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Associative Memory for Honest and Dishonest Faces in Younger and Older Adults

Kylie O. Alberts, Mary C. Whatley, and Alan D. Castel
Department of Psychology, University of California, Los Angeles

Older adults often show a deficit in associative memory for faces paired with pieces of information. Older adults also have a heightened trust for faces despite the information the faces are associated with, in some cases. The present study investigated young and older adults' associative memory for faces associated with scams, donations, or a neutral label and whether trustworthiness would be reflective of these associations. In three experiments, participants viewed faces associated with these labels for either 6 s (Experiment 1), 3 s (Experiment 2), or unlimited time (Experiment 3) and were tested on their memory for the labels. In addition, they rated the faces on their honesty before and after the label was presented. While young adults were more accurate than older adults when recalling the associated labels overall, both age groups showed a significant reduction in honesty ratings for the faces associated with scams after the association was made in all experiments. Therefore, these results illustrate that despite associative memory deficits, older adults can adjust their trust ratings for faces based on learning associative information regarding scams and fraud.

Public Significance Statement

Our research demonstrated that while young adults were more accurate than older adults in remembering associated labels, both age groups exhibited a significant reduction in honesty ratings for faces linked to scams. This finding indicates that despite associative memory deficits, older adults can still modify their trust levels based on scam associations. This insight significantly enhances our understanding of age-related differences in associative memory and trust, with important implications for developing interventions to protect older adults from fraud.

Keywords: memory, aging, associative memory, trust, metacognition

Scams are more and more prevalent each year. In 2020, the Federal Trade Commission reported more than 2.1 million reports of fraud, and consumers lost more than 3.3 billion dollars (Federal Trade Commission, 2021). Millions of older adults specifically are targeted by scams, resulting in significant financial losses (American Association of Retired People, 2025). Thus, it is essential to understand how older adults remember information and people associated with scams. Unfortunately, older adults show a deficit in associative memory when needing to bind two pieces of information in memory (Castel et al., 2016; Old & Naveh-Benjamin, 2008), specifically with name-to-face pairings (e.g., L. E. James, 2006; Naveh-Benjamin et al., 2004), face-to-face pairings (e.g., Rhodes et al., 2008), and faces paired with negative monetary value (Castel et al., 2016). It is possible that these associative memory deficits could contribute to older adults' scam susceptibility. Therefore, the present study aimed to understand young and older adults' memory of faces associated with scams.

Trustworthiness

Older adults, on average, are more trusting than young adults (Bailey & Leon, 2019) and are found to rate faces cued to be untrustworthy with higher trustworthiness scores than young adults (Castle et al., 2012). Due to older adults' deficits in associative

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Kylie O. Alberts https://orcid.org/0009-0007-6113-2903
Mary C. Whatley https://orcid.org/0000-0003-3609-5630
Alan D. Castel https://orcid.org/0000-0003-1965-8227

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Correspondence concerning this article should be addressed to Kylie O. Alberts or Alan D. Castel, Department of Psychology, University of California, Los Angeles, 502 Portola Plaza, Los Angeles, CA 90095, United States. Email: albertsk@g.ucla.edu or castel@ucla.edu

memory, ratings of trustworthiness tend to rely on familiarity rather than recollection of associated information regarding trustworthiness. Skurnik et al. (2005) found that the more older adults were familiarized with false claims, the more likely they were to remember the false claim as accurate, so it is possible that older adults are more likely to trust people associated with scams if they are familiar. Trustworthiness in individuals may also be linked to emotional responses. Rule et al. (2012) found that faces deemed untrustworthy were better remembered than faces that were deemed trustworthy in young adults.

In line with this finding, young adults seem to show a bias in memory toward negative information. Younger adults tend to remember negative information over neutral information (Touryan et al., 2007), but this bias appears to be less present in memory for associations (Bisby & Burgess, 2014, 2017; Okada et al., 2011). In fact, Bisby and Burgess (2014) found that associative memory for negative information is impaired compared to neutral information. Given this distinction, it is possible that memory for faces who are associated with being untrustworthy (having negative affect) may be worse than for faces associated with being trustworthy (having positive affect), presumably because untrustworthy people are perceived as a threat and therefore trigger negative emotions in individuals.

Memory failures are common among young and older adults. When these explicit memory failures occur, will people still have an implicit memory of who is trustworthy? Implicit memory is not conscious and can be measured in priming or other types of assessments that measure the unintentional binding of information in our memory (Dew & Giovanello, 2010; Roediger, 1990; Schacter, 1987). Dew and Giovanello (2010) found that young and older adults can have an implicit memory for newly learned associated items. Therefore, in terms of trustworthiness, older adults could still believe someone is untrustworthy, even if they may not be able to explicitly say why they believe the person to be untrustworthy. The present study aims to look at these concepts further.

Associative Memory

Older adults could potentially avoid remembering one's association with a scam because it is negative emotional information (Williams & Drolet, 2005). Carstensen's (1992) Socioemotional Selectivity Theory posits that older adults devote more effort to deriving emotional meaning to items with positive affect than items with negative affect and even show a positivity bias (see Reed et al., 2014) by selectively attending to faces associated with positive outcomes (Mather & Carstensen, 2005) and remembering less negative information than younger adults (Charles et al., 2003). Castel et al. (2016) found that older adults showed a deficit in associative memory for items paired with negative monetary value, while young adults did not, suggesting that this positivity bias may extend to associative memory.

However, an alternative hypothesis posits that older adults may show improved memory for information associated with scams due to importance. Scams are negatively charged items, but they are also important to remember for our safety. Older adults may have enhanced accuracy for information that is particularly important to remember (Castel, 2008). Older adults can perform comparably to young adults in terms of accuracy in remembering high-value information in a value-directed remembering task (e.g., Castel, 2008; Castel et al., 2002, 2013). These effects extend to being able to remember more realistic associative information, such as critical medical interactions (Hargis & Castel, 2018), severe allergies (Middlebrooks et al., 2016), and important faces (Hargis & Castel, 2017). Therefore, older adults may show similar memory performance when associating a face with a scam.

Thus, these two hypotheses present competing explanations: one suggests older adults may avoid negative associations, leading to poorer memory for scams, while the other proposes that older adults prioritize important negative information, like scams, for safety reasons. The present study aims to investigate these competing hypotheses further.

The present study also investigates whether younger and older adults are metacognitively aware of their accuracy in remembering faces with scams. Both young and older adults are generally accurate in their metacognitive judgments regarding associative memory performance (Eakin et al., 2014; Hertzog et al., 2010; Watier & Collin, 2011).

The Present Study

Investigating potential deficits in associative memory and our overall trustworthiness for others is essential for understanding how we process potentially risky situations, such as scams. In addition, it could provide insight into potential effective strategies for remembering people. When people explicitly focus on the trustworthiness of faces when trying to remember them, people remember the faces better (Bower & Karlin, 1974). Therefore, rating people on their trustworthiness when you meet them may be an effective strategy if you would like to remember a face.

The present study, specifically, investigated how associations with negative information, like scams, and positive information, like donations, affect the perceived trustworthiness of faces and the ability to remember these associations in both young and older adults. Young and older adult participants rated the trustworthiness of faces and then learned whether the faces were associated with a scam, donation, or neutral condition. Memory for the associations was tested, and participants again rated the trustworthiness of the faces. We aimed to see if these emotional associations would lead people to trust some faces over others and if there would be an age difference in the accuracy and trustworthiness of the faces. We predicted that young adults would learn paired associations more accurately than older adults overall due to older adults' deficits in associative memory (Castel et al., 2016; Old & Naveh-Benjamin, 2008), but age differences may be larger for faces associated with scams, as older adults tend to avoid negative associations (Bisby & Burgess, 2017; Okada et al., 2011). As previously noted, there are competing hypotheses. One possibility is that older adults may avoid negative associations, leading to poorer memory for scams. However, it is also possible that older adults prioritize important negative information, like scams. We specifically predict that older adults' enhanced memory for important negative information will outweigh the tendency to avoid negative associations (Murphy et al., 2024), and therefore, older adults will be able to decrease their trustworthiness for scams.

Regarding trust, our hypotheses were driven by the positivity bias (Mather & Carstensen, 2005; Williams & Drolet, 2005). We predicted older adults would trust the faces more across all conditions compared to young adults (Bailey & Leon, 2019). However, once associated with scams, we anticipated a decrease in trustworthiness,

with this effect more pronounced among young adults. When faces are paired with a donation, we predicted an increase in perceived trustworthiness among both age groups. We also examined whether young and older adults would implicitly recognize trustworthiness when they fail to explicitly remember the associations. We predicted that both age groups may implicitly remember a face's trustworthiness despite explicitly misremembering the association (Dew & Giovanello, 2010). We sought to understand the confidence levels in forming these associations.

Last, we aimed to assess the impact of exposure time on the perceived trustworthiness of the faces, by having participants view the associations for varied durations: 3 s, 6 s, and self-paced. We anticipated that extended time limits would improve memory accuracy, consequently enhancing the "correctness" of trustworthiness ratings for the faces (Brubaker & Naveh-Benjamin, 2014). Specifically, we expected older adults to show more of a deficit in associative memory for the shortest exposure (3 s) than young adults (Kilb & Naveh-Benjamin, 2011). We predict this deficit would diminish with longer exposure times (Brubaker & Naveh-Benjamin, 2014). However, it is important to note that older adults do not use the additional study time to the same degree as young adults under intentional learning (see also F. I. Craik & Rabinowitz, 1985; Dunlosky & Connor, 1997). Prior research on self-regulated learning and strategy production has suggested that older adults may not consistently benefit from extended time as younger adults do, possibly due to their reliance on less effective strategies or difficulties in adopting optimal encoding strategies even when additional time is available (e.g., Hertzog et al., 2012). In contrast, younger adults may engage in more elaborative processing during this additional time, such as forming deeper associations or creating richer mental representations, which older adults are less likely to employ (F. I. M. Craik, 2022). This raises questions about whether the anticipated improvements with longer exposures might be limited for older adults, contrary to the general literature on age-related declines in processing speed and memory performance (Salthouse, 2014).

