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Age Effects on Trustworthiness Activation and Trust Biases in Face Perception

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Abstract

Objective: Older adults evaluate faces as being more trustworthy than do younger adults. The present work examined whether aging is associated with changes in the dynamic activation of trustworthiness categories toward faces, and if category activation relates to enhanced trust.

Method: Younger and older adults categorized faces as trustworthy or untrustworthy while computer mouse trajectories were recorded to measure dynamic category activation.

Results: Older, but not younger, adults had more dynamic category activation (i.e., trustworthy and untrustworthy) when they viewed untrustworthy versus trustworthy faces. This tendency predicted a bias (pronounced with age) toward evaluating faces as being trustworthy.

Discussion: A pronounced trust bias in aging may be related to greater dynamic activation of trustworthiness (vs untrustworthiness) when perceiving faces.

Keywords: Categorization, Face perception, Impression formation, Trustworthiness

Older adults (OAs) evaluate faces as being more trustworthy than do younger adults (YAs) (Castle, Eisenberger, Seeman, Moons, & Boggero, 2012; Zebrowitz, Franklin, Hillman, & Boc, 2013). This bias is not because OAs cannot dissociate untrustworthiness from trustworthiness. Indeed, YAs and OAs agree which faces are trustworthy or untrustworthy (e.g., Zebrowitz et al., 2013). Rather, this bias likely emerges due to age differences in positivity. For instance, OAs report that untrustworthy faces are more approachable than do YAs (Castle et al., 2012). The trust bias in aging is important to consider because OAs trust individuals with untrustworthy reputations more than do YAs (Bailey et al., 2016). Characterizing the trust bias is thus critical for understanding OAs' greater susceptibility to deceit than YAs (Ruffman, Murray, Halberstadt, & Vater, 2012).

OAs' trust bias could potentially emerge through how facial cues influence impressions. For instance, more trustworthy impressions may stem from OAs being either less responsive to negative facial cues or more responsive to positive cues. For example, OAs perceive less danger in faces than do YAs (Ruffman, Sullivan, & Edge, 2006). This critically occurs even though both OAs and YAs categorize the same faces as being dangerous. Thus, although OAs correctly identify negative cues, they may be less responsive to them. Although people might assume that OAs exhibit a trust bias because they are more positive than YAs overall, OAs could be less attuned to cues signaling untrustworthiness. How might this occur?

OAs' potentially lower responsiveness to negative cues might contribute to their trust bias through the dynamic processes underlying face perception. Social categories (e.g., race or trustworthiness) are automatically activated when perceiving faces. Recent work suggests that, contrary to prior conceptualization, category activation dynamically occurs (Freeman & Ambady, 2011). That is, perceivers partially

activate multiple categories (e.g., approach and avoid) before settling on one categorization (e.g., I will avoid this person; Martens, Hasinski, Andridge, & Cunningham, 2012). Here, we examined if trustworthiness-related category activation relates to the trust bias, and if differences in activating trustworthiness-related categories emerge in aging.

Importantly, dynamic category activation predicts behavior (Johnson, Lick, & Carpinella, 2015). For instance, highly trusting individuals activate both approach and avoidance categories when perceiving untrustworthy (vs trustworthy) faces to a greater extent than do less trusting individuals (Martens et al., 2012). Dynamic category activation can thus elucidate why OAs and YAs have high consensus on faces being trustworthy or untrustworthy, but different behavior (e.g., OAs' trust bias; Zebrowitz et al., 2013). We predict that OAs will dynamically activate multiple categories (i.e., trustworthy and untrustworthy) to a greater extent when they evaluate untrustworthy (vs trustworthy) faces. In other words, OAs may disproportionately activate the category of trustworthiness when perceiving faces (because they activate it for both trustworthy and untrustworthy faces).

