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# Does Aging Impair First Impression Accuracy? Differentiating Emotion Recognition From Complex Social Inferences

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Young adults can be surprisingly accurate at making inferences about people from their faces. Although these first impressions have important consequences for both the perceiver and the target, it remains an open question whether first impression accuracy is preserved with age. Specifically, could age differences in impressions toward others stem from age-related deficits in accurately detecting complex social cues? Research on aging and impression formation suggests that young and older adults show relative consensus in their first impressions, but it is unknown whether they differ in accuracy. It has been widely shown that aging disrupts emotion recognition accuracy, and that these impairments may predict deficits in other social judgments, such as detecting deceit. However, it is unclear whether general impression formation accuracy (e.g., emotion recognition accuracy, detecting complex social cues) relies on similar or distinct mechanisms. It is important to examine this question to evaluate how, if at all, aging might affect overall accuracy. Here, we examined whether aging impaired first impression accuracy in predicting real-world outcomes and categorizing social group membership. Specifically, we studied whether emotion recognition accuracy and age-related cognitive decline (which has been implicated in exacerbating deficits in emotion recognition) predict first impression accuracy. Our results revealed that emotion recognition accuracy did not predict first impression accuracy, nor did age-related cognitive decline impair it. These findings suggest that domains of social perception outside of emotion recognition may rely on mechanisms that are relatively unimpaired by aging.

*Keywords:* aging, impression formation, thin slices, emotion recognition, cognitive decline



Extensive research in social cognition and aging suggests that older adults (OA) may rely on different strategies when forming first impressions as compared to young adults (YA; e.g., Blanchard-Fields & Norris, 1994; Hess & Auman, 2001; Hess, Follett, & McGee, 1998; Horhota & Blanchard-Fields, 2006). Specifically, OA may hold individuals more accountable for their actions (Blanchard-Fields, 1994, 1996; Blanchard-Fields & Beatty, 2005) and rely more heavily on trait-diagnostic cues when forming first impressions (Hess, Bolstad, Woodburn, & Auman, 1999; Hess & Pullen, 1994). Although these different strategies may lead to more accurate social judgments in some cases (Brewer & Lui, 1984; Hummert, Garstka, Shaner, & Strahm, 1994), research suggests that aging may have negative repercussions for the perception of some groups, particularly outgroup members (Gonsalkorale, Sherman, & Klauer, 2009; Stewart, von Hippel, & Radvansky, 2009; von Hippel, Silver, & Lynch, 2000).

Together, these findings suggest that there are age differences in the outcomes of impression formation. However, it remains unknown whether aging affects the way that impressions are initially formed. Simply put, if OA extract different information from targets during their initial evaluations, this may affect how they categorize those individuals, and, by extension, their subsequent impressions of those individuals. Indeed, extensive research has demonstrated that social categorization (e.g., the categories that individuals assign to others) have a powerful effect on their ensuing attitudes (e.g., Perdue, Dovidio, Gurtman, & Tyler, 1990; Tajfel, Billig, Bundy, & Flament, 1971).

## Young Adults' First Impressions are Accurate and Resilient

Although social categories have been traditionally viewed in terms of simple social cues (such as those demarcating differences in race, age, and sex; e.g., Fiske, 2000), a body of research has demonstrated that YA also extract complex social cues from brief exposures to faces (e.g., traits or social groups; Tskhay & Rule,

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2013; Zebrowitz, 1997). Critically, individuals' spontaneous, complex social perceptions and categorizations are ubiquitous and, at times, accurate (Ambady & Skowronski, 2008). For instance, YA judgments of extraversion and intelligence from briefly viewing static images of faces have been shown to significantly correlate with the targets' self-reported extraversion and measures of their actual intelligence, respectively (Borkenau & Liebler, 1993; Murphy, 2007; Zebrowitz, Hall, Murphy, & Rhodes, 2002). Moreover, research has also demonstrated that YA can accurately identify others' group affiliations (such as someone's political affiliation, religion, or even their sexual orientation) more accurately than chance from brief exposures to static images of their faces (see Tskhay & Rule, 2013 for review).

Identifying complex social cues has highly impactful outcomes, ranging from identifying group membership (e.g., Macrae & Bodenhausen, 2000) to predicting a politician's electoral success (e.g., Poutvaara, Jordahl, & Berggren, 2009) and even a CEO's profitability (Rule & Ambady, 2008). Given the impact that complex social cues have on behavior, it is important to examine whether aging affects the ability to extract different complex social cues from faces during their initial judgments. If so, it may elucidate why OA evaluate others differently than do YA. Specifically, the current study examines whether OA extract different cues from faces during their initial judgments by looking specifically at the *accuracy* of their first impressions from faces.

## Aging and Consensus in First Impressions

A small body of research has begun to examine the effects of aging on first impressions but has primarily focused on consensus, not accuracy (e.g., Castle et al., 2012; Franklin & Zebrowitz, 2013; Zebrowitz, Franklin, Hillman, & Boc, 2013). Group consensus refers to how strongly perceivers agree with each other in their first impressions. Overall accuracy, however, refers to judgments that are predictive or correct at levels significantly greater than chance guessing. The key finding from this line of research is that OA and YA do not differ in the overall consensus of their impressions, but that they may differ in the magnitude of the impressions. For instance, Zebrowitz, Franklin, Hillman, and Boc (2013) found that OA showed similar levels of consensus in their impressions of the competence, health, hostility