Experiment 1

Experiment 1 investigated associative memory and trustworthiness by asking participants to rate the trustworthiness of faces that were paired with a scam, donation, neutral, or no association condition (where faces were not associated with anything). Participants viewed each face followed by the associated condition for 6 s each before their memory for the association was tested. Six seconds allowed participants to view the faces before making judgments of them, especially for older adults (Kilb & Naveh-Benjamin, 2011), while also allowing participants to make valuable associations.

Method

Transparency and Openness

Each study's design and analyses were not preregistered. Data were analyzed using Jamovi (The Jamovi Project, 2023), and all figures were made using R Studio (RStudio Team, 2020), specifically using the "ggplot2" package (v3.3.3; Wickham, 2016). All information needed to reproduce the analyses is available on the Open Science Framework, including stimuli, data, and analysis code (Alberts et al., 2024). Informed consent was acquired, and the study was completed in accordance with the Univeristy of California Los Angeles (UCLA) institutional review board (IRB). The study was titled "Memory, Attention, Emotion and Aging" with protocol number: IRB-12-0617.

Participants

Sixty young adult participants were recruited from the UCLA undergraduate subject pool and completed the experiment online. Four young adult participants were excluded for not completing the experiment, resulting in a final sample of 56 young adults (age range = 18–28, $M_{age} = 20.12$, $SD_{age} = 1.6$; 47 female, nine male; 26 Asian/Pacific Islander, one Black, 10 Hispanic, 15 White, four other/unknown). Each young adult participant received course credit for participating in the study, with 1 hr of participation resulting in one-course credit being granted. Seventy-three older adult participants were recruited on Amazon's Mechanical Turk and were compensated US$10/hr. Seventeen older adults were excluded from the experiment: three for not meeting the age requirement, one for not finishing the experiment, and 13 for providing a nonsensical answer in our Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA; including not answering a simple math question correctly). The final older adult sample size was 56 (age range: 58–72; $M_{age} = 62.93$, $SD_{age} = 3.18$, 41 female, 15 male; one Asian/Pacific Islander, one Black, 53 White, one other/unknown; seven high school graduate, four some college, no degree, two Associate's degree, 34 Bachelor's degree, 10 Graduate degree). Potential health issues or mental health statuses of the participants were not collected. Data collection took place between September 2022 through January 2023. An a priori power analysis, using G*Power 3.1.7 (Faul et al., 2007), indicated that for a 4 (Condition: Scam, Donation, Neutral, No Association) × 2 (Time: Pre, Post) × 2 (Age: Young, Old) mixed repeated-measures ANOVA, assuming $\alpha = .05$ and power = .80, 110 participants would be needed to reliably detect a small effect size ($\eta_p^2 = .01$).

Materials

The faces used in this experiment were from the Chicago Face Database (Ma et al., 2015). The faces were equal parts male and female, and they self-identified as Asian, Black, Latino, and White. All faces had neutral expressions and were subjectively rated as middle-aged adults, which ensured that neither age group had an age-related advantage in the task (Rhodes & Anastasi, 2012).

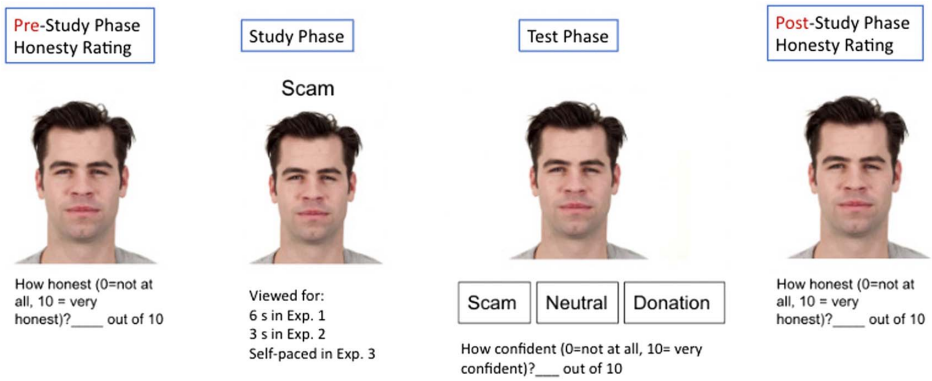
Procedure

Participants were first asked to rate 48 faces on how trustworthy they appeared on a scale of 0 (*not trustworthy at all*) to 10 (*very trustworthy*). Each face was shown one at a time for 6 s. Participants rated each face immediately after viewing it (see Pre-Study Phase Honesty Rating in Figure 1).

Next, in the study phase, participants were told they would be shown a series of faces that would be paired with a scam (indicating that the person committed fraud), donation (indicating that they donated to charity), and neutral (indicating they did not commit fraud or donate to charity). Participants were asked to remember faces and their labels for a later memory test. Then, 36 faces randomly picked from the previously rated 48 faces were randomly paired with the

Figure 1

The General Procedure Used for All the Experiments



Note. Adapted from "The Chicago Face Database: A Free Stimulus Set of Faces and Norming Data," by D. S. Ma, J. Correll, and B. Wittenbrink, 2015, *Behavior Research Methods*, *47*(4), pp. 1122–1135 (https://doi.org/10.3758/s13428-014-0532-5). CC BY 4.0. Reprinted with permission. Exp. 1 = Experiment 1; Exp. 2 = Experiment 2; Exp. 3 = Experiment 3; s = seconds. See the online article for the color version of this figure.

word scam, donation, or neutral (see Study Phase, in Figure 1). All faces were shown consecutively for 6 s each, in a random order.

Immediately after the study phase, participants' memory was tested (see Test Phase, in Figure 1). In the test phase, participants were shown the same 36 faces as in the study phase, each face one at a time in random order, and were asked if the face had been paired with a scam, donation, or neutral. The participants had unlimited time to give their response. After providing their response, participants were asked to indicate their confidence in their memory response on a scale of 0 (*not confident at all*) to 10 (*very confident*). After the test phase, participants completed the same honesty ratings task as in the Pre-Study Phase with all 48 faces (see Post-Study Phase Honesty Rating, Figure 1).

Results

Accuracy

We analyzed the participants' accuracy at remembering faces and their paired associations by fitting a logistic mixed-effects model using the *glmer* function using R Version 4.3.1 (R Core Team, 2021). Our model included a two-way interaction for Age (Young vs. Old) × Condition (Scam vs. Donation vs. Neutral). All variables were dummy coded, with "older adults" as the comparison for age and "donation" for the comparison group for condition. We also included a random intercept for participants and face images. In order to test the simple effects of the model, we compared the estimated marginal means of the full model using *emmeans* and *pairs* functions from Version 1.8.4 of the *emmeans* R package (Lenth, 2023). There was a significant difference in the age group where older adults ($M = 0.54$, $SD = 0.27$) were less accurate at remembering faces and their paired associations than young adults ($M = 0.62$, $SD = 0.23$), $OR = 0.68$, 95% CI [0.49, 0.95], $z = 2.26$, $p = .02$. There was also a significant difference for condition where faces paired with scams ($M = 0.60$, $SD = 0.27$), $OR = 1.35$, 95% CI [0.82, 1.22], $z = 3.59$, $p = .001$, and donations ($M = 0.60$, $SD = 0.23$), $OR = 1.35$, 95% CI [1.12, 1.64], $z = 3.59$, $p = .001$, were better remembered than faces paired with neutral ($M = 0.53$, $SD = 0.25$). There was no significant age by condition interaction. The results are shown in Figure 2. In addition, we calculated sensitivity scores for young and older adults. Those results are shown in Table 1.

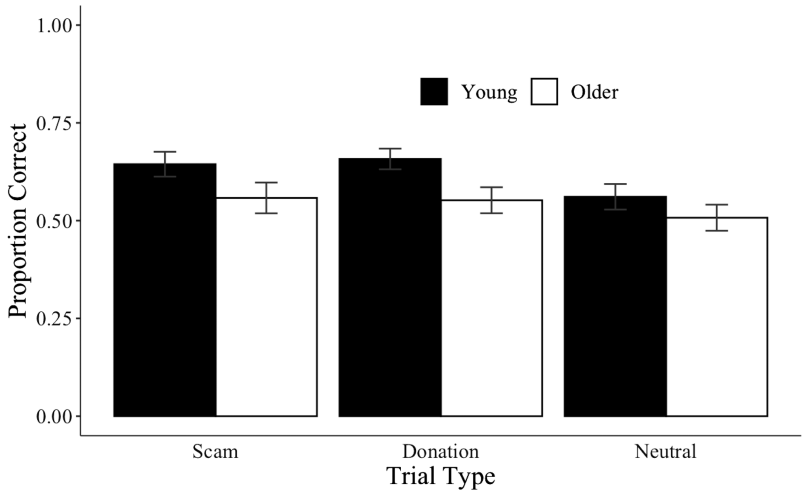
Confidence Ratings

A Pearson correlation coefficient was conducted between participants' average accuracy and confidence ratings for each condition. Memory accuracy was significantly correlated with confidence ratings in young, $r(166) = .48$, $p < .001$, and older adults, $r(166) = .19$, $p = .016$. A linear mixed-effects model was conducted to examine potential differences in confidence for the different trial types and age groups. Our model used the *lmer* function from Version 1.1.26 of the linear mixed-effects models using "Eigen" and S4 R package (Bates et al., 2015). All predictors in the model were the same as those in the accuracy model described above. There was a significant effect of condition, where participants were significantly more confident at remembering faces associated with a scam ($M = 6.89$, $SD = 1.69$) over faces associated with neutral ($M = 6.34$, $SD = 1.67$), $b = 0.56$, $SE = .08$, $z = 6.61$, $p < .001$. Participants were also more confident in remembering faces associated with donation ($M = 6.81$, $SD = 1.49$) compared to neutral, $b = 0.45$, $SE = .08$, $z = 5.40$, $p < .001$. There was no difference in confidence between scam and donation, $b = 0.10$, $SE = .08$, $z = 1.21$, $p = .45$. Additionally, there was no significant effect of age, $b = 0.01$, $SE = .29$, $t = .04$, $p = .97$, but there was a significant interaction between age and condition. Older adults were more confident in responses for scams than neutral, $b = 0.38$, $SE = .12$, $z = 3.30$, $p = .01$. Young adults were more confident in their responses for donation, $b = 0.64$, $SE = .12$, $z = 5.33$, $p < .001$, and scam than neutral, $b = 0.72$, $SE = .12$, $z = 6.01$, $p < .001$.