We assessed dynamic category activation by analyzing computer mouse trajectories when YAs and OAs categorized faces as trustworthy or untrustworthy. We first verified that OAs had a stronger trust bias than YAs. Second, we examined whether OAs were more likely than YAs to dynamically activate untrustworthiness and trustworthiness categories toward untrustworthy (vs trustworthy) faces. Finally, we tested if dynamic category activation (i.e., trustworthy and untrustworthy) toward untrustworthy and trustworthy faces increased and decreased, respectively, the trust bias. These patterns would establish that category activation modulates a trust bias expected to be pronounced with age.

Method

Participants

Forty-four OAs (M_{age} = 71.60, SD = 6.06, 29 females) and 44 YAs (M_{age} = 18.90, SD = 2.20, 28 females) from the greater Indiana University community participated. Power analyses (f^2 = .18, α = .05, and power = .80) targeted 79 participants to detect an Age × Trustworthiness interaction on dynamic category activation. OAs completed the Mini-Mental State Examination (M = 28.70, SD = 1.13) as well as standard measures of executive ability (Glisky, Polster, & Routhieaux, 1995) to ensure they were normal functioning.

Stimuli

Given consensus in trustworthiness evaluations (Rule, Krendl, Ivcevic, & Ambady, 2013), past work has used norms to preselect untrustworthy and trustworthy faces for categorization tasks (e.g., Wilson, Young, Rule, & Hugenberg, 2018). Sixty male faces (30 trustworthy and 30 untrustworthy) were selected via YAs' and OAs' norms (Cassidy & Gutchess, 2015). Trustworthy faces (M = 4.36, SD = 0.25) were more trustworthy than untrustworthy faces (M = 3.64, SD = 0.23), $t(58)$ = 11.70, p < .001, but similarly distinctive and attractive, ps > .22. We purposefully selected trustworthy and untrustworthy faces that did not fall on the extreme ends of the norming scale in order to introduce ambiguity into the task. This was necessary to ensure a range of trust bias values because calculating bias requires false alarms and hits.

Procedure

On each of 60 trials (Figure 1A), participants clicked a "start" button at the screen's bottom-center and a face appeared in its place. Participants evaluated faces by clicking "Trustworthy" or "Untrustworthy" labels in the top left or right screen corners. Label placement was counterbalanced across participants, with faces randomly presented. Participants were reminded to respond quicker if their movements were initiated after 400 ms. Practice involved evaluating four trustworthy and four untrustworthy faces. X and Y coordinates of mouse trajectories (sampling rate = 70 Hz) were recorded.

Mouse Trajectory Analyses

For each trial, area under the curve (AUC), defined as the area between observed and straight trajectories from the start and end points, was recorded. Larger AUCs reflect more dynamic activation of opposite trust categories (e.g., a trajectory drawn to "trustworthy" when ultimately evaluating a face as "untrustworthy"). Larger AUCs indicate more dynamic category activation. Trajectories were remapped rightward for comparison.

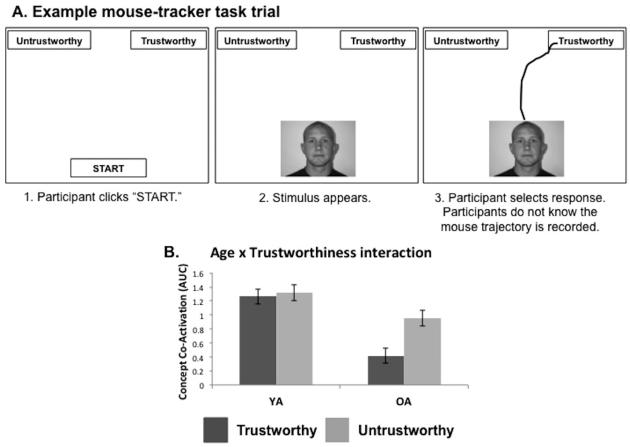

Figure 1. Example trial (A). More trajectory attraction to the opposite concept reflects more dynamic category activation (i.e., larger AUC values). Mouse trajectories revealed an Age × Trustworthiness interaction reflecting more dynamic category activation for untrustworthy versus trustworthy faces in OAs, but not in YAs (B). AUC = area under the curve; OA = older adult; YA = younger adult.

