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Running Head: Perceptions of Trust

Neural and Behavioral Bases of Age Differences in Perceptions of Trust

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Abstract

Older adults are disproportionately vulnerable to fraud, and federal agencies have speculated that excessive trust explains their greater vulnerability. Two studies, one behavioral and one using neuroimaging methodology, identified age differences in trust and their neural underpinnings. Older and younger adults rated faces high in trust cues similarly, but older adults perceived faces with cues to untrustworthiness to be significantly more trustworthy and approachable than younger adults. This age-related pattern was mirrored in neural activation to cues of trustworthiness. Whereas younger adults showed greater anterior insula activation to untrustworthy versus trustworthy faces, older adults showed muted activation of the anterior insula to untrustworthy faces. The insula has been shown to support interoceptive awareness that forms the basis of 'gut feelings,' which represent expected risk and predict risk-avoidant behavior. Thus, a diminished 'gut' response to cues of untrustworthiness may partially underlie older adults' vulnerability to fraud.

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Older adults are disproportionately vulnerable to frauds of many kinds. Both the Federal Bureau of Investigation (1) and the Federal Trade Commission (2) have conjectured that older adults' excessive positive responses to other people may underlie their vulnerability. Consistent with this idea, a large body of literature indicates that older adults shape their experiences and social networks in ways that lead to positive socioemotional outcomes (3). As such, older adults' judgments of the trustworthiness of others may also be skewed in a positive direction. Affective judgments of trustworthiness implicate processing in limbic regions, including the amygdala and insula (4, 5). Accordingly, age differences in trust may be reflected in altered patterns of activation in these neural regions.

We report the results of two investigations that address how older adults process facial cues indicative of trust differently from younger adults. The first is a behavioral study in which participants rated faces that varied in cues conveying trustworthiness (trustworthy, neutral, untrustworthy) (4). The second study used functional neuroimaging to identify whether facial cues of trustworthiness are processed differently in the brains of older versus younger adults. We predicted that older adults would perceive people to be more trustworthy and that this pattern would be reflected in lesser insula and/or amygdala responses to the stimuli.

Study 1

People make many inferences about personal attributes from facial features (6, 7). One fundamental such judgment is whether a person is inherently trustworthy or not (5, 8). The present study investigated whether there are reliable age differences in how older and younger adults infer trust from facial cues.

Results

Older and younger adults observed faces that had previously been selected to convey cues regarding trustworthiness (trustworthy, neutral, or untrustworthy) (4) and rated them on how trustworthy and approachable the person seemed to be. These ratings were subjected to Age group (younger versus older) by Face Type (trustworthy, neutral, untrustworthy) mixed model ANOVAs, with the second factor being within-participants. Consistent with predictions, there was a significant age by face type interaction, $F(2, 270) = 7.176$, $p = .001$, $\eta_p^2 = .050$: Faces high in trust cues were perceived as equally trustworthy by older ($M = .952$, $SE = .075$) and younger adults ($M = .926$, $SE = .167$), $F < 1$; neutral faces were also perceived as equally trustworthy by older ($M = .451$, $SE = .069$) and younger adults ($M = .309$, $SE = .153$), $F < 1$; in contrast, untrustworthy faces were perceived as significantly more trustworthy by older adults ($M = -.757$, $SE = .073$) than by younger adults ($M = -1.404$, $SE = .162$), $F(1, 135) = 13.267$, $p < .001$ (Figure 1a). Thus, as predicted, older adults perceived faces conveying cues to untrustworthiness to be more trustworthy, compared to younger adults, although they did not differ in their evaluations of faces high or medium in cues related to trust.

Analyses of approachability ratings showed related patterns. A main effect of age group indicated that older adults viewed the photographed people as more approachable ($M = .577$, $SE = .061$) than younger adults ($M = .078$, $SE = .137$), $F(1, 137) = 10.985$, $p = .001$, $\eta_p^2 = .074$. These main effects were qualified by a significant age group by face trustworthiness interaction, $F(2, 274) = 13.735$, $p < .001$, $\eta_p^2 = .091$. Trustworthy faces were perceived as equally approachable by older adults ($M = 1.478$, $SE = .075$) and younger adults ($M = 1.191$, $SE = .162$), $F(1, 137) = 2.441$, $p = .120$. Similarly, older ($M = .875$, $SE = .067$) and younger adults ($M = .635$, $SE = .150$) perceived neutral faces as equally approachable $F(1, 137) = 2.145$, $p = .145$. However, older adults ($M = -.624$, $SE = .072$) perceived untrustworthy faces to be significantly more approachable (that is, less unapproachable) than was true for younger adults ($M = -1.591$, $SE = .162$), $F(1, 137) = 29.885$, $p < .001$. Thus, consistent with the trustworthiness results, older adults regarded the people pictured in the photographs as more approachable than younger adults did, and this was especially true for the faces conveying cues of untrustworthiness.