We also ran a model for confidence ratings for only faces that were not accurately remembered. When comparing the estimated marginal means, it revealed that older adults ($M = 6.09$, $SD = 1.87$) were more confident in their inaccurate responses than young adults ($M = 5.13$, $SD = 1.83$), $b = 0.96$, $SE = .31$, $t = 3.07$, $p = .003$. There was also no significant effect of condition, but there was a significant

Figure 2

The Correct Selection of the Type of Information Each Face Is Paired With, for Young and Older Adults, Separated by Trial Type in Experiment 1



Note. Error bars reflect the standard error of the mean.

condition by age interaction. Confidence ratings were significantly higher for donation, $b = 1.05$, $SE = .34$ $t = 3.10$, $p = .03$, and scams, $b = 1.37$, $SE = .34$, $t = 4.02$, $p = .001$ for older adults than young adults. There was no difference for neutral faces, $b = 0.45$, $SE = .33$, $t = 1.35$, $p = .76$.

Honesty Ratings

We also used a linear mixed-effect model to analyze the honesty ratings for faces in the prestudy phase and the poststudy phase. Our model included a three-way interaction for Age (Young vs. Old) × Condition (Scam vs. Donation vs. Neutral) × Time (Pre vs. Post). Similar to our analysis for accuracy, we compared estimated marginal means to test the simple effects of the model, and all predictors were dummy coded with "post" as the comparison condition for the time variable. The model showed a significant effect of condition where faces associated with scams had overall lower honesty ratings than donations, $b = 0.65$, $SE = .05$, $z = 12.71$, $p < .001$, and neutral, $b = 0.48$, $SE = .05$, $z = 9.42$, $p < .001$, but did not differ from no association (faces that were not associated with any condition), $b = 0.27$, $SE = .19$, $z = 1.43$, $p = .48$. There was also a significant difference between neutral and donation, $b = 0.17$, $SE = .05$, $z = 3.2$, $p = .006$, where donation was rated as more trustworthy. There was no difference between donation and no association, $b = 0.39$, $SE = .19$, $z = 2.09$, $p = .16$, nor between neutral and no association, $b = 0.22$, $SE = .19$, $z = 1.2$, $p = .64$. There was a significant effect of age, $b = 0.56$, $SE = .21$, $t = 2.65$, $p = .008$, where overall older adults reported higher honesty ratings than young adults. The main effect for time point was also found to be significant, $b = 0.36$, $SE = .10$, $t = 3.59$, $p < .001$, where honesty ratings were higher before the association was made than after.

There was, however, a significant interaction between condition and time point. Honesty ratings decreased after the faces were associated with scams, $b = 0.90$, $SE = .07$, $z = 12.48$, $p < .001$. In addition, honesty ratings significantly increased after being associated with a donation, $b = 0.44$, $SE = .07$, $z = 6.05$, $p < .001$. There was no difference in honesty ratings across time point for neutral faces, $b = 0.11$, $SE = .07$, $z = 1.58$, $p = .76$, and no association, $b = 0.0007$, $SE = .07$, $z = 0.01$, $p = 1.00$. There was no significant condition by age interaction, time by age interaction, or three-way interaction. The results are shown in Figure 3.

We then examined honesty ratings for only the faces for which participants accurately remembered the association to assess explicit memory for trustworthiness using a similar three-way model to that described above. We found a significant effect of condition where faces associated with scams had significantly lower honesty ratings than those paired with donation, $b = 1.20$, $SE = .08$, $z = 15.88$, $p < .001$, and the neutral condition, $b = 0.83$, $SE = .08$, $t = 10.74$, $p < .001$. In addition, faces associated with donations had significantly higher honesty ratings than neutral faces, $b = 0.37$, $SE = .08$, $z = 4.73$, $p < .001$. There was also a significant effect of age, where older adults reported higher honesty ratings overall than young adults, $b = 0.57$, $SE = .23$, $t = 2.47$, $p = .01$. Last, there was a significant effect of time point, $b = 0.72$, $SE = .15$, $z = 4.71$, $p < .001$, where honesty ratings were higher before the association was made than after.

In addition, there was a significant interaction between condition and time. When faces were associated with scams, honesty ratings significantly decreased from pre- to poststudy phase, $b = 1.60$,

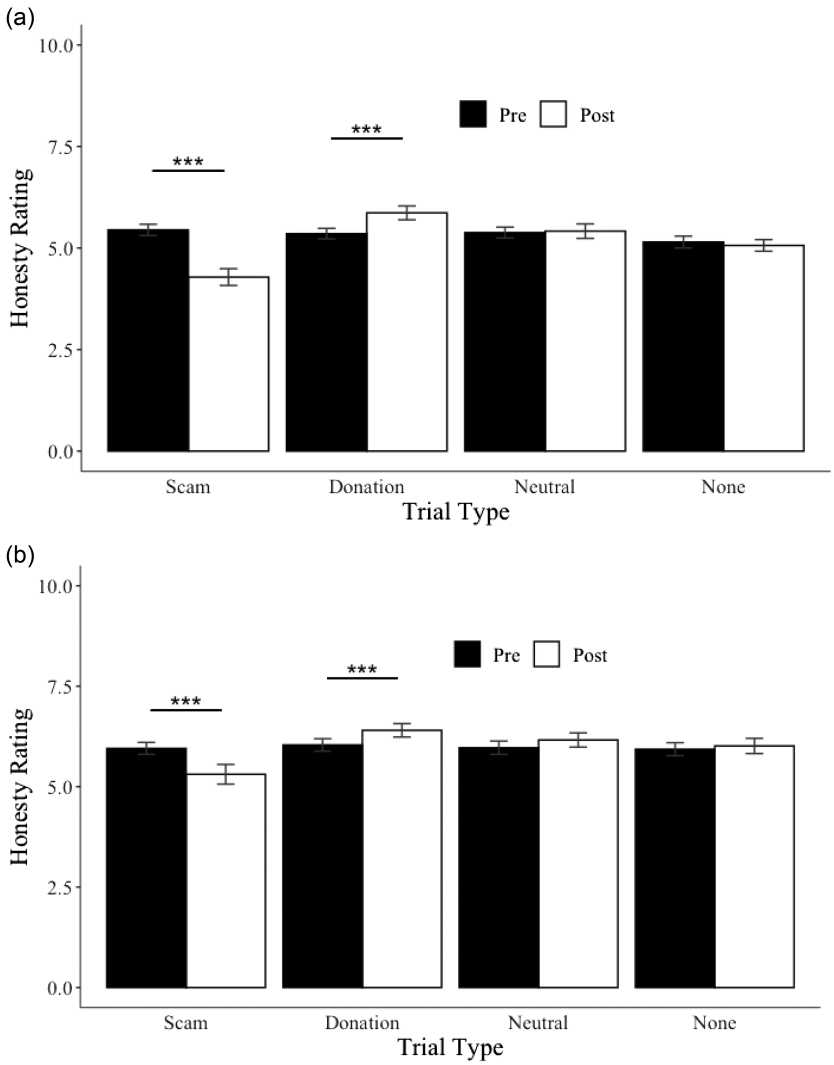
Table 1

Sensitivity Measures for Young and Older Adults in Experiment 1

Age group	Trial type	Hit	False alarm	Sensitivity (d')	Bias (c)
Young adult	Scam	.64	.36	.72	0
	Donation	.66	.34	.82	0
	Neutral	.56	.44	.30	0
Older adult	Scam	.55	.45	.25	0
	Donation	.54	.46	.20	0
	Neutral	.51	.49	.05	0

Figure 3

Pre- and Posthonesty Ratings for Young (a) and Older Adults (b), Separated by Trial Type for Experiment 1



Note. Error bars reflect the standard error of the mean.
*** $p < .001$.

$SE = .10$, $z = 15.43$, $p < .001$. Honesty ratings also significantly increased after the faces were associated with donations, $b = 0.77$, $SE = .10$, $z = 7.43$, $p < .001$. There was no significant effect of time on honesty ratings for faces in the neutral condition, $b = 0.27$, $SE = .11$, $z = 2.50$, $p = .12$. There was no significant condition by age interaction, time by age interaction, nor three-way interaction. In sum, honesty ratings significantly decreased when a face was associated with a scam and increased when a face was associated with a donation for explicitly remembered faces and this did not differ for young and older adults. All averages are shown in Table 2.

Next, we examined honesty ratings for only the faces for which participants failed to remember the correct association to assess a more implicit test of memory for trustworthiness using a similar three-way model to that described above. There was a significant effect of age where older adults reported higher honesty ratings overall than young adults, $b = 0.94$, $SE = .24$, $t = 3.89$, $p < .001$. No other predictors or interactions in the model were significant. In sum, older adults rated faces paired with donations and neutral lower than younger adults for forgotten items, but this did not differ by time point.

Discussion

As predicted, young adults had a more accurate associative memory than older adults. However, contrary to our hypothesis, the age difference in accuracy did not change across the different conditions and specifically was not smaller for the scam faces.

Consistent with our hypothesis and prior research, older adults, on average, were more trusting of the faces than young adults (Bailey & Leon, 2019). Young and older adults also rated faces associated with

Table 2
Honesty Ratings in Experiment 1

Time	Age	Scam		Donation		Neutral		No association	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
All faces									
Pre	Young	5.45	1.04	5.35	0.96	5.38	1.01	5.15	1.09
	Old	6.05	1.11	6.11	1.15	6.04	1.23	5.96	1.21
Post	Young	4.28	1.55	5.87	1.28	5.42	1.33	5.06	1.07
	Old	5.32	1.83	6.49	1.25	6.23	1.33	6.03	1.42
Accurately remembered faces									
Pre	Young	5.41	1.26	5.51	1.07	5.40	1.34	—	—
	Old	6.02	1.30	6.19	1.21	6.05	1.47	—	—
Post	Young	3.85	1.93	6.25	1.42	5.67	1.86	—	—
	Old	5.11	2.20	6.83	1.21	6.35	1.62	—	—
Inaccurately remembered faces									
Pre	Young	5.36	1.38	5.13	1.20	5.30	1.55	—	—
	Old	6.05	1.30	6.02	1.32	6.14	1.30	—	—
Post	Young	5.38	1.41	4.92	1.55	4.93	1.53	—	—
	Old	5.87	1.70	6.01	1.59	6.09	1.42	—	—

Note. Em dash indicates no findings to report.

scams as less trustworthy and faces associated with a donation as more trustworthy once the association was made. Interestingly, despite the difference in accuracy, these changes were not different among young and older adults. Possibly, older adults implicitly remembered that faces were untrustworthy despite explicitly failing to remember what condition the face was associated with (Dew & Giovanello, 2010). However, when we examined honesty ratings within only forgotten face-condition pairs, we found no differences in pre and posthonesty ratings across conditions.