Table 1. Means (*SD*s) (A) and Regression Statistics (B)

	Hits	False alarms	A′	B″
A. *M* (*SD*)				
YA	0.63 (0.17)	0.41 (0.18)	0.68 (0.10)	−0.01 (0.24)
OA	0.75 (0.18)	0.53 (0.20)	0.70 (0.11)	−0.22 (0.33)
B. Regression statistics				
Variable	β (standardized)	*t*	*R*	R^2
Step 1			.668	.446
Age	−.24	2.48*		
AUC: untrustworthy	−.41	4.86***		
AUC: trustworthy	.37	3.87***		
Step 2			.674	.454
Age	−.25	1.22		
AUC: untrustworthy	−.38	2.93**		
AUC: trustworthy	.32	2.64*		
Age × AUC: untrustworthy	−.08	0.50		
Age × AUC: trustworthy	.10	0.90		

Note: AUC = area under the curve; OA = older adult; YA = younger adult. Age: 0 = YA, 1 = OA.
*p < .05. **p < .01. ***p < .001.

Following norms (Freeman & Ambady, 2010), trials with initiation times over 400 ms were excluded (M_{OA} = 3.30 trials, *SD* = 3.78; M_{YA} = 1.27 trials, *SD* = 1.92; $t(86) = 3.17$, $p = .002$). YAs ($M = 22.82$, $SD = 3.97$) and OAs ($M = 22.11$, $SD = 4.37$) made a similar number of incorrect categorizations (i.e., categorizations mismatched norms), $t(86) = 0.79$, $p = .43$. YAs and OAs differed in why they made these errors. YAs ($M = 10.82$, $SD = 4.97$) incorrectly categorized trustworthy faces more than OAs ($M = 7.07$, $SD = 4.89$), $t(86) = 3.57$, $p = .001$. OAs ($M = 15.05$, $SD = 5.92$) incorrectly categorized untrustworthy faces more than YAs ($M = 12.00$, $SD = 5.20$), $t(86) = 2.56$, $p = .01$.

AUC analyses focused on correct trials (e.g., untrustworthy faces called untrustworthy). This focus is consistent with analysis norms (Freeman & Ambady, 2010) and reflects work showing that YAs and OAs generally agree on which faces are trustworthy and untrustworthy (Zebrowitz et al., 2013). Moreover, linking AUCs from correct trials with the trust bias would theoretically link work on general trustworthiness agreement with OAs' impression positivity (Castle et al., 2012).

Results

OAs Exhibit a Trust Bias Relative to YAs

We first replicated that although YAs and OAs agree as to whether faces are trustworthy or untrustworthy, OAs more positively perceive faces. We analyzed evaluations using signal detection (e.g., Krendl, Rule, & Ambady, 2014). Trustworthy responses represented signal. Untrustworthy responses represented noise. Hits were classified as categorizing trustworthy faces as trustworthy. False alarms were classified as categorizing untrustworthy faces as trustworthy. Assigning signal and noise in forced choice tasks is arbitrary, making analyses of the reverse pattern redundant (Macmillan & Creelman, 2004). Bias statistic B″ characterized the trust bias. Lower B″ reflects a trust bias. Sensitivity statistic A′ characterized accuracy (the extent to which impressions matched norms). See Table 1 (A) for descriptive statistics.

One-sample *t* tests (B″ ≠ 0) showed that OAs had a trust bias, $t(43) = 4.44$, $p < .001$, but YAs did not, $t(43) = 0.33$, $p = .75$. Importantly, B″ was lower for OAs than YAs, $t(86) = 3.39$, $p = .001$. YAs and OAs both showed above-chance accuracy (A′ > .5; YA: $t(43) = 11.84$, $p < .001$; OA: $t(43) = 11.32$, $p < .001$). Importantly, A′ did not differ with age, $t(86) = 0.53$, $p = .60$, meaning YAs and OAs agreed as to whether faces were trustworthy or untrustworthy. Prior work has suggested that age-related positivity stems from the downregulation of negative emotions (Mather & Carstensen, 2005), yet extant work has not linked executive ability to OAs' trust bias (e.g., Zebrowitz et al., 2013). Consistent with extant work, OAs' executive ability ($M = 0.19$, $SD = 0.59$) did not correlate with A′ or B″, *p*s > .33. Failing to show this link is potentially due to the relatively automatic processing of facial trustworthiness (Rule et al., 2013).