Study 1 Discussion

Older adults perceive facial cues relating to trust differently than younger adults. Although the two age groups rated faces high or neutral in trust cues similarly, older adults rated untrustworthy faces as significantly more trustworthy and approachable than younger adults did. Thus, older adults' propensity to see people as trustworthy occurs disproportionately at the untrustworthy end of the trust dimension. Essentially, then, older adults regard the faces as more similar than younger adults, who made sharper discriminations based on cues to trust. These findings provide some support for the contention that older adults' vulnerability to fraud may have at least a partial basis in a reduced sensitivity to cues to untrustworthiness. We next examined whether older adults' lack of sensitivity to cues related to trust is reflected in patterns of neural activation.

Study 2

Study 2 examined neurocognitive mechanisms underlying age differences in perceptions of trust. Participants saw pictures of faces pre-rated to range in trustworthiness, which came from an expanded continuous set similar to the three discrete types of stimuli used in Study 1. To identify neural processes related to explicit trust perception, participants evaluated the trustworthiness of the face by making a binary judgment of each face as either 'trustworthy' or 'untrustworthy' (trustworthiness judgments). As a comparison task, participants rated the same faces as either 'female' or 'male' (gender judgments), which involves only passive exposure to facial cues of trustworthiness. For analytic purposes, faces were divided into those perceived to be trustworthy versus untrustworthy.

Age-related differences in explicit judgments of untrustworthy faces found in Study 1 led to hypotheses regarding activation in the anterior insula, a region believed to contribute to decision making by instantiating valenced subjective feeling states (9). This region has previously been implicated in assessing trustworthiness and responding to breaches in trust (10). We also examined the amygdala, a region that has been associated with processing facial cues regarding untrustworthiness (4, 5, 11).

First, we hypothesized an age x task interaction in the anterior insula, such that compared to younger adults, older adults would show reduced activation during explicit judgments of trustworthiness. Critically, we also predicted an age x trustworthiness interaction in the anterior insula and amygdala, such that when compared to younger adults, older adults would show a muted response to untrustworthy faces.

Results

ROI Analyses. Based on *a priori* hypotheses regarding the involvement of the anterior insula and amygdala, we began by examining task-related effects using region of interest (ROI) analyses within anatomically defined bilateral anterior insula (AI) and amydala ROIs.

Anterior Insula ROI. We first focused on our control cohort of younger adults to identify neural activation associated with trust perception and subjected their data to a 2(face type) x 2(task) ANOVA. As predicted, there was a main effect of task, reflecting greater bilateral AI activity when making trustworthiness vs. gender judgments, $F(1,19)=27.51$, $P<.001$. There was also a main effect of face type, such that untrustworthy (vs. trustworthy) faces led to greater activity in the bilateral AI, $F(1,19)=4.89$, $P=.02$. There was no task x trustworthiness interaction $F(1,19)=.092$, $P=.383$. In contrast, when the same ANOVA was performed for the sample of older adults, they showed no significant effects of task $F(1,17)=.272$, $P=.305$, trustworthiness $F(1,17)=.095$, $P=.381$, or task x trustworthiness $F(1,17)=.00$, $P=.497$; these findings suggest that, consistent with their lesser sensitivity to trust cues in Study 1, older adults do not show differential AI activity in response to untrustworthy vs. trustworthy faces or to making trustworthy (vs. gender) evaluations.

To compare bilateral anterior insula activity for the age groups directly, a 2(age) x 2(face type) x 2(task) ANOVA was performed. Significant main effects for age F(1,36)=5.3, P=.014, face type F(1,36)=3.79, P=.03, and task F(1,36)=7.77, P=.004 were found, such that there was greater AI activity for younger vs. older adults overall, for untrustworthy vs. trustworthy faces, and for the trustworthy vs. gender judgments. More importantly, there was a significant age x task interaction F(1,36)=13.16, P<.001 and a marginally significant age x trustworthiness interaction F(1,36)=2.56, P=.059 (see figure 2), such that younger adults showed more activation of the anterior insula than older adults during the trust rating task and in response to untrustworthy faces. Because the age x trustworthiness interaction was marginally significant, we explored further and found that it reached significance in the left anterior insula F(1,36)=2.905, P=.049, but was only marginally significant in the right anterior insula F(1,36)=1.925, P=.087. No other interactions were significant.

Amygdala ROI. No significant main effects or interactions were present in the amygdala in either age group when the groups were modeled separately as a 2(trustworthiness) x 2(task) ANOVA or when directly compared in a 2(age) x 2(trust-level) x 2(task) ANOVA (see supplement for F statistics).

Whole brain analyses. To obtain a more detailed picture of neural regions that were differentially activated as a function of age, we next conducted whole brain analyses.

