re-encode their impressions, perhaps orienting to additional aspects of the information, and this may have happened more in the self and common relative to the non-social prompts.

Additionally, we assessed whether behavioural content affected memory for impressions. Interpersonal consequences and valence operated in combination to increase participants' tendency to remember more positive than negative trait associations when a behaviour was high in

interpersonal consequences. People selectively remember more positive than negative self-related information (Mischel, Ebbesen, & Zeiss, 1976), and the self-referencing nature of the task may have biased participants towards remembering positive attributes. Although the current data did not support the presence of an overall positivity bias, we did find a bias in both young and older adults when a behaviour's interpersonal consequences were high. Due to this interaction's marginal significance, future research is necessary to understand this finding.

EXPERIMENT 2

In Experiment 2 we manipulated interpersonal meaningfulness at encoding, which differs from self-referencing in that it emphasises relationships rather than focusing on the self in isolation. Calling attention to relationships may lead to a richer encoding experience with age, as self-focus broadens to include more interpersonal information (Freund & Smith, 1999; K. Mitchell et al., 2009) and self-concept emphasises interdependence and relationships (Reichstadt, Depp, Palinkas, Folsom, & Jeste, 2007). We hypothesised that an interpersonally meaningful context would engage attention and memory processes in older adults, strengthening memory for impressions. We anticipated this difference would affect older over young adults, who prioritise information acquisition rather than emotional meaning at encoding (Fredrickson & Carstensen, 1990; Fung & Carstensen, 2003).

We also examined how intentionality affects older adults' memory for impressions. Implicit impressions occur spontaneously, involving few attentional resources (Todorov & Uleman, 2003), while explicit impressions reflect controlled behaviour (Uleman, Chaiken, & Trope, 1999). If implicit processing mechanisms are relatively spared with age (Craik, 1994), older adults might display enhanced memory for implicitly formed impressions relative to an explicit condition requiring controlled processing. However, explicit conditions emphasising a meaningful goal could increase memory compared to an implicit condition in older adults, given that older adults perform better in the presence of a personally salient goal (Hess, 2006; Hess et al., 2009). Thus intentionality could impact older adults in one of two different ways, although young adults, who more flexibly deploy cognitive resources in explicit conditions, should be unaffected.

Ageing-related research has suggested that performing concurrent tasks ameliorates attentional biases towards positive information (Knight et al., 2007; Mather & Knight, 2005). This may suggest that while age-related biases might occur in an implicit encoding context, making judgements in an explicit task may reduce biases towards positive information. Given that Experiment 2 also tested whether intentionality (explicitly or implicitly forming impressions) affects memory for impressions, we tested how memory for positive and negative impressions differed based on intentionality at encoding. Although some work finds that biases emerge under controlled conditions (Mather & Carstensen, 2005), we expected that for older adults, positive and negative traits would be equally remembered when intentionality was explicit, with participants forming and overtly stating their judgements, although a positivity bias would emerge in an implicit context.

Method

Participants. A total of 24 older adults (66–84 years old, 9 males; $M = 77.08$, $SD = 4.56$) and 24 undergraduate and graduate students (18–28 years old, 7 males; $M = 20.42$, $SD = 2.72$) who did not participate in Experiment 1 were recruited and completed the same cognitive measures. Older adults completed the MMSE ($M = 28.63$, $SD = 1.21$), had more years of education ($M = 16.00$, $SD = 1.98$) than young adults ($M = 13.92$, $SD = 1.74$), $t(46) = 3.88$, $p < .001$, and had higher vocabulary scores ($M = 35.46$, $SD = 2.89$) than young adults ($M = 32.00$, $SD = 4.25$), $t(46) = 3.30$, $p < .01$. Young adults exhibited faster processing speed ($M = 71.83$, $SD = 9.00$) than old ($M = 52.96$, $SD = 10.32$), $t(46) = 6.76$, $p < .001$, and had higher letter-number sequencing scores ($M = 12.29$, $SD = 2.69$) than old ($M = 9.08$, $SD = 2.80$), $t(46) = 4.05$, $p < .001$.

Stimuli. All 96 sentences and faces from the dataset were used. Although this included the 48 used in Experiment 1, the faces and sentences were randomly re-paired (equally divided between positive and negative valence

across the four age/gender face groups) for Experiment 2.