Dynamic Category Activation Toward Untrustworthy Versus Trustworthy Faces Increases With Age

We next entered AUCs into a 2 (Age: YAs, OAs) × 2 (Trustworthiness: trustworthy, untrustworthy) analysis of variance (ANOVA). A Trustworthiness effect showed larger AUCs for untrustworthy ($M = 1.19$, $SD = 0.79$) than trustworthy ($M = 0.88$, $SD = 0.85$) faces, $F(1, 86) = 6.45$, $p = .01$, $\eta_p^2 = .07$. An Age effect showed larger AUCs for YAs ($M = 1.32$, $SD = 0.46$) than OAs ($M = 0.75$, $SD = 0.46$), $F(1, 86) = 32.16$, $p < .001$, $\eta_p^2 = .27$. Critically, an Age ×

Trustworthiness interaction emerged, $F(1, 86) = 4.20$, $p = .04$, $\eta_p^2 = .05$ (Figure 1B). OAs' AUCs were larger for untrustworthy ($M = 1.04$, $SD = 0.79$) than trustworthy faces ($M = 0.46$, $SD = 0.59$) faces, $t(43) = 3.85$, $p < .001$. OAs thus activated the category of trustworthy toward untrustworthy faces more than they activated the category of untrustworthy toward trustworthy faces. YAs had no difference ($M_{trustworthy} = 1.28$, $SD = 0.87$; $M_{untrustworthy} = 1.35$, $SD = 0.77$), $t(43) = 0.31$, $p = .76$. Put another way, YAs had more dynamic category activation than OAs for trustworthy faces, $t(86) = 5.28$, $p < .001$. No difference emerged for untrustworthy faces, $t(86) = 1.88$, $p = .06$. Exploratory analyses revealed parallel patterns for inaccurate categorizations. We analyzed AUCs for incorrect categorizations on an exploratory basis. The results were largely consistent with those conducted with the correct categorizations. We did not include AUCs for correct and incorrect trials in the same ANOVA because more trials were correct versus incorrect. Three OAs were excluded for having no incorrect categorizations of trustworthy faces. AUCs were entered into a 2 (Age: YAs, OAs) × 2 (Trustworthiness: trustworthy, untrustworthy) ANOVA. An Age × Trustworthiness interaction emerged, $F(1, 83) = 4.97$, $p = .03$, $\eta_p^2 = .06$. OAs' AUCs were larger for trustworthy ($M = 1.16$, $SD = 1.12$) versus untrustworthy ($M = 0.44$, $SD = 0.37$) faces, $t(40) = 4.29$, $p < .001$. Thus, OAs had more dynamic category activation toward faces evaluated as untrustworthy versus trustworthy. YAs had no difference ($M_{trustworthy} = 1.45$, $SD = 1.06$; $M_{untrustworthy} = 1.50$, $SD = 1.37$), $t(43) = 0.18$, $p = .86$.

Age and Dynamic Category Activation Relate to the Trust Bias

Finally, a linear regression determined whether age (0 = YAs, 1 = OAs) and AUCs (dynamic category activation) for untrustworthy and trustworthy faces contributed to B″, with lower B″ reflecting an increased trust bias. The overall model was significant, $F(3, 84) = 22.51$, $p < .001$, accounting for 44.60% of variance (Table 1 (B)). Age predicted lower B″. Higher AUCs for untrustworthy and trustworthy faces predicted, respectively, lower and higher B″. Prior work suggests women may display enhanced trust versus men (e.g., Haselhuhn, Kennedy, Kray, Van Zant, & Schweitzer, 2015). We thus included gender and its interactions with age and AUCs for trustworthy and untrustworthy faces in a regression predicting B″. Gender did not predict B″, $p = .98$. All other results maintained direction and significance.