Again, we first focused on the control cohort of younger adults to identify neural activity associated with typical trust perception. The main effect of task (*all trustworthiness judgments > all gender judgments*) revealed that younger adults show heightened activation in bilateral anterior insula (right : 33, 23, 1; t=5.51, k=160 & left: -30 20 -8; t=4.65; p=.001, k=57, cluster extent threshold 25 voxels), when making explicit judgments of trustworthiness, and no other neural regions reached significance. For the main effect of face type (*all untrustworthy faces > all trustworthy faces*), younger adults also showed heighted activation in left anterior insula (-39, 23, -2; t=4.21, k=66; p=.001, cluster extent threshold 25 voxels) and right inferior frontal gyrus (57, 32, 7; t=5.4, k=45; p=.001 cluster extent threshold 25 voxels) when viewing faces with untrustworthy features across both judgment tasks, and no other neural regions reached significance. In contrast, older adults showed no neural regions that were significantly more active when making explicit judgments of trustworthiness vs. gender or when subjects were viewing untrustworthy vs. trustworthy faces. Thus, as in Study 1, older adults did not appear to discriminate strongly between trustworthy and untrustworthy faces, whereas younger adults did.

Finally, to directly compare trust-related neural responses in younger and older adults, we conducted whole brain two-sample t-tests. To identify a whole brain age x task interaction, the contrast *all trustworthiness judgments* > *all gender judgments* was compared in younger vs. older adults. This analysis revealed that older adults showed reduced activation in bilateral anterior insula relative to younger adults; (right: 36, 23, 1; t=5.21, k=75 & left: -30, 20, -2; t=3.26, k=27, p=.001 cluster extent threshold 25 voxels). To identify a whole brain age x face type interaction, the contrast *all untrustworthy faces* > *all trustworthy faces* was compared in younger vs. older adults. Effects in this contrast were too subtle to detect at threshold; however, a small left anterior insula cluster was present when the significance threshold was reduced (-45, 32, 13; t=3.37, p<.005 uncorrected).

Study 2 Discussion

These results demonstrate that the anterior insula is critical for explicitly judging trustworthiness, and is particularly important for perceiving untrustworthy faces, whether or not participants are explicitly assessing trustworthiness. Consistent with predictions, each of these effects interacted with age such that, compared to younger adults, older adults show lesser anterior insula activation when making explicit judgments of trustworthiness and when perceiving untrustworthy faces.

The anterior insula has been implicated in reactions of disgust (9) and shown to support interoceptive awareness more generally (12). Researchers have suggested this mapping of visceral states forms the basis of ‘gut feelings’ that inform decision-making (13, 14). Previous research has also shown that neural activation in the anterior insula is important for assessing risks (15), responding to breaches in trust (10), representing expected financial risks, and predicting choice of safer outcomes (16). Following this interpretation, reduced anterior insula activation seen in older adults may be a neural indicator of a weaker warning signal than is present in younger adults, and as such, may be implicated in older adults’ higher perceptions of trustworthiness in the presence of cues to untrustworthiness.

Although we did not expect to see an age x task interaction in the amygdala (because the threat-related amygdala response is thought to be automatic and thus should be present during both explicit and implicit (gender) perceptions of trustworthiness), our hypothesized age x face type interaction was not found. This lack of significant findings for the amygdala is a surprise, given previous research (4,11) that implicates the amygdala in perceptions of trust. It may be that the amygdala is not engaged in responses to stimuli such as these. Specifically, the stimuli in this study did not explicitly convey emotional states, which reduces the likelihood of seeing a robust amygdala response. Alternatively, prior work (4, 11) has shown several different patterns of amygdala activation in response to trust cues, and so there is currently little basis for predicting exactly how the amygdala may be related to perceptions of trust and how that might be moderated by age.

General Discussion

Two studies, one behavioral and one using neuroimaging methodology, investigated age differences in perceived trust. Older adults rated faces high and neutral in trust cues the same as younger adults did, but perceived untrustworthy faces to be significantly more trustworthy and approachable than younger adults did. These results are consistent with research on age differences in emotion regulation. Across a variety of experiences and perceptions, older adults show a positivity bias (17): They report being happy and satisfied with life (18), they experience negative emotions after unpleasant interpersonal events less strongly than younger adults (19), they remember positive information better than negative information (20), they attend more to positive or neutral information than negative information (21), and they recover faster from negative emotions (3). This general pattern of findings is consistent with Socioemotional Selectivity theory (17), which posits a general pruning by older adults of negative experiences and people in ways that may foster well-being. The present results are consistent with this pattern: older adults did not discriminate trustworthy from untrustworthy faces as sharply as younger adults did (Study 1), instead regarding untrustworthy faces as more trustworthy and approachable; and older adults did not show left anterior insula activation to untrustworthy faces as younger adults did (Study 2). Thus, a visceral early warning system that may alert younger adults to be cautious in the presence of cues regarding trust/distrust may not be present to the same degree in older adults.

On the whole, this pattern of lesser sensitivity to negative cues, such as those that cue untrustworthiness, may be a benign contribution to the well-being of older adults much of the time. However, this propensity may also put older adults at risk of failing to process cues to untrustworthiness that they should attend to. As noted, the Federal Trade Commission (2) and the FBI (1) have speculated that one reason older adults are more vulnerable than younger adults to frauds of all kinds, especially financial frauds, may be because they fail to process cues related to untrustworthiness when perceiving others, relative to younger adults.