Procedure. Procedures were modified from Experiment 1, with the following differences. Participants completed 12 trials in a row with the same intentionality instruction at encoding. Intentionality instructions appeared for 5000 ms before each block. Explicit instructions were "Form and state your impression of this person out loud" and implicit instructions were "Read the sentence out loud". For each trial, a face was presented alone for 1000 ms. Next, intentionality instructions reappeared while the same face and a trait-inferring sentence were presented for 5000 ms. Participants generated a one-word impression of the person based on the sentence, and stated it aloud during the explicit condition. Immediately afterwards, participants viewed the face coupled with a meaningfulness prompt for 5000 ms. The interpersonally meaningful prompt read, "Do I want this person to play a role in my life?" and the irrelevant prompt read, "Does this person have a pet?" (Figure 1B).

Face–sentence pairs were counterbalanced among intentionality and meaningfulness conditions, totalling four task versions. An experimenter was present at encoding to ensure that participants generated traits in the explicit condition. Face–behaviour pairs appeared twice, in random order once per run. Participants were not told why face–behaviour pairs were repeated, and were not told to generate the same impression in each run. There were eight blocks (alternating explicit and implicit intentionality), with a 4000-ms delay between each block. Meaningfulness was manipulated evenly within each block.

The retrieval and additional tasks were administered in the same manner as Experiment 1.

Results

Retrieval accuracy. We analysed participants' retrieval accuracy using a $2 \times 2 \times 2 \times 2$ ANOVA with Age Group (young, old) as a between-groups factor and Intentionality (explicit, implicit), Interpersonal Meaningfulness (meaningful, irrelevant), and Inferred Trait Valence (negative, positive) as within-group factors (see Table 1B). We confirmed these findings on a subset of sentences matched for young and older adults' arousal and valence extremity ratings.[1]

Older ($M = 69.00\%$) and younger ($M = 72.00\%$) adults similarly remembered trait associations, $F(1, 46) = 2.66$, $p > .10$, $\eta_p^2 = 0.06$. There were no main effects of Intentionality or Interpersonal Meaningfulness, and no interaction of Intentionality by Age Group, Fs < 1, *ns*. There was a significant Age Group by Interpersonal Meaningfulness interaction, $F(1, 46) = 5.99$, $p < .05$, $\eta_p^2 = 0.12$ (Figure 3A). While young adults performed similarly in the meaningful ($M = 71.00\%$, $SD = 8.81\%$) and irrelevant conditions ($M = 73.00\%$, $SD = 8.33\%$), $F(1, 23) = 1.94$, *ns*, older adults had marginally enhanced memory in the meaningful ($M = 70.70\%$, $SD = 8.81\%$), over the irrelevant ($M = 66.60\%$, $SD = 8.33\%$) condition, $F(1, 23) = 4.06$, $p = .056$, $\eta_p^2 = 0.15$.

Analyses revealed a main effect of Inferred Trait Valence, $F(1, 46) = 8.25$, $p < .01$, $\eta_p^2 = 0.15$. More positive ($M = 72.40\%$, $SD = 9.00\%$) than negative ($M = 68.40\%$, $SD = 8.31\%$) impressions were remembered. This was qualified by an interaction with Intentionality, $F(1, 46) = 8.29$, $p < .01$, $\eta_p^2 = 0.15$ (Figure 3B). Implicitly, participants remembered more positive ($M = 74.50\%$, $SD = 9.70\%$) than negative ($M = 66.30\%$, $SD = 11.09\%$) impressions, $F(1, 47) = 16.77$, $p < .001$, $\eta_p^2 = 0.26$, but explicitly, positive ($M = 70.20\%$, $SD = 11.78\%$) and negative ($M = 70.40\%$, $SD = 11.09\%$) did not differ, $F(1, 47) < 1$, *ns*.

Sentence subset counterbalanced for interpersonal consequences. Experiment 1 showed that a behaviour's interpersonal consequences—that is, whether a behaviour affected few or many people—influenced memory. Specifically, impressions formed from behaviours high in interpersonal consequences were better remembered than low. We assessed whether this effect was also present in Experiment 2. Because the full set of 96 sentences was not counterbalanced for interpersonal consequences, we created a counterbalanced subset by removing 16 face–behaviour pairs. This 80 pair subset was also counterbalanced by valence and

[1] By removing 16 sentences we verified this pattern of results in a subset of sentences better matched for arousal and valence extremity across age groups. Although our counterbalancing scheme should have eliminated these effects across conditions, we wanted to ensure that older adults' tendency to rate sentences as higher in arousal and valence extremity than young did not account for the pattern of recognition data. Results did not deviate in significance or direction from the full sentence set.