As expected, young and older adults were accurate in their confidence in remembering the paired associations (Eakin et al., 2014; Hertzog et al., 2010; Watier & Collin, 2011). In addition, we found that older adults were more confident in their accuracy for faces associated with scams and donations than young adults. Older adults were also more confident in their inaccurate responses than young adults. Both age groups were also more confident in their memory of faces associated with a scam than faces associated with any other condition. This finding implies that young and older adults could have been attending to these faces more than the other conditions or at least they were aware of the importance of remembering faces associated with scams because of the potentially costly result of forgetting them.

Experiment 2

In Experiment 1, the study time was limited, so each participant viewed each face for 6 s. In Experiment 2, we examined whether the effects found in Experiment 1 would change if we limited the time the participants saw each face more. A quicker presentation rate has been found to significantly decrease memory accuracy for face–scene associations (Brubaker & Naveh-Benjamin, 2014). The presentation rate of stimuli might have an even more significant effect on older adults than younger adults. A longer presentation rate has been found to diminish the age-related differences in the accuracy of remembering face-scene pairings (Kilb & Naveh-Benjamin, 2011). Thus, reducing the presentation rate may translate to a lower ability to learn face and trustworthiness associations effectively.

In Experiment 2, each face was viewed for 3 s before the participants could rate the faces for trustworthiness. Participants were also only allowed to study each face and the paired association for 3 s during the study phase. Three seconds constrained the participants in how much time they could study the face and assess trustworthiness. The present experiment can uncover how quickly young and older adults encode trustworthiness associations in memory by reducing the time spent viewing the face–label association.

Method

Participants

Fifty-eight young adult participants were recruited from the UCLA undergraduate subject pool and received course credit for their participation. One young adult was excluded from the experiment for not completing the experiment, resulting in a total young adult sample size of 57 (age range: 18–29; $M_{age} = 20.68$, $SD_{age} = 2.07$; 41 female, eight male, two other; one Indigenous Person/Alaskan Native, 24 Asian/Pacific Islander, 11 Hispanic, 16 White, five other/unknown). All participants completed the experiment online. Eighty older adult participants were recruited through Amazon's Mechanical Turk and were compensated US$10/hr. Nineteen older adults were excluded from the study, 11 for not meeting the age requirement, four for not completing the study, and four for providing a nonsensical response for the CAPTCHA (including not answering a simple math question correctly), resulting in a total sample size of 61 older adult participants (age range = 56–78, $M_{age} = 63.73$, $SD_{age} = 4.90$; 30 female, 31 male; one Asian/Pacific Islander, two Black, 57 White, one other/unknown; six high school graduate, six some college, no degree, eight Associate's degree, 25 Bachelor's degree, 16 Graduate degree). Potential health issues or mental health statuses of the participants were not collected. Data collection took place from April to August of 2022.

Materials and Procedure

The faces were the same as those used in Experiment 1. The procedure was the same as in Experiment 1, with the only change

being that faces were shown for 3 s rather than 6 s. Participants rated faces for trustworthiness after being shown the faces for 3 s each. The participants then studied faces paired with a scam, neutral, or donation or the face was not studied (no association condition). The faces were also shown for 3 s in the study phase. The participants were tested on the associations in the test phase and were given unlimited time to indicate their responses. After the test phase, participants again rated faces on their trustworthiness but were only shown the faces for 3 s before being asked to make these trustworthiness judgments. Informed consent was acquired, and the study was completed in accordance with the UCLA IRB.

Results

Accuracy

We analyzed the participants' accuracy in remembering the faces' paired associations by fitting a logistic mixed-effects model, which was the same as that described in Experiment 1. There was a significant effect of condition. Participants were more accurate at remembering scams ($M = 0.60$, $SD = 0.20$) than donations ($M = 0.54$, $SD = 0.21$), $OR = 1.33$, 95% CI [0.62, 0.91], $z = 3.57$, $p = .001$, and neutral, $OR = 1.28$, 95% CI [0.65, 0.94], $z = 3.09$, $p = .006$, but there was no significant difference between donation and neutral faces ($M = 0.55$, $SD = 0.23$), $OR = 0.96$, 95% CI [0.80, 1.16], $z = 0.46$, $p = .88$. There was no significant effect of age, $OR = 1.02$, 95% CI [0.78, 1.32], $z = 0.11$, $p = .91$. However, there was a significant interaction between age and condition. Items associated with scams ($M = 0.67$, $SD = 0.18$) were remembered more accurately than items associated with a donation ($M = 0.49$, $SD = 0.22$) in young adults, $OR = 1.88$, 95% CI [0.38, 0.74], $z = 5.46$, $p < .001$. However, there were no differences between the accuracy of scams ($M = 0.57$, $SD = 0.21$) and donations ($M = 0.59$, $SD = 0.19$) in older adults, $OR = 1.06$, 95% CI [0.82, 1.22], $z = 0.50$, $p = .99$. There also was no difference between the accuracy of donation faces in young ($M = 0.49$, $SD = 0.22$) and older adults ($M = 0.58$, $SD = 0.19$), $OR = 1.51$, 95% CI [0.96, 2.40], $z = 2.58$, $p = .10$, scam faces in young ($M = 0.63$, $SD = 0.67$) and older adults ($M = 0.57$, $SD = 0.18$), $OR = 0.76$, 95% CI [0.48, 1.21], $z = 1.66$, $p = .56$, nor neutral faces in young ($M = 0.56$, $SD = 0.23$) and older adults ($M = 0.54$, $SD = 0.24$), $OR = 0.90$, 95% CI [0.57, 1.43], $z = 0.63$, $p = .99$. The results are shown in Figure 4. In addition, we calculated sensitivity scores for young and older adults. Those results are shown in Table 3.

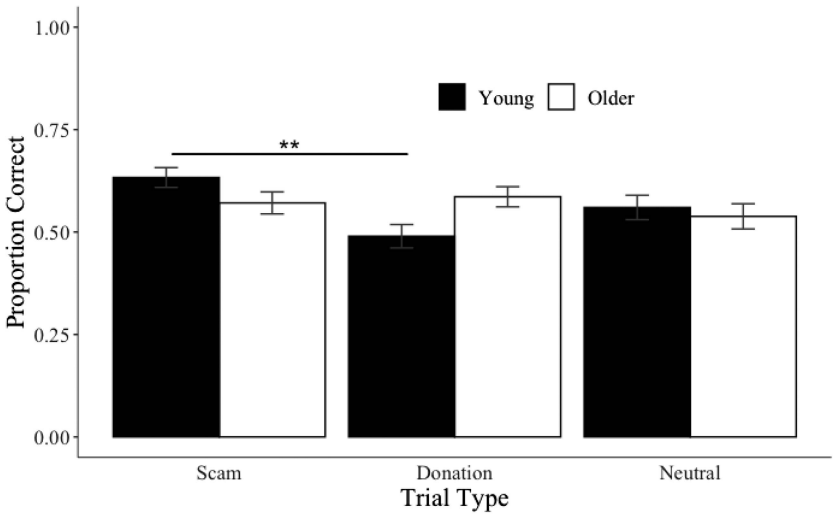
Confidence Ratings

A Pearson correlation coefficient was calculated between participants' average accuracy and confidence ratings for the different conditions. Accuracy was significantly correlated with confidence ratings in young, $r(169) = .258$, $p < .001$, and older adults, $r(181) = .24$, $p < .001$. A linear mixed-effects model was conducted, which was the same as in Experiment 1. There was a significant effect of age where older adults ($M = 6.62$, $SD = 1.69$) were more confident than young adults ($M = 5.90$, $SD = 1.47$), $b = 0.84$, $SE = .11$, $t = 2.88$, $p = .005$. There was also a significant effect of condition where people were significantly more confident in remembering scam faces than neutral faces, $b = 0.39$, $SE = .08$, $z = 4.90$, $p < .001$, and donation faces, $b = 0.29$, $SE = .08$, $z = 3.63$, $p < .001$, while there was no difference in confidence for remembering donation and neutral faces, $b = 0.10$, $SE = .08$, $z = 1.26$, $p = .42$. There was no significant condition by age interaction.

We also ran a model for confidence ratings for only faces that were not accurately remembered, which revealed a significant effect of age where older adults ($M = 6.02$, $SD = 1.83$) were more confident than young adults ($M = 5.00$, $SD = 1.66$), $b = 1.06$, $SE = .29$, $t = 3.65$, $p < .001$. There was no significant effect of condition nor a significant interaction between condition and age.

Figure 4

The Correct Selection of the Type of Information Each Face Is Paired With, for Young and Older Adults, Separated by Trial Type in Experiment 2



Note. Error bars reflect the standard error of the mean.
** $p > .01$.