The behavioral findings are reflected in patterns of neural activation in response to cues of trustworthiness. Younger adults showed preferential activation of the anterior insula both when making ratings of trustworthiness and when viewing untrustworthy faces. The results indicated no significant activation of the anterior insula during older adults’ evaluations of trustworthiness or viewing of untrustworthy faces. The anterior insula is critical for creating interoceptive (feeling-based) representations of visceral cues, which can be thought of as ‘gut feelings’ (9, 22, 23), and people with lower interoceptive awareness experience less arousal in response to negative emotional stimuli (24). Consistent with this analysis, anterior insula activity has been shown to represent expected risk and to predict risk aversion in a monetary game (16), suggesting that the heightened negative visceral feelings associated with anterior insula activity might aid in risk aversion. Importantly, interoceptive awareness tends to decline with age (25), and compared to younger adults, older adults show muted left anterior insula activation when anticipating monetary loss (26), which supports the interpretation of anterior insula activity as a visceral ‘warning signal.’ The present study connects these two lines of research by suggesting that a diminished interoceptive ‘gut response’ in older adults contributes to their tendency to be trusting, with the possibility that it affects vulnerability to fraud and poor financial decision-making.

An alternative explanation for the results is that people who are older at this particular point in time process cues to untrustworthiness differently than younger adults, both behaviorally and in the brain, i.e., a cohort effect. That is, the current older cohort may simply be a more trusting one. A second alternative explanation is that more positive and trusting people live longer (i.e., selective mortality). Several investigations, however, have shown that the balance of positive to negative experience that changes with age is seen over time and is not particular to one particular cohort. For example, there is a steady improvement in the ratio of positive to negative experience across adulthood. This process becomes evident sufficiently early in adulthood to refute the possibility that enhanced well-being in late life simply reflects the experience of one cohort or selective mortality of more trusting people (27, 28).

The present results are consistent with older adults’ general positivity bias in person perception and with their heightened vulnerability to fraud, a vulnerability that has been credited to being overly trusting (1,2). However, studies using economic game-type formats sometimes find that older adults are more cautious in their willingness to invest (e.g. 29, 30), although the evidence is mixed (31). This paradigm difference in age-related findings may be due to older adults' unfamiliarity with economic games. Alternatively, certain kinds of cues (faces) may evoke different responses than other kinds of cues (e.g., proposed monetary transfer in an economic game); such instructions may make older adults more cautious, given possible reduced financial circumstances. Older adults do, however, provide larger rewards to people who have invested in them, reflecting a heightened trustworthiness. Studies have also shown that older adults are actually less afraid of being victimized, despite their greater vulnerability to many kinds of crime (32).

The consequences of misplaced trust for older adults are severe. A recent study estimates that older adults (over 60) lost at least $2.9 billion in 2010 to financial exploitation, ranging from home repair scams to complex financial swindles (33). This figure represents a 12% increase from 2008. Older adults' reduced sensitivity to cues related to trust may partially underlie this vulnerability.

Conclusion

Older adults perceive faces conveying cues of untrustworthiness as more trustworthy and approachable than younger adults. Differences in activation of the anterior insula observed when evaluating trustworthiness and in response to cues suggestive of untrustworthiness may underlie this age difference. As such, older adults may have a lower visceral warning signal in response to cues of untrustworthiness, which could make deciding whom to trust difficult, and may at least partially underlie their vulnerability to fraud.

Methods

Study 1

Participants were 143 adults (40 men and 103 women). The sample was comprised of 119 older adults (aged 55-84, mean $M = 68.76$, $SD = 6.601$) and a comparison group of 24 younger adults (aged

20-42, *M* = 23.21, *SD* = 5.090) who completed a study of "perception of personal qualities." The younger adults were students and employees at a large Western university, and the older adults were residents of a retirement community. The education levels of the older adults ranged from some high school to post-graduate degrees, and the younger adults had at least some college; there was no overall difference in education level.

Participants saw and rated frontal images of faces that encompass a range of cues related to trustworthiness, a task developed by Adolphs, Tranel, and Damasio (4). All pictures are gaze forward images of approximately equal size and equivalent background and picture both genders and an array of ages. For the stimuli in Study 1, we chose 10 faces that had been previously been selected to be trustworthy, 10 faces selected to be neutral, and 10 faces selected to be untrustworthy (4). Participants rated, on 7-point scales, the extent to which each face was "very untrustworthy (-3) to very trustworthy (3)" and the extent to which each face was "very unapproachable (-3) to very approachable (3)".

Following this task, participants completed questionnaires assessing dispositional trust (34); Future Time Perspective (35); and loneliness (36). Analyses concerning these measures appear in the Supplementary Information section.