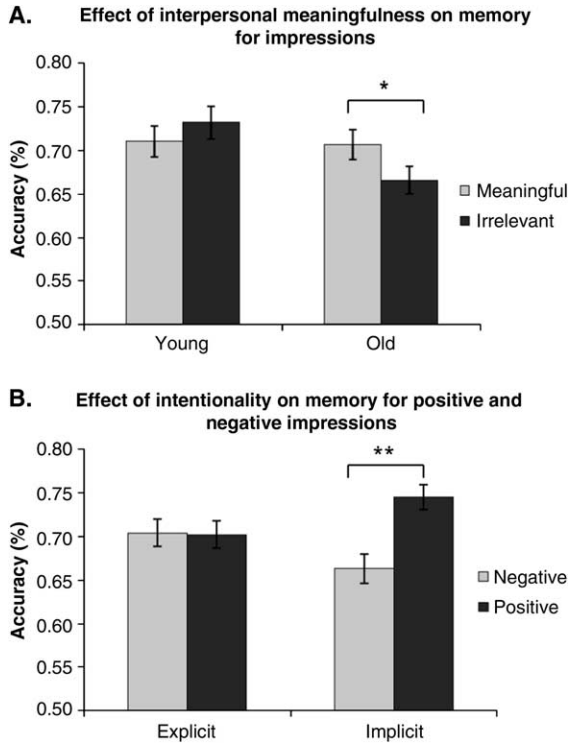

Figure 3. Accuracy in Experiment 2: (A) Older adults had enhanced memory for impressions encoded in the interpersonally meaningful over irrelevant context, whereas young adults did not display this bias. (B) In the explicit intentionality condition participants remembered similar numbers of negative and positive impressions, but in the implicit condition there was a bias to remember more positive than negative impressions. * $p = .056$, ** $p < .001$

matched for arousal and valence extremity. We reanalysed participants' retrieval accuracy in a 2×2 ANOVA using Inferred Trait Valence (negative, positive) and Interpersonal Consequences (low, high) as factors. There was a main effect of Interpersonal Consequences $F(1, 47) = 24.96$, $p < .001$, $\eta_p^2 = 0.35$ such that participants remembered more pairs with high interpersonal consequence ($M = 73.30\%$, $SD = 9.01\%$ vs. $M = 66.60\%$, $SD = 9.01\%$). Interpersonal Consequences did not interact with Valence, $F(1, 47) = 1.84$, *ns*.

Reliability of generated impressions when compared with target traits. Participants generated impressions for 95.78% ($SD = 6.06\%$) of trials in the explicit condition. Impressions matched the targets from norms for 73.84% of trials ($SD = 12.09\%$). Young adults gave marginally more responses ($M = 97.42\%$, $SD = 3.66\%$) than older adults ($M = 94.15\%$, $SD = 7.50\%$), $t(40) = 1.80$, $p < .10$. Young adults' responses matched targets less ($M = 69.42\%$, $SD = 7.03\%$) than older adults' responses ($M = 78.24\%$, $SD = 14.48\%$), $t(40) = 2.48$, $p < .05$.[2]

Discussion

Experiment 2's results suggest that memory for impressions is spared with age, establishing that interpersonal meaningfulness mediates the extent to which older adults remember impressions. Older adults had increased memory for impressions when the context emphasised interpersonal meaningfulness, whereas young adults were unaffected by this manipulation. This emphasis potentially made source material more meaningful to older adults and, consistent with other work (Fredrickson & Carstensen, 1990; Rahhal et al., 2002), resulted in enhanced memory.

Although intentionality did not affect performance on its own, task design may have contributed to the null result. Because participants alternated between blocks of explicit and implicit intentionality, carryover effects could have led participants to utilise similar processes. Using intentionality as a between-groups factor could better discern its contribution to memory for impressions.

While positive impressions were remembered more often than negative, this was especially true for the implicit condition. Although SST (Carstensen et al., 1999) suggests that older, more than younger, adults preferentially focus on positive information to optimise emotional experience, younger and older individuals may be less engaged by negative traits when they are low-arousal. Although some research evidences negative biases when remembering impressions (Rozin & Royzman, 2001), this might be limited to extremely negative and arousing behaviours (Wojciszke et al., 1993). Given the low-arousal nature of the task and behavioural sentences,

[2] We examined whether the number of matches between of spoken and target impressions affected our pattern of results. We classified participants as having high or low match level by using a median split the percentage of matched impressions, and used Match Level as an additional between-groups factor in our ANOVA to determine whether the extent of matched impressions influenced memory performance. There was no main effect of Match Level, $F(1, 38) = 1.30$, *ns*, and no interaction between Age Group and Match Level, $F(1, 38) < 1$, *ns*. Match Level did not significantly interact with any of the discussed findings of Experiment 2. This suggests that the extent to which spoken traits matched the target in the explicit intentionality condition did not affect memory performance.

participants may have tended to overweight positive and underweight low-arousal negative information (Nickerson, 1998) when forming impressions.