Table 3
Sensitivity Measures for Young and Older Adults in Experiment 2

Age group	Trial type	Hit	False alarm	Sensitivity (d')	Bias (c)
Young adult	Scam	.63	.37	.66	0
	Donation	.49	.51	−.05	0
	Neutral	.56	.44	.30	0
Older adult	Scam	.57	.43	.35	0
	Donation	.59	.41	.46	0
	Neutral	.54	.46	.20	0

Honesty Ratings

We also used a linear mixed-effect model to analyze the honesty ratings for faces in the prestudy phase and the poststudy phase, similar to Experiment 1. The model showed there was a significant effect of condition, where participants rated faces paired with scams as less trustworthy than donation, $b = 0.47$, $SE = .05$, $z = 8.67$, $p < .001$, neutral ($M = 5.62$, $SD = 1.19$), $b = 0.42$, $SE = .05$, $z = 7.88$, $p < .001$, and no association faces, $b = 0.49$, $SE = .07$, $z = 7.25$, $p < .001$. The effect of age was significant, $b = 0.63$, $SE = .20$, $t = 3.09$, $p = .002$, where older adults gave higher honesty ratings than young adults. There was also a significant condition by age interaction. Older adults gave higher honesty ratings for donation faces, $b = 0.68$, $SE = .19$, $z = 3.60$, $p = .008$, scam faces, $b = 0.58$, $SE = .19$, $z = 3.09$, $p = .04$ and neutral faces ($M = 6.00$, $SD = 1.15$) than young adults, $b = 0.66$, $SE = .19$, $z = 3.47$, $p = .01$. Older adults did not give higher honesty ratings for faces that had no association ($M = 5.83$, $SD = 1.04$) than young adults, $b = 0.60$, $SE = .19$, $z = 3.00$, $p = .05$; however, it neared significance. The effect of time was not significant, $b = 0.09$, $SE = .11$, $t = 0.89$, $p = .38$. There was a significant interaction between condition and time that showed that honesty ratings for faces that were associated with scams were significantly lower after the association was made, $b = 0.94$, $SE = .08$, $z = 12.48$, $p < .001$. There was no significant difference between the pre- and posthonesty ratings for faces associated with donation, $b = 0.14$, $SE = .08$, $z = 1.91$, $p = .54$, neutral, $b = 0.06$, $SE = .08$, $z = 0.76$, $p = .99$, and no association, $b = 0.20$, $SE = .08$, $z = 2.62$, $p = .15$. There was no significant interaction between time and age, and the three-way interaction was not significant. The results are shown in Figure 5.

We then examined honesty ratings for only the faces for which participants accurately remembered the association to assess explicit memory for trustworthiness using a similar three-way model that we used for all honesty ratings and comparing estimated marginal means. We found a significant effect of condition where participants rated faces paired with donations as significantly more honest than scams, $b = 1.15$, $SE = .06$, $z = 18.02$, $p < .001$, and neutral faces, $b = 0.30$, $SE = .07$, $z = 4.53$, $p < .001$. Faces paired with neutral were also rated as significantly more honest than faces paired with scams, $b = 0.85$, $SE = .06$, $z = 13.61$, $p < .001$. The effect of time was significant where honesty ratings overall were higher before the association was made, $b = 0.65$, $SE = .12$, $t = 5.43$, $p < .001$. There was also a significant condition by time interaction where honesty ratings for donation faces were significantly lower before than after the association was made, $b = 0.64$, $SE = .09$, $z = 7.06$, $p < .001$, and honesty ratings for faces associated with scams significantly decreased after the association was made, $b = 1.54$, $SE = .08$, $z = 18.23$, $p < .001$. There was no significant difference for the pre- and posthonesty ratings of faces paired with neutral, $b = 0.006$, $SE = .09$, $z = 0.08$, $p = 1.00$. The main effect of age was significant where older adults reported higher honesty ratings than young adults, $b = 0.74$, $SE = .22$, $t = 3.42$, $p < .001$. There was no significant condition by age interaction, time by age, nor condition by time by age interaction found. In sum, honesty ratings significantly decreased when a face was associated with a scam and increased when associated with a donation for explicitly remembered faces, and this did not differ for young and older adults.

Next, we examined honesty ratings for only the faces for which participants failed to remember the correct association to assess a more implicit test of memory for trustworthiness using a similar three-way model that we used for all honesty ratings and comparing estimated marginal means. There was a significant effect of condition where faces associated with scams had higher honesty ratings than donations, $b = 0.45$, $SE = .09$, $z = 5.20$, $p < .001$, and were rated marginally higher than neutral, $b = 0.20$, $SE = .09$, $z = 2.24$, $p = .06$. In addition, faces associated with neutral had significantly higher honesty ratings than those associated with donation, $b = 0.26$, $SE = .08$, $z = 3.06$, $p = .006$. The main effect of time was significant where honesty ratings were found to be overall lower after the paired associations were made, $b = 0.69$, $SE = .17$, $t = 4.17$, $p < .001$. The effect of age was not found to be significant, $b = 0.26$, $SE = .25$, $t = 1.06$, $p = .29$. There was also a significant interaction between time and age. There was a significant difference between the honesty ratings of young and older adults before the associations were made with the faces where older adults reported significantly higher honesty ratings than young adults, $b = 0.79$, $SE = .21$, $z = 3.75$, $p < .001$. There were no differences between young and older adults' honesty ratings after the association was made, $b = 0.44$, $SE = .21$, $z = 1.97$, $p = .20$. There was no significant condition by age interaction, condition by time interaction, nor condition by time by age interaction. In sum, surprisingly, faces that were associated with scams had higher honesty ratings than faces associated with neutral and donation for forgotten faces and this did not differ by time point. All averages are shown in Table 4.

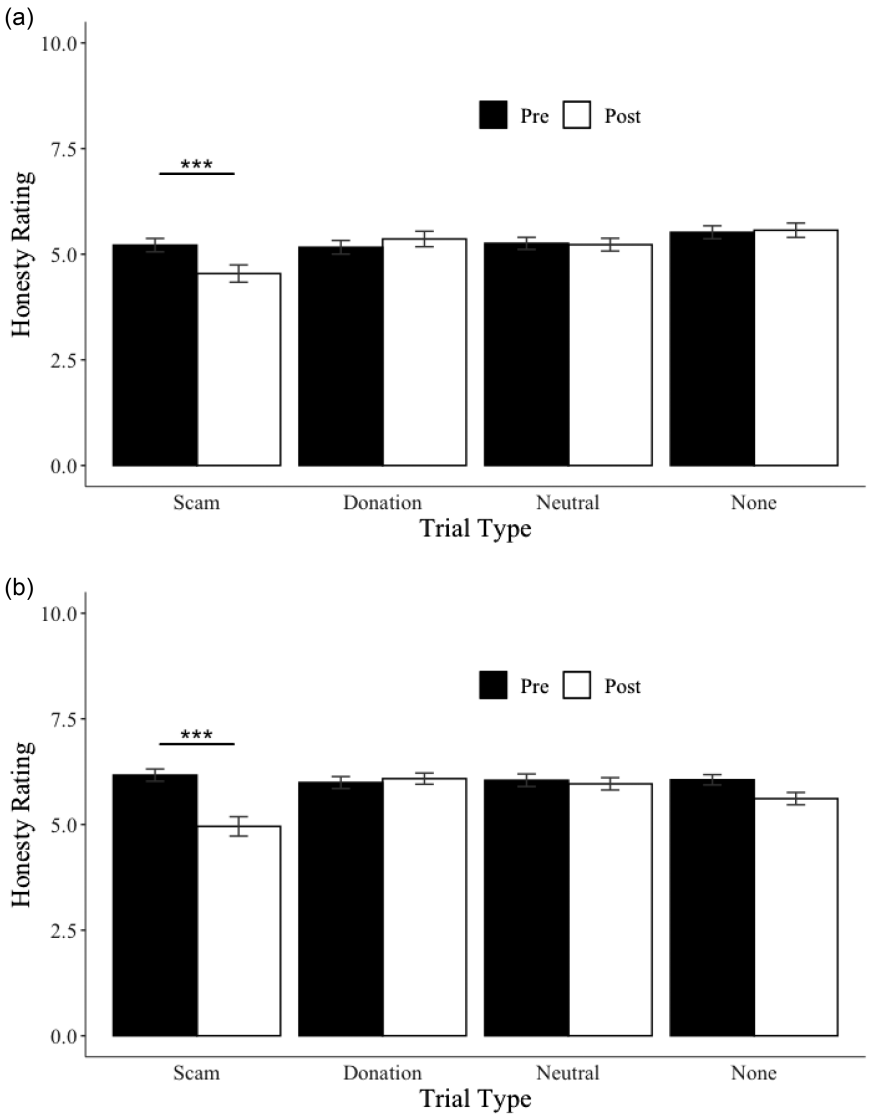
Discussion

Contrary to Experiment 1, our results from Experiment 2 revealed that when the viewing time for the faces was restricted, there was no difference in accuracy among the two age groups. This could be due to an increased difficulty in the task, resulting in a lack of a difference in performance accuracy between groups, which may have diminished the advantage typically observed in younger adults. We find this result to be somewhat surprising, however, this observation aligns with the notion that in Experiment 1, young adults might have utilized the extra time to create more elaborate associations in memory (F. I. M. Craik, 2022; Kilb & Naveh-Benjamin, 2011). Young adults were also more accurate at remembering faces associated with scams than faces associated with neutral. Therefore, young adults may have prioritized encoding more salient or important associations, such as those involving scams, while older adults may have struggled to employ such strategic prioritization effectively (see also F. I. Craik & Rabinowitz, 1985; Dunlosky & Connor, 1997).

Consistent with Experiment 1, older adults overall had higher honesty ratings than young adults (Bailey & Leon, 2019; Castle

Figure 5

Pre- and Posthonesty Ratings for Young (a) and Older Adults (b), Separated by Trial Type for Experiment 2



Note. Error bars reflect the standard error of the mean.
*** $p > .001$.

et al., 2012; Skurnik et al., 2005). Older adults also gave higher honesty ratings for faces paired with donation and neutral faces than young adults. This could be explained by older adults showing a positivity bias that young adults do not show (Castel et al., 2016). Also consistent with Experiment 1, honesty ratings for faces associated with scams decreased after the association was made, therefore showing that people were able to remember accurate impressions, despite the time limit. However, we did not find increased honesty ratings for the faces associated with donations, further showing the potential perceived importance of remembering the faces associated with a scam.

We investigated whether participants were implicitly remembering the paired associations despite inaccurately categorizing them by analyzing honesty ratings for the forgotten associations and found that overall honesty ratings were lower for all conditions after the association was made. This could be explained by the reduced time limit for viewing the faces leading to a potential overall distrust of the faces when they did not remember the association. Overall, older adults had higher honesty ratings than young adults despite conditions, as shown in Experiment 1. We also found similar confidence results as in Experiment 1, where older adults were more confident than young adults. Similar to Experiment 1, we found that participants were more confident in their accuracy for remembering faces associated with scams than neutral or donation. Both age groups were also accurate in their confidence ratings.