To test if AUCs for trustworthy or untrustworthy faces affected OAs more than YAs, we entered the two Age × AUC interaction terms into the model. This model did not explain more variance than the first (R^2 change = .01). Dynamic category activation did not impact the trust bias differentially with age. Rather, OAs and YAs differed in the extent of their category activation. Specifically, OAs had more disparity in their category activation than YAs.

Discussion

Our results replicated work showing that although OAs and YAs agree on faces being trustworthy or untrustworthy (e.g., Zebrowitz et al., 2013), OAs perceive faces as more trustworthy than YAs (e.g., Castle et al., 2012). This study extended these findings by showing that dynamic category activation toward untrustworthy and trustworthy faces increases and decreases, respectively, the trust bias. Critically, OAs activated trustworthiness and untrustworthiness categories when evaluating untrustworthy faces, but tended to activate only trustworthiness toward trustworthy faces. YAs did not exhibit this difference.

Greater dynamic category activation when faces are untrustworthy versus trustworthy may drive impression positivity because it suggests more overall activation of trustworthiness. Indeed, more trusting individuals activate approach tendencies toward untrustworthy faces more than they activate avoid tendencies toward trustworthy faces (Martens et al., 2012). YAs neither exhibited disproportionate activation nor the trust bias. It is unlikely that this pattern was due to task constraints because YAs exhibit differential category activation in myriad contexts (e.g., Freeman, Ambady, Rule, & Johnson, 2008). Notably, YAs had greater dynamic category activation than OAs overall. Suggesting *disparity* in dynamic category activation toward untrustworthy versus trustworthy faces to drive the trust bias, OAs exhibited disparity in category activation and a trust bias. Critically, OAs' disparity reflected more overall activation of trustworthiness. Moreover, OAs also had less dynamic category activation toward trustworthy faces than YAs, suggesting less untrustworthiness activation. No difference emerged for untrustworthy faces. Further reflecting their trust bias, OAs had more incorrect categorizations of untrustworthy faces than YAs.

OAs disproportionately activated trustworthiness relative to untrustworthiness irrespective of the type of face they evaluated. One possibility for this pattern might be OAs' increased social expertise (Hess & Auman, 2001). Negative morality-related stimuli are less frequently expected than positive (Mende-Siedlecki, Baron, & Todorov, 2013). Because trustworthiness relates to morality (Fiske, Cuddy, & Glick, 2007), OAs' baseline expectation could be that people are trustworthy. Alternatively, OAs may be more aware than YAs that relative facial trustworthiness inaccurately predicts behavior (Rule et al., 2013), potentially reflecting enhanced social reasoning with age (Grossmann et al., 2010). Untrustworthy cues may activate and factor into OAs' impressions less when perceiving faces as a result. Future work should assess these possibilities.

These possibilities may more generally reflect that trustworthiness is more accessible to OAs versus YAs when perceiving faces. That is, trustworthiness may be a primary heuristic for OAs guiding their behavior. Given OAs' reliance on heuristics in decision-making (Johnson, 1990), trustworthiness may be particularly

salient for OAs even when faces are ultimately evaluated as untrustworthy. Supporting this idea, age-related trust biases are pronounced among untrustworthy faces (Castle et al., 2012).

We used signal detection to characterize the trust bias because the task utilized dichotomous categorizations. Future work may test if dynamic category activation affects trust biases obtained through a range of ratings. Using a scale may extend the present work by characterizing subtle differences in how trust biases emerge. Another limitation of the present study regards its Western participants. Although perceivers from Western and Eastern cultures agree on trait inferences from faces (Albright et al., 1997), elements underlying trust behavior differ between cultures (Yuki, Maddux, Brewer, & Takemura, 2005). Future work may assess whether the present findings are broadly generalizable.

Trust biases are important to characterize given OAs' greater susceptibility to deception (Ruffman et al., 2012). The present work evidences that trust biases pronounced with age may in part be due to shifts in dynamically activating trustworthiness-related categories during face perception.

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Conflict of Interest

The authors declare no conflicts of interest.

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