Study 2

Participants. Forty-four healthy right-handed participants screened for health, psychological, and cognitive counterindications participated in an fMRI study of trust perception. The sample consisted of twenty-three older adults (aged 55-80, Mean = 66.39, SD = 6.11; 12 female), recruited with the help of the Recruitment Core of the UCLA Older Americans Independence Center, from Los Angeles retirement centers and communities. Education level ranged from some high school to post-graduate degree. The comparison group was twenty-one younger adults (aged 23-46, Mean 33.24, SD = 7.51; 8 female) recruited from the broader Los Angeles community who also had an education level ranging from some high school to post-graduate degree. On the day of each participant's appointment, we administered the Mini Mental State Exam (MMSE) and employed a cutoff of 23 out of 30. On the basis of this score and/or responses to the physiological screener (a repeat of the telephone screener employed initially), X participants were excluded. Subsequent to completing the fMRI study, five older participants were excluded from analysis, three for movement greater than 3mm within each run and two for strokes not reported during screening, leaving 39 participants total.

Stimuli. A set of grayscale frontal images, expanded from Study 1, of 60 gaze-forward male and female faces of varying ages, set to approximately the same size and equivalent background contrast were the stimuli. These images were selected to represent of the full range of trustworthiness (4).

Psychological task. The scanning session for each participant was divided into two runs, a target task run and a control task run. In the target task, participants made a binary trustworthiness judgment (*is this person trustworthy or untrustworthy?*), and in the control task, participants made a binary gender judgment (*is this person male or female?*). All participants viewed the task through fMRI stimulus presentation goggles and responded using their right hand to make a button press. Prior to the start of each run, participants viewed a screen indicating which judgment to make, '*Trust*' or '*Gender.*' Both runs were of an event-related design, with 60 faces presented sequentially for 2 seconds each, with a 3-6 second variable inter-stimulus interval fixation cross displayed between each face. A similar task was previously used by Winston, Strange, O'Doherty, and Dolan (5). The same 60 faces were used for both the trust and gender judgment tasks; however, there was a different standardized face order for each task, and the run order was counterbalanced between participants. After scanning, participants were shown the faces again (in a different order) and asked to rate each face for trustworthiness and approachability using a 1-7 Likert scale.

Study 2: Image Acquisition and Data Analysis

Participants were scanned during task performance using a Siemens 3 Tesla Trio MRI scanner with 12-channel head coil at the UCLA Ahmanson-Lovelace Brain Mapping Center. See Supplementary Materials for the scanning parameters and preprocessing steps.

An event-related first-level model was specified, in which events were modeled as zero duration and convolved with a canonical hemodynamic response function (HRF). Each face condition (trustworthy and untrustworthy) was modeled separately for each task (gender and trust judgments) and appropriate linear contrasts were applied to the design to enable determination of regions active for each condition between the tasks. All first level contrast images were entered into a 2-sample t-test random effects analysis to investigate age differences at the group level. Unless otherwise specified, whole-brain analyses were conducted using a statistical criterion of at least 25 voxels exceeding a voxel-wise threshold of $P < .001$. This joint voxel-wise and cluster-size threshold corresponds to a false-positive discovery rate of 5% across the whole brain, as estimated by a Monte Carlo simulation implemented using AlphaSim in AFNI (37). ROI analyses were performed using the Marsbar toolbox (http://marsbar.sourceforge.net) to estimate average percent signal change across all voxels in each ROI. All anatomical ROIs were defined using the Wake Forest University PickAtlas anatomical toolbox (http://fmri.wfubmc.edu/cms/software#PickAtlas, 38). The insula ROI was cutoff at 15 in the y direction to restrict analysis to anterior regions.

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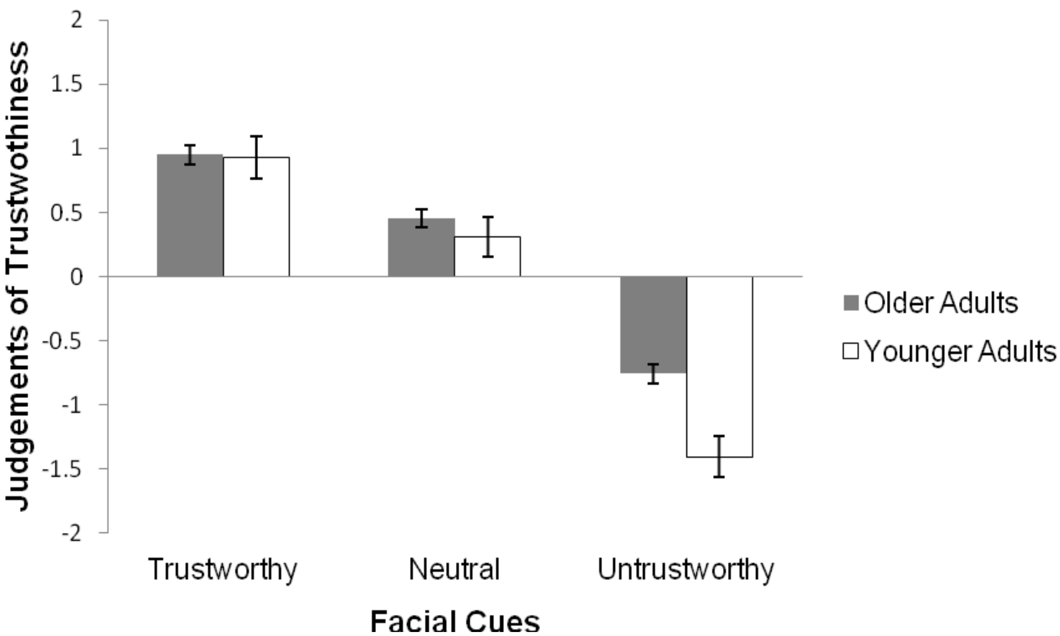
Figure 1A. Older and younger adults' ratings of the trustworthiness of faces varying in trust cues