Table 4
Honesty Ratings in Experiment 2

Time	Age	Scam		Donation		Neutral		No association	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
All faces									
Pre	Young	5.21	1.19	5.16	1.21	5.26	1.08	5.52	1.17
	Old	6.17	1.12	5.99	1.09	6.05	1.15	6.06	0.96
Post	Young	4.54	1.54	5.36	1.38	5.23	1.13	5.57	1.28
	Old	4.95	1.79	6.08	1.03	5.96	1.14	5.61	1.13
Accurately remembered faces									
Pre	Young	5.00	1.28	5.49	1.19	5.42	1.18	—	—
	Old	6.15	1.26	6.14	1.18	5.99	1.33	—	—
Post	Young	3.95	1.70	5.92	1.43	5.40	1.28	—	—
	Old	4.55	2.13	6.67	1.16	6.06	1.36	—	—
Inaccurately remembered faces									
Pre	Young	5.46	1.52	4.98	1.51	5.11	1.22	—	—
	Old	6.25	1.31	5.83	1.22	6.11	1.31	—	—
Post	Young	5.49	1.92	4.80	1.57	5.00	1.41	—	—
	Old	5.75	1.54	5.07	1.41	5.75	1.57	—	—

Note. Em dash indicates no findings to report.

In sum, Experiment 2 showed that when faces were associated with scams, young and older adults significantly reduced their honesty ratings, which was not found for other conditions, despite there being no difference in accuracy for remembering the conditions which were shown in Experiment 2.

Experiment 3

Experiments 1 and 2 limited the time each participant could view each face. Experiment 3 aimed to see if the effects found in Experiments 1 and 2 would change if the participants were allowed to study the faces for as long as they wanted, making the study a self-paced experiment. Older adults may benefit from self-paced study time (Dunlosky & Conner, 1997) and focus more on the scam faces if this information is considered more important to remember (cf. Murphy et al., 2023). Therefore, a self-paced study would be important to examine because if participants are studying the scam associations longer, then that may indicate that they want to remember those or find them important, even if their memory may not reflect that when study time is limited. So, it allows us to have a better understanding of goals and whether memory is strategic.

Method

Participants

Participants were 103 young adults recruited from the UCLA undergraduate subject pool (age range: 18–29; M_{age} = 20.29, SD_{age} = 1.90; 85 female, 17 male, one other; 45 Asian/Pacific Islander, four Black, nine Hispanic, 38 White, seven other/unknown) who received course credit for their participation. Ninety-seven older adult participants were recruited on Prolific (age range: 55–84; M_{age} = 61.33, SD_{age} = 6.10; 63 female, 33 male, one other; one Indigenous Person/Alaskan Native, three Asian/Pacific Islander, two Black, four Hispanic, 85 White, two other/unknown; 11 high school graduate, 26 some college, no degree, 12 Associate's degree, 31 Bachelor's degree, 17 Graduate degree). Potential health issues or mental health statuses of the participants were not collected. All participants completed the experiment online. We decided to use Prolific instead of Amazon's Mechanical Turk due to the large number of participants who did not pass our CAPTCHA in Experiments 1 and 2. Nine older adult participants were excluded for not completing the experiment and one participant was excluded for providing a nonsensical answer to the CAPTCHA (including not answering a simple math question correctly). We decided to double our sample size from previous studies and aimed to collect around 100 younger adults and 100 older adults in each condition, in order to compensate for differences in the design of the experiment compared to Experiments 1 and 2 and ensure we have adequate power in our experiment. Data collection took place from January to April of 2023.

Materials and Procedure

The materials were the same as those used in Experiments 1 and 2. Experiment 3 was identical to Experiments 1 and 2, except this task was self-paced. Like Experiment 1, participants viewed 48 faces for 6 s each and then rated them on their trustworthiness. In the study phase, participants viewed 36 faces paired with a scam, donation, or neutral target and were instructed to study the faces for as long as they wanted. The participants were then tested on the paired associations and then rated all 48 faces again after viewing each face for 6 s. Although the study was self-paced, participants did not have the opportunity to return to a face that was previously viewed. Informed consent was acquired, and the study was completed in accordance with the UCLA IRB.

Results

Accuracy

We analyzed the participants' accuracy at remembering faces and their paired associations by fitting a logistic mixed-effects model. The model was the same as the models in the previous experiments. There was a significant effect of condition where participants were significantly more accurate at remembering the faces that were

associated with scams ($M = 0.67$, $SD = 0.22$) than neutral ($M = 0.60$, $SD = 0.23$), $OR = 1.49$, 95% CI [0.59, 0.80], $z = 5.87$, $p < .001$, and donation ($M = 0.58$, $SD = 0.21$), $OR = 1.54$, 95% CI [0.56, 0.76], $z = 6.61$, $p < .001$. There was no difference in accuracy for donation and neutral, $OR = 0.95$, 95% CI [0.82, 1.11], $z = 0.74$, $p = .74$. There was also a significant effect of age, $OR = 1.41$, 95% CI [0.57, 0.89], $z = 2.92$, $p = .004$, where young adults ($M = 0.65$, $SD = 0.23$) were significantly more accurate at remembering the paired associations than older adults ($M = 0.58$, $SD = 0.21$). There was no significant interaction between age and condition. The results are shown in Figure 6. In addition, we calculated sensitivity scores for young and older adults. Those results are shown in Table 5.

Table 5
Sensitivity Measures for Young and Older Adults in Experiment 3

Age group	Trial type	Hit	False alarm	Sensitivity (d')	Bias (c)
Young adult	Scam	.69	.31	.99	0
	Donation	.63	.37	.66	0
	Neutral	.64	.36	.72	0
Older adult	Scam	.65	.35	.77	0
	Donation	.54	.46	.20	0
	Neutral	.56	.44	.30	0

Confidence Ratings

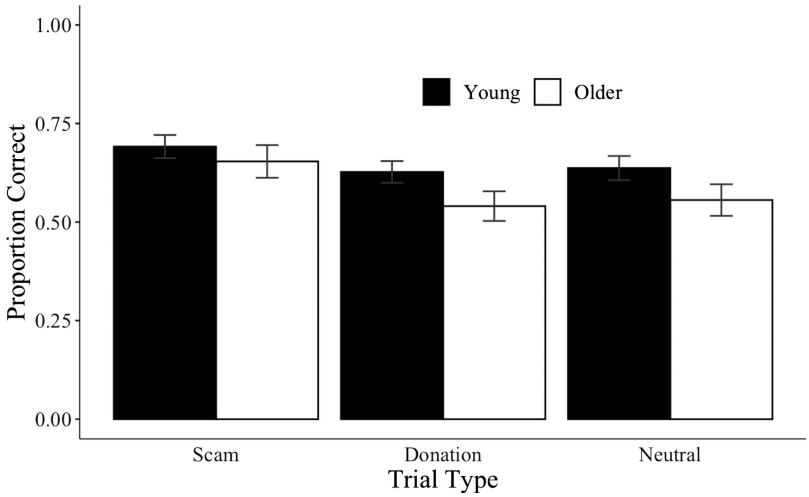
A Pearson correlation coefficient was calculated for participants' average accuracy and confidence ratings. Accuracy was significantly related to confidence in young adults, $r(301) = .47$, $p < .001$, and older adults, $r(289) = .27$, $p < .001$. However, the size of this correlation was weaker than what was found for young adults. We also conducted a linear mixed-effects model to assess confidence ratings. Our model included a two-way interaction for Age (Young vs. Old) × Condition (Scam vs. Donation vs. Neutral). We also included a random intercept for participants. We compared estimated marginal means to test the simple effects of the model. The effect of age was not significant, $b = 0.32$, $SE = .36$, $t = 0.88$, $p = .37$, but there was a significant effect of condition, where participants were more confident in their accuracy for faces associated with scams ($M = 7.24$, $SD = 2.88$) than neutral ($M = 6.46$, $SD = 2.22$), $b = 0.80$, $SE = .11$, $z = 7.14$, $p < .001$. Participants were also more confident at remembering donation ($M = 6.88$, $SD = 2.38$) than neutral, $b = 0.44$, $SE = .11$, $z = 3.93$, $p < .001$, or scam, $b = 0.36$, $SE = .11$, $z = 7.14$, $p < .001$. The interaction between age and condition was not significant.

We also ran a model for confidence ratings for only faces that were not accurately remembered, which revealed no significant effect of age, $b = 0.51$, $SE = .42$, $t = 1.20$, $p = .23$. However, the effect of condition was significant, where participants were less confident in their memory for faces that were associated with a scam ($M = 5.14$, $SD = 1.80$) than for those that were associated with neutral ($M = 6.19$, $SD = 2.44$), $b = 0.66$, $SE = .18$, $t = 3.57$, $p = .001$, or donation ($M = 5.82$, $SD = 3.48$), $b = 0.50$, $SE = .18$, $t = 2.74$, $p = .02$. There was no difference in confidence between donation and neutral, $b = 0.16$, $SE = .17$, $t = 0.91$, $p = .63$. There was not a significant interaction between condition and age.

Study Time

We also used a linear mixed-effect model to analyze how long the participants studied the faces. Our model included a two-way interaction for Age (Young vs. Old) × Condition (Scam vs. Donation vs. Neutral). We compared estimated marginal means to test the simple effects of the model. There was a significant effect of age where older adults ($M = 4.27$ s, $SD = 3.96$ s) studied the faces significantly longer than young adults ($M = 2.90$ s, $SD = 1.8$ s), $b = 1102.53$, $SE = 434.29$, $t = 2.54$, $p = .01$. There was no significant effect of condition. Numerically, participants seemed to view the faces associated with scams the longest ($M_{young} = 3.1$ s, $SD_{young} = 1.9$ s, $M_{old} = 4.5$ s, $SD_{old} = 4.4$ s), donation the second longest ($M_{young} = 3.1$ s, $SD_{young} = 1.9$ s, $M_{old} = 4.2$ s, $SD_{old} = 3$ s),

Figure 6
The Correct Selection of the Type of Information Each Face Is Paired With, Young and Older Adults, Separated by Trial Type in Experiment 3



Note. Error bars reflect the standard error of the mean.

and neutral the shortest (M_{young} = 2.6 s, SD_{young} = 1.7 s, M_{old} = 4.2 s, SD_{old} = 4.4 s). These differences were not significant, however. There was also no significant condition by age interaction.