Moreover, the positivity bias elicited in the implicit condition was not caused by differences across the age groups in the extremity of arousal or valence ratings between positively and negatively valenced sentences. Although negative sentences were rated marginally more arousing than positive, if anything, this should make the negative sentences more memorable (Doerksen & Shimamura, 2001; Kensinger & Corkin, 2003).

The lack of a positivity bias in the explicit intentionality condition complements findings that concurrent tasks at encoding can disrupt a focus on positive information (Knight et al., 2007; Mather & Knight, 2005), and that performing concurrent tasks may also interrupt a positivity bias when forming impressions in low-arousal circumstances. Unlike Experiment 1, where the manipulation occurred after forming impressions, the explicit intentionality condition in Experiment 2 required generating an appropriate adjective while forming an impression at the same time, while the implicit condition did not require such a task. In Experiment 2, explicitly generating a trait word within the 5 seconds before answering the prompt may have also added the pressure of an explicit concurrent task to those trials. This differs from Experiment 1, which did not have additional instructions requiring participants to speak aloud while forming impressions before the prompt.

Interpersonal consequences contributed to memory, with impressions better remembered for behaviours having high relative to low consequences for others. Traits high in interpersonal consequences affect perceived trust (Singh et al., 2009), and may be prioritised in memory given that inferred traits can be useful in predicting the future behaviours of others in relation to the self.

GENERAL DISCUSSION

Two studies examined the contribution of contextual factors to memory for impressions in young and older adults. Our data indicate that memory for socio-emotional source material, the traits inferred from behavioural information and associated with actors, is spared with age under some conditions. This finding extends research positing that emotional context ameliorates age-related source memory impairments (May et al., 2005) to the social information underlying impressions.

Our results elaborate on Todorov and Olson's (2008) suggestion that memory for impressions is spared with age, using larger samples of older participants. Experiment 1 assessed the benefit of self-referencing on impression memory, indicating that self-related as well as social, but not explicitly self-related, encoding contexts improve memory for young and older adults. This potentially suggests that social meaning deepens encoding of source information, which may be conceptually similar to work showing that emotional context enhances source memory (May et al., 2005; Rahhal et al., 2002). Self-report, however, indicated considerable overlap in the processes engaged for self and common contexts at encoding, suggesting these contexts did not differ enough to elicit a self-reference effect in memory for impressions, relative to the common condition.

While older adults benefit from self-relevant strategy use (Glisky & Marquine, 2009; Gutchess et al., 2007), the results of Experiment 2 indicate that older adults may receive disproportionate benefits in memory when a context emphasises interpersonal relationships, contrasting the self-reference conditions used in Experiment 1. Although older adults have difficulty initiating retrieval processes (Luo & Craik, 2009), they may more easily initiate these processes when encoding contexts address their socio-emotional goals, contrasting young adults' emphasis on novelty and information acquisition (Carstensen & Mikels, 2005; Fung & Carstensen, 2003). Emphasising interpersonal relationships did not improve memory for young adults, who showed slightly greater memory for associations encoded in the personally irrelevant context (Figure 3A). This pattern could reflect young adults' information acquisition focus regardless of social relevance, in that young adults may have recruited resources to consider the possibilities given ambiguous information (e.g., pet ownership).

Although Experiment 2 identified that interpersonal meaningfulness improved memory for impressions in older adults, it is likely one of several memory-enhancing factors. Future research must address the role of other factors, such as morality or personal identification with a behaviour, in enhancing memory for impressions across the lifespan. Additionally, while the current studies are recognition-based, recall-based tasks may be more difficult for older adults;

future work should address this distinction when considering the preservation of the mechanisms underlying the retrieval of impressions.