Figure 1B. Older and younger adults' ratings of the trustworthiness of faces varying in trust cues



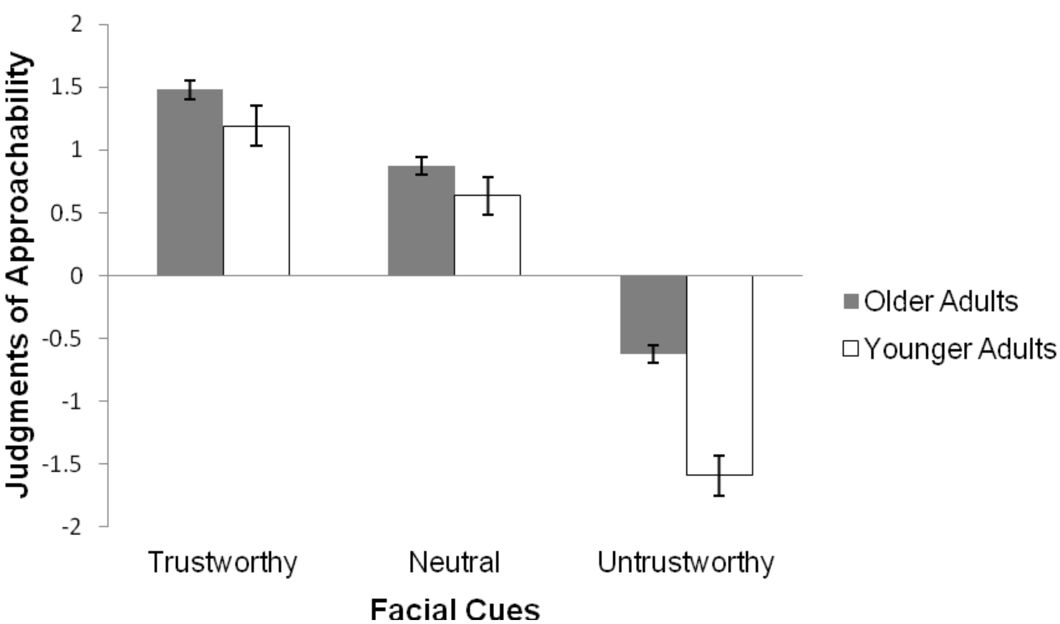
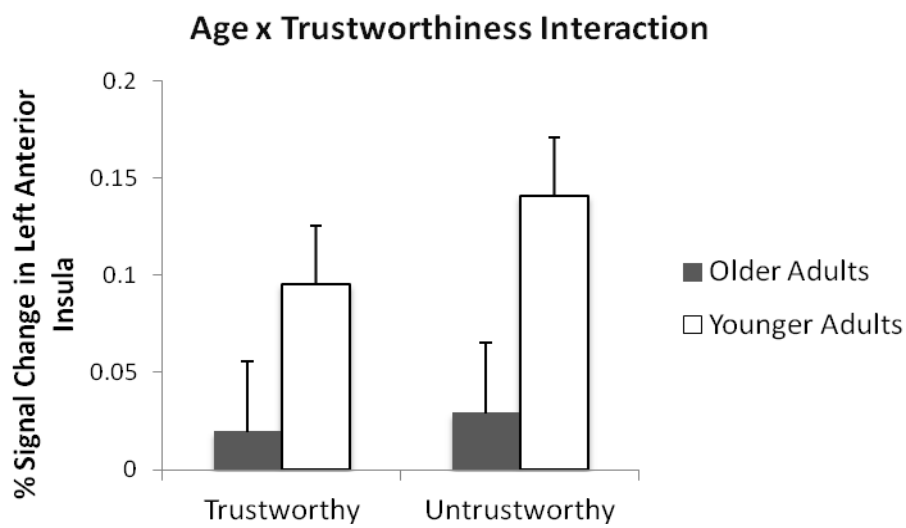
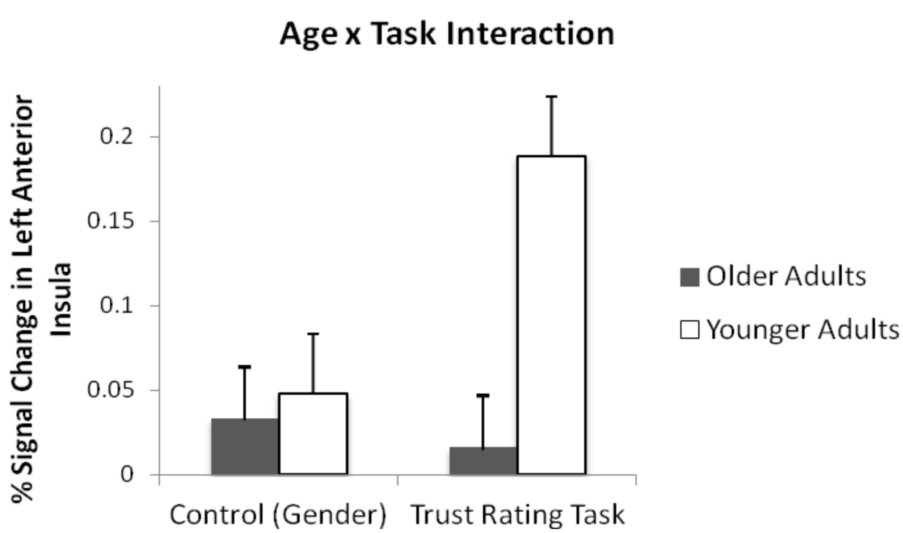