A Pearson correlation revealed that the relationship between accuracy and study time of the faces was significant, $r(592) = .23$, $p < .001$. Therefore, the longer the participants studied the faces, the more accurately they remembered the paired association.

Honesty Ratings

We also used a linear mixed-effect model to analyze the honesty ratings for faces in the prestudy phase and the poststudy phase. Our model included a three-way interaction for Age (Young vs. Old) × Condition (Scam vs. Donation vs. Neutral) × Time (Pre vs. Post). Similar to our previous models, we compared estimated marginal means to test the simple effects of the model. There was a significant difference in condition. Participants rated faces associated with scams as being significantly less trustworthy than faces associated with neutral, $b = 0.70$, $SE = .04$, $z = 17.44$, $p < .001$, and donation, $b = 0.35$, $SE = .04$, $z = 23.02$, $p < .001$. There was no difference between scam and no association, $b = 0.30$, $SE = .22$, $z = 1.38$, $p = .51$. Faces associated with donation were rated as significantly more trustworthy than neutral, $b = 0.23$, $SE = .04$, $z = 5.59$, $p < .001$, and no association, $b = 0.63$, $SE = .22$, $z = 2.93$, $p = .02$. There was no difference between faces associated with neutral and no association, $b = 0.41$, $SE = .22$, $z = 1.89$, $p = .23$. Additionally, there was no effect of time, $b = 0.06$, $SE = .08$, $t = 0.78$, $p = .44$, nor of age, $b = 0.02$, $SE = .02$, $t = 1.07$, $p = .29$. There was, however, a significant interaction between condition and time. Honesty ratings decreased after being associated with a scam, $b = 1.42$, $SE = .06$, $z = 24.96$, $p < .001$, and no association, $b = 0.23$, $SE = .06$, $z = 4.01$, $p = .001$, and increased for donation, $b = 0.25$, $SE = .06$, $z = 4.43$, $p < .001$. There was no significant difference between pre- and postneutral ratings, $b = 0.09$, $SE = .06$, $z = 1.61$, $p = .75$. There was also a condition by age interaction. Young and older adults had higher honesty ratings for neutral (young: $b = 0.82$, $SE = .22$, $z = 14.52$, $p < .001$, older adults: $b = 0.59$, $SE = .06$, $z = 10.19$, $p < .001$) and donation (young: $b = 0.97$, $SE = .06$, $z = 17.29$, $p < .001$; older: $b = 0.88$, $SE = .06$, $z = 15.30$, $p < .001$) than scams. There was a significant time by age interaction where young ($b = 0.24$, $SE = .04$, $z = 6.15$, $p < .001$) and older adults, $b = 0.50$, $SE = .04$, $z = 12.31$, $p < .001$, had significantly higher honesty ratings in the pre than the post. Older adults also had higher honesty ratings than young adults prior to learning the associations, $b = 0.45$, $SE = .16$, $z = 2.76$, $p = .03$, but there was no age difference after learning the associations, $b = 0.19$, $SE = .16$, $z = 1.19$, $p = .63$. There was no significant condition by time by age interaction. The results are in Figure 7.

We then examined honesty ratings for only the faces for which participants accurately remembered the association to assess explicit memory for trustworthiness using a similar three-way model that we used for all honesty ratings and comparing estimated marginal means. We found a significant effect of condition where faces associated with donations were rated as significantly more trustworthy than neutral, $b = 0.42$, $SE = .06$, $z = 7.63$, $p < .001$, and scam ($M = 4.64$, $SD = 1.62$), $b = 1.52$, $SE = .05$, $z = 28.21$, $p < .001$. Neutral faces were also significantly more trustworthy than scam faces, $b = 1.10$, $SE = .05$, $z = 20.46$, $p < .001$. There was also a significant effect of time where honesty ratings were higher before the association was made, $b = 0.07$, $SE = .01$, $t = 5.36$, $p < .001$, and a significant effect of age where older adults reported higher honesty ratings than young adults, $b = 0.04$, $SE = .02$, $z = 2.26$, $p = .02$. There was a significant condition by time interaction. Honesty ratings of donations before the association were significantly lower than after the association was made, $b = 0.68$, $SE = .08$, $z = 8.73$, $p < .001$. Honesty ratings for faces associated with scams significantly decreased after the association was made, $b = 2.01$, $SE = .07$, $z = 27.87$, $p < .001$. There was no difference for faces associated with neutral, $b = 0.03$, $SE = .08$, $z = 0.33$, $p = .99$. There was no condition by age interaction, a time by age interaction, nor a significant condition by time by age interaction. In sum, faces associated with donation were rated as more trustworthy after the association was made and faces associated with scams were rated as less trustworthy for explicitly remembered items in both young and older adults.

Next, we examined honesty ratings for only the faces for which participants failed to remember the correct association to assess a more implicit test of memory for trustworthiness using a similar three-way model that we used for all honesty ratings and comparing estimated marginal means. There was no effect of condition. However, the effect of time was significant where honesty ratings were higher before the associations were made than after, $b = 0.59$, $SE = .12$, $t = 5.06$, $p < .001$. There was also a time by age interaction. Older adults had higher honesty ratings before the association was made than after, $b = 0.49$, $SE = .07$, $z = 6.88$, $p < .001$, but there was no difference across time points for young adults, $b = 0.03$, $SE = .08$, $z = 0.37$, $p = .98$. There was no effect of age, a significant interaction between time by condition interaction, condition by age interaction, nor between condition by time by age interaction. In sum, honesty ratings were higher before the associations were made and this did not differ for condition or age for forgotten items. All averages can be found in Table 6.

Discussion

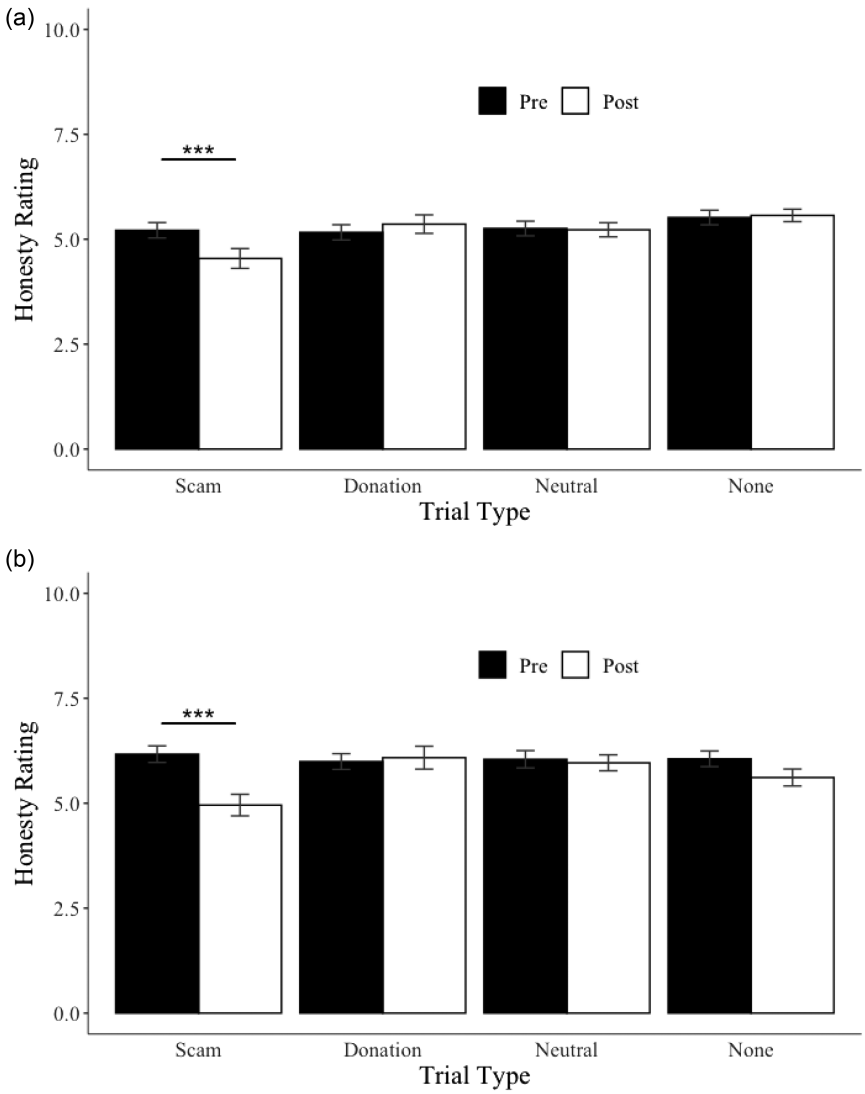
In Experiment 3, older adults, on average, studied the faces for 4.27 s, and young adults studied the faces for 2.90 s. Although older adults studied the faces for longer, they were less accurate than young adults at remembering them, consistent with prior research (e.g., Naveh-Benjamin et al., 2004). For both age groups, there was a significant correlation between study time and accuracy. Participants were more accurate at remembering the faces associated with scams rather than donation or neutral, implying that they attended to those faces more because of the potential cost of forgetting them (Table 7).

Consistent with the other experiments, the honesty ratings for faces associated with scams decreased after the association was made, but not for any of the other conditions. In addition, older adults gave higher honesty ratings than young adults overall. When looking at honesty ratings for only accurate responses, the findings were consistent with the prior experiments for the faces associated with scams. However, there was also a significant increase in honesty ratings for faces associated with donations. This finding was shown in Experiment 1 but not in Experiment 2. Therefore, this could mean that when time is limited, participants may be unable to form positive associations as strongly as negative ones.

We replicated our confidence findings from Experiments 1 and 2, where performance accuracy and confidence scores were correlated in young and older adults. However, participants were significantly more confident in their recall of scams than neutral ones. This

Figure 7

Pre- and Posthonesty Ratings for Young (a) and Older Adults (b), Separated by Trial Type for Experiment 3



Note. Error bars reflect the standard error of the mean.
*** $p > .001$.

finding is in line with the increased accuracy for scams compared to the other conditions and, therefore, could mean that participants wanted to attend to faces associated with scams for longer than the other conditions. This could be hinted at by the slightly longer study time in faces associated with scams compared to the other conditions. However, that effect was not significant.