Our retrieval measure in the current studies assumes that target traits were inferred from the presented behaviours and associated with actors. Behavioural (Todorov & Uleman, 2002, 2003) and event-related potential (Jinkyung & Kitayama, 2011) work supports the idea that after viewing face–behaviour pairs, inferred traits are spontaneously bound to actors and later retrieved. Given that our paradigm is similar to those used in previous work (Todorov & Uleman, 2002), utilised the same behavioural sentences used in prior experiments, and that in Experiment 2 a majority of generated impressions matched the targets, it seems unlikely that implicitly generated impressions significantly deviated from the inferred traits. To explore this claim, future work could test memory for specific behaviours, rather than memory for behaviour-related traits, to examine whether exact behaviours or more general impressions are remembered when endorsing a trait at retrieval. However, there is evidence that individuals may recognise inferred impressions even when the original behaviours are not recalled or recognised, suggesting that the trait inferences are quite robust (Todorov & Uleman, 2002). While the question of whether participants inferred and remembered these target impressions is important, given previous work, we believe the current findings are a valid representation of potential age similarities and differences when remembering impressions.

Ageing-related research illustrates that with increasing meaningfulness, older adults engage more available resources, potentially signifying that the activation of these mechanisms improves memory (Hess et al., 1998; Hess & Tate, 1991). Using fMRI one can elucidate these mechanisms, comparing whether medial prefrontal cortex, fundamental in impression formation (J. Mitchell, Macrae, & Banaji, 2005), is functionally intact with age and contributes to memory for impressions, or if other regions mediate these processes in older adults.

These studies also emphasise the influence of content on remembering impressions. In Experiment 2 high interpersonal consequences led to higher levels of memory than behaviours with less interpersonal relevance. This is consistent with work showing that people project themselves into situations as if behaviours affect them (Vonk, 1999), such that good or bad social judgements are more extreme for behaviours with high interpersonal consequences.

Although Experiment 2 evidenced a positivity bias, contrasting work evidencing a prioritisation of negative information (Rozin & Royzman, 2001), Experiment 1 did not show this effect. Experiment 2 may be more cognitively taxing than Experiment 1 due to a larger number of trials, allowing a positivity bias to emerge when participants must more selectively allocate cognitive resources. However, this difference could be due to encoding strategies. In Experiment 1 participants potentially encoded more positive than negative self-related impressions from the self and common conditions due to similar processing, because our manipulation emphasised the self. These behaviours may have been especially salient if they affected many people, as people may be less likely to think of themselves as performing behaviours that negatively impact others. This potentially is manifested in a positivity bias qualified by interpersonal consequences. The encoding contexts employed in Experiment 2 may better tease apart these effects by emphasising interpersonal relationships over self-reference, causing participants to prioritise high interpersonal implications while also highlighting positive information, instead of potentially associating positive information with the self. These differing findings illustrate the need for additional research investigating how these characteristics shape the encoding of impressions into memory, and if using more extremely valenced and arousing behavioural material reduce these positivity biases (Wojciszke et al., 1993).

Alternatively, the effects involving positivity illustrated in both of the current studies may reflect a guessing bias in that people, particularly older adults, tend to endorse positive over negative responses (Isaacowitz et al., 2007). While exploratory analyses show some evidence of this, the study was not designed to examine this.[3] Additional studies systematically comparing lures and employing different retrieval tasks

[3] ANOVAs using inferred trait valence (negative, positive) and the valence match of the lure (same, e.g., both positive; different, e.g., one positive, one negative) were conducted to determine a potential positive guessing bias in the retrieval task. Statistical support for positive guessing biases was consistent across both experiments, with participants tending to endorse the positive adjective when choosing between traits of different valence. Such a bias was not apparent when choosing between valence-matched traits. Data available upon request from the authors.

(e.g., recall) are needed to assess whether the positivity finding reflects guessing or attentional biases towards encoding positive over negative information.

Because older adults' memories improve with repeated presentation (Light, Patterson, Chung, & Healy, 2004), the presentation of each face–behaviour pair twice at encoding might potentially enhance memory among older, but not necessarily younger adults. Thus the lack of age differences in these studies may have resulted from repetition, the social nature of the stimuli, or a combination of both. Repetition, however, did not improve older adults' memory for impressions encoded in an irrelevant context to the level of those encoded in an interpersonally meaningful context, making it unlikely that improvements resulted from repetition alone.

These findings add to an emerging literature that supports the preservation of the cognitive processes underlying impression formation, and provide evidence that memory for social information, such as impressions, is spared with age in some conditions. Future research assessing the neural bases of impression formation can further characterise the mechanisms through which socio-emotional processing involved in impression formation shapes memory with age.

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