*Figure 2.*Activation of Left Anterior Insula in younger and older adults in response to facial cues (a) and task (b).



(a)



(b)

Supplementary Information

Face Stimuli

Stimuli were obtained from Adolphs, Tranel, and Damasio (4) and pre-screened; only those that showed adult male and female faces that appeared to range in age from mid or late 20s through 70s were retained. A few stimuli were deemed inappropriate (a man wearing sunglasses), and these were discarded from the stimulus set prior to the conduct of the investigations. For Study 1, we used the standard deviations of trust ratings previously obtained by Adolphs et al. (4), to identify faces that were homogeneously perceived to be trustworthy, homogeneously perceived as neutral, and homogeneously perceived as untrustworthy. The result was three sets of ten faces each. In Study 2, the nature of the study required a larger number of stimuli, and so 60 faces that ranged continuously across the Adolphs et al. (4) trustworthy/approachability ratings were employed.

Telephone Health Screen

Prospective participants were screened out if they indicated any of the following conditions: brain damage, active coronary artery disease, significant arrhythmia, uncontrolled hypertension, post-traumatic stress disorder (PTSD), a history of stroke or other neurological disorder, cardiac stents, pregnancy, anxiety disorders, depression or dysthymia, asthma or other respiratory disease, bipolar disorder, or any psychiatric illness such as schizophrenia.

Manipulation Checks: Study 1

A main effect of face trustworthiness on ratings of trustworthiness confirmed pretesting of those faces, $F(2, 270) = 286.480$, $p < .001$, $\eta_p^2 = .680$. Trustworthy faces were perceived to be more trustworthy ($M = .939$, $SE = .092$) than both neutral faces ($M = .380$, $SE = .084$), $F(1, 135) = 98.506$, $p < .001$, and untrustworthy faces ($M = -1.081$, $SE = .089$), $F(1, 135) = 343.655$, $p < .001$. Neutral faces were seen as more trustworthy than untrustworthy faces, $F(1, 135) = 275.788$, $p < .001$.

A main effect of face trustworthiness on approach ratings also emerged, $F(2, 274) = 539.529$, $p < .001$, $\eta_p^2 = .797$. Trustworthy faces were more approachable ($M = 1.335$, $SE = .092$) than both neutral faces ($M = .755$, $SE = .082$), $F(1, 37) = 102.836$, $p < .001$, and untrustworthy faces ($M = -1.107$, $SE = .089$), $F(1, 137) = 659.505$, $p < .001$ and neutral faces were more approachable than untrustworthy faces, $F(1, 137) = 598.770$, $p < .001$.

Individual Differences: Study 1

Participants completed questionnaire assessments of individual difference measures potentially related to judgments of trustworthiness. The General Trust Measure (34) is an 11-item scale that assesses how much people are inclined to trust others. Examples of items are "most people are trustworthy" and "in today's society, if you are not careful, people will use you" (reverse-coded). Participants indicated how much they agree with each item on 5-point scales with labeled endpoints (1 = strongly disagree, 5 = strongly agree).

The Future Time Perspective measure developed by Carstensen and Lang (35) is a 10-item measure which includes such statements as "many opportunities await me in the future" and "I have the sense that time is running out" (reverse-coded). Participants rate the items on 7-point scales from "very untrue" (1) to "very true" (7).

The UCLA Loneliness Scale is a reliable and well-validated assessment of loneliness (36) that has been used extensively with both younger and older adults (e.g., 39, 36). It includes items such as "I feel isolated from others" (reverse-coded), "people are around me but not with me" (reverse-coded), and "there are people I can talk to". Participants rate the extent to which they feel this way on a 4-point scale, where one indicates "I have never felt this way" and four indicates "I have felt this way often".

Consistent with previous research, older adults scored higher on the General Trust Measure ($M = 4.244$) than younger adults ($M = 3.648$), $t(137) = -4.049$, $p < .001$ and lower on the Future Temporal

Perspective Scale (*M* = 3.798) compared to younger adults (*M* = 5.278), $t(137) = 6.106$, $p < .001$. There was no difference in loneliness between older adults (*M* = 3.355) and younger adults (*M* = 3.300), $t(137) = .529$, $p = .598$.