General Discussion

This study examined how associations with negative information, like scams, and positive information, like donations, affect the perceived trustworthiness of faces and the ability to remember these associations in young and older adults. In addition, the study investigated if feelings of trustworthiness would be explicitly or implicitly affected as well as if the time the participants had to make the associations would influence the trustworthiness of faces.

Results from Experiments 1 and 3 for accuracy of remembering faces were consistent with our hypothesis and prior work that older adults were less accurate at remembering the faces' associations than young adults due to a deficit in associative memory (Castel et al., 2016; Old & Naveh-Benjamin, 2008). However, results for Experiment 2 revealed no difference in age. These findings suggest that age differences diminish when participants study associations for a shorter time and similarly diminish when older adults are given as much time as they need to learn the associations. Young and older adults had similar accuracy in remembering the associations, possibly because younger adults did not have additional time to engage in more elaborative encoding (Kilb & Naveh-

Table 6
Honesty Ratings in Experiment 3

Time	Age	Scam		Donation		Neutral		No association	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
All faces									
Pre	Young	5.33	1.38	5.38	1.34	5.39	1.36	5.12	1.38
	Old	5.82	1.32	5.98	1.29	5.82	1.35	5.41	1.31
Post	Young	3.95	1.60	5.82	1.49	5.49	1.51	4.98	1.19
	Old	4.36	1.68	6.05	1.47	5.52	1.35	5.08	1.25
Accurately remembered faces									
Pre	Young	5.39	1.41	5.49	1.35	5.46	1.31	—	—
	Old	5.72	1.43	6.07	1.45	5.95	1.41	—	—
Post	Young	3.56	1.72	6.17	1.57	5.56	1.37	—	—
	Old	3.90	1.89	6.62	2.30	5.76	1.45	—	—
Inaccurately remembered faces									
Pre	Young	5.35	1.73	5.25	1.61	5.25	1.69	—	—
	Old	5.91	1.56	5.90	1.38	5.72	1.58	—	—
Post	Young	5.33	1.55	4.98	1.56	5.11	2.00	—	—
	Old	5.49	1.47	5.32	1.42	5.25	1.59	—	—

Note. Em dash indicates no findings to report.

Benjamin, 2011) and because older adults can improve performance when given extra time to study.

Scams were the only condition that consistently influenced the faces' trustworthiness, where participants decreased their honesty ratings for faces after learning they were associated with a scam across all experiments. Honesty ratings for faces associated with donations increased in Experiment 1 and Experiment 3 (for the accurate responses only). Therefore, the negative impact of scams on trustworthiness seems more robust than the positive impact of donations for young and older adults. In addition, results from Experiment 3 showed that both age groups were more accurate at remembering the faces associated with scams than the other conditions, which is contrary to prior research showing that older adults are less likely to remember the amount of money that was

Table 7
Summary Table of Experiments 1, 2, and 3

Test type	Experiment 1	Experiment 2	Experiment 3
Accuracy	Age: O < Y Condition: S and D > N	Condition: S > N and D Condition × Age: Y S > Y D	Condition: S > N and D Age: O < Y
Honesty rating	Condition: S < D and N D > N Age: O > Y Condition × Time: S pre > S post D pre < D post	Condition: S < D, N and NA Age: O > Y Condition × Age: D O, N O > D Y, N Y S O > S Y D O > S O Condition × Time: S pre > S post	Condition: S < N and D D > N, NA N > NA Age: O > Y Condition × Time: S pre > S post NA pre > NA post D pre < D post Condition × Age: Y N and Y D > Y S O N and O D > O S Time × Age: Y pre > Y post O pre > O post O pre > Y pre
Honesty rating (accurate only)	Condition: S < D and N D > N Age: O > Y Time: pre > post Condition × Time: S pre > S post D pre < D post	Condition: D > S and N N > S Age: O > Y Time: pre > post Condition × Time: S pre > S post D pre < D post	Condition: D > N and S N > S Age: O > Y Time: pre > post Condition × Time: S pre > S post D pre < D post
Honesty rating (inaccurate only)	Age: O > Y	Condition: S > N and D N > D Time: pre > post Time × Age: O pre > Y pre	Time: pre > post Time × Age: O pre > O post O pre > Y pre
Confidence rating	Condition: S and D > N Condition × Age: O S > O N Y D and Y S > Y N	Age: O > Y Condition: S > N, D	Condition: S > N D > N and S
Confidence rating (inaccurate only)	Age: O > Y Condition × Age: O D > Y D	Age: O > Y	Condition: S < N and D
Study time	—	—	Age: O > Y

Note. Em dash indicates no findings to report. O = older adults; Y = young adults; S = scam; D = donation; N = neutral; NA = no association.

paired with faces that owed money to the participant (i.e., a loss), relative to faces that were paired with money that could be gained, displaying a positivity bias in older adults (Castel et al., 2016). In the present study, it may be the scam information is more meaningful and has great consequential implications, leading older adults to preferentially bind this information, which is an important avenue for future research (see also Hargis & Castel, 2018; Murphy et al., 2023). Thus, the present study did not show a positivity bias possibly because of the importance of remembering scam-related information. When negative information is important enough to remember, older adults have been shown to accurately remember the association (Hargis & Castel, 2018; Middlebrooks et al., 2016). The significance of scams, as evidenced by the millions of dollars consumers lose annually (Federal Trade Commission, 2021), may lead older adults to give precedence to making scam associations in memory. In Experiment 3, where participants were able to self-pace, participants were more accurate at remembering scams than the other conditions, and there was a significant correlation between study time and accuracy of remembering the faces. Although the condition had no significant effect on study time, scams were slightly studied for longer than the other conditions. This is particularly relevant given that older adults are frequently the targets of scam attempts that exploit memory vulnerabilities (Ross et al., 2014). Older adults must be hyperaware and prioritize remembering what could be costly, such as scams (Murphy et al., 2023). These findings could be impactful for potential interventions for consumers that could help them avoid falling for scams. If young and older adults are educated on what types of information or advertisements could be risky or a scam, they could remember not to trust the information, and future research could examine this with an effective intervention that includes the monetary value of scams as a basis for prioritizing information in memory.

Older adults were more trusting of the faces overall than young adults, consistent with prior research (e.g., Bailey & Leon, 2019; Castle et al., 2012; Skurnik et al., 2005). Although older adults were less accurate than young adults in remembering the paired associations, both age groups' trustworthiness ratings accurately reflected their association with scams across all experiments. Therefore, even though older adults' associative memory was less accurate than young adults, older adults could still determine who was least trustworthy. Skurnik et al. (2005) described older adults as appearing to have a diminished "gut feeling" for feelings of untrustworthiness. The present study challenges this idea because although older adults were more trusting than young adults overall, older adults could still determine who was untrustworthy at a comparable degree to young adults. These results could have a few explanations. Older adults may still be experiencing a "feeling" of untrustworthiness despite not being able to explicitly remember the source of their feelings of untrustworthiness (Rahhal et al., 2002). These results could also imply that at first introduction to information, older adults are more trusting than young adults but still can update their beliefs upon learning new information, whether explicitly or implicitly (Dew & Giovanello, 2010), which is consistent with prior research showing that despite having difficulty remembering the sources of information, some information can still be remembered (Rahhal et al., 2002). Trustworthiness ratings were influenced by the presence of scams for both younger and older adults, suggesting that older adults have some access to this information. However, when we investigated young and older adults' honesty ratings for faces they did not explicitly remember, none of the experiments showed that participants rated the faces associated with a scam as being less trustworthy. Therefore, these associations may not influence trustworthiness on an implicit level, which goes against prior research that young and older adults can have implicit memory for newly learned associated items (Dew & Giovanello, 2010). It may be that older adults do retain some gist-based information (e.g., Castel, 2024; Greene & Naveh-Benjamin, 2022a) about trustworthiness that then later influences honesty ratings.

Some potential limitations of this study are that all the data was collected online, leading to a potential lack of attention to the experiment and the inability to control various aspects of the participants' environment. These issues are common in online research with younger and older adults (Greene & Naveh-Benjamin, 2022b). This sample may also represent some older adults who often use the Internet and may be targeted by scams and fraud. Future studies should investigate these findings further and determine the robustness of the effects in other samples. In addition, participants' honesty ratings of faces associated with positive affect such as donations should be further examined since the findings were variable in the present study and could have implications for decision making and charitable giving. In addition, future studies should be conducted to see if these findings about scams can be used as a basis for intervention. Future research should also investigate the lack of older adult deficit in performance accuracy when time was limited in Experiment 2. Future research may show differences by using a more restrictive study time, such as if much shorter times were used that limited older adults' ability to do initial encoding of both the items and associative information, which might then lead to more pronounced deficits for older adults due to general slowing (Salthouse, 2014).

A potential limitation of this study is that young adult participants received course credit, while older adults received money for their participation. Therefore, young and older adults may have had different motivations for completing this task. While this is somewhat common in similar research that examines cross-sectional studies of cognition and aging (cf. Greene & Naveh-Benjamin, 2022b; Schwartz et al., 2023), a future experiment should investigate these findings without a discrepancy in motivation between age groups. In addition, our sample size does vary in the education level and gender of the participants, which could have created a confound for the results. Future studies should investigate these findings with education level and gender differences in mind. Future research should also further examine different variations of procedure where there is no Test Phase. This would investigate how initial encoding, without any retrieval of the pairings, could also play a role in the honesty judgments (perhaps due to fluency or liking of each face). This would help parse whether the present study's findings are influenced by encoding and retrieval of the pairings. In terms of metacognitive measures, it was not the primary research question and therefore we did not investigate it in our current experiment, but a future study may want to investigate metacognitive effects or mechanisms underlying these findings.

The present study showed that when faces are associated with scams, perceived trustworthiness decreases for younger and older adults. While young adults were overall more accurate than older adults when recalling the associated conditions, both age groups' honesty ratings reflected a sensitivity to scams, suggesting older adults do learn important information about trustworthiness. Older

adults' heightened trustworthiness in others could potentially make them more susceptible to falling for scams, but with additional study time, older adults may be able to improve their memory for faces associated with scams.

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