Because there were age differences in scores on the General Trust Measure and the Future Temporal Perspective Scale, mediation analyses (40) were run to examine whether age differences in each of these measures explained the age differences in perceived trust. For the measure of dispositional trust (General Trust measure), age significantly predicted participants' trust of untrustworthy faces (β=.299, p<.001) and participants' dispositional trust (β=.327, p<.001). When simultaneously predicting participants' reported trust of untrustworthy faces, dispositional trust remained a significant predictor (β=.235, p=.006). Age also remained a significant predictor (β=.221, p=.010), but the significant drop in predictive power revealed that the effect of age on trust judgments of untrustworthy faces was partially mediated by dispositional differences Z=2.286, p=.022 (Figure S1A). We conducted analogous analyses to examine whether dispositional trust mediated younger and older adult's differential approach of untrustworthy faces (Figure S1B). Age significantly predicted the perceived approachability of untrustworthy faces (β=.423, p<.001). When simultaneously predicting participants' reported desire to approach untrustworthy faces, dispositional trust remained a significant predictor (β=.284, p<.001) as did age group (β=.33, p<.001), which however, again significantly dropped in predictive power, indicating partial mediation, Z=2.697, p=.007. In contrast to the mediation found for dispositional trust, similar mediation analyses showed no support for mediation by participants' score on the Temporal Perspective Scale.

Scanning parameters and processing steps: Study 2

For each participant we acquired functional T2*-weighted echoplanar image volumes (3.4x3.4 in-plane resolution, slice thickness = 4mm, gap = 1mm, 33 interleaved slices, TR = 2000ms, TE = 30 ms, flip angle = 75 degrees, matrix = 64x64, FOV 200mm) divided evenly across two runs. Participants were placed in a light head restraint to reduce artifact associated with head movement and each run began with two 'dummy' volumes to establish a T1 equilibrium for brain signals. Additionally, a high resolution T1-weighted MPRAGE structural scan (1x1x1 mm resolution, inversion time = 900 ms, 160 slices, TR = 1900 ms, TE = 3.4 ms, flip angle = 9 degrees, matrix 256x256, FOV = 220 mm) was acquired for each participant.

Functional data were analyzed with Statistical Parametric Mapping (SPM8, Wellcome Department of Cognitive Neurology, London) operating in MATLAB. Within each run, image volumes were realigned to correct for head motion (6 DOF affine transform using the first EPI in each time series as the template), co-registered to participant space MPRAGE, normalized into Montreal Neurological Institute space (re-sampled at 3x3x3 mm) using automated segmentation of grey matter, white matter, and CSF; and then smoothed with an 8 mm (full width at half maximum) Gaussian kernel.

Table S1

Correlations of individual difference measures with trust and approach judgments for untrustworthy, neutral, and trustworthy faces separately: Study 1

	Trust Judgments			Approach Judgments		
	Untrustworthy Faces	Neutral Faces	Trustworthy Faces	Untrustworthy Faces	Neutral Faces	Trustworthy Faces
General Trust Measure	.308***	.206*	.188*	.392***	.286**	.257**
Temporal Perspective Scale	-.084	.060	-.014	-.191*	-.048	-.106
UCLA Loneliness Scale	.038	.028	-.071	.094	.051	-.019

* $p < .05$

** $p < .01$

*** $p < .001$

Figure S1A. Mediation of age group effect on trust judgments of untrustworthy faces by participants' scores on the General Trust Measure: Study 1

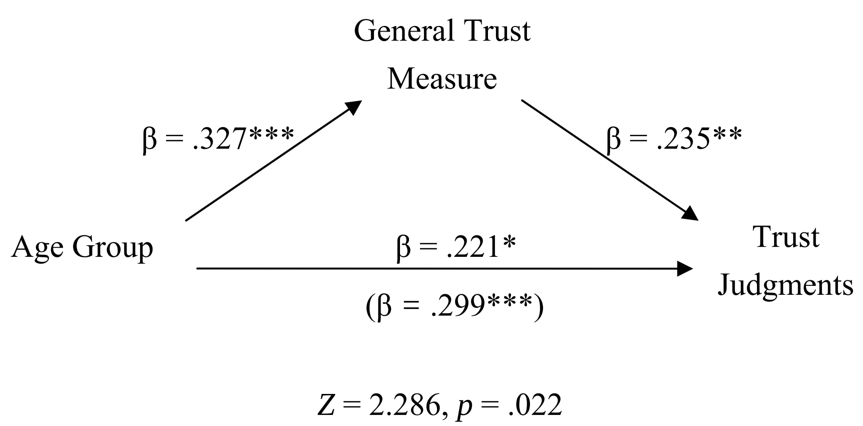


Figure S1B. Mediation of age group effect on approachability judgments of untrustworthy faces by participants' scores on the General Trust Measure: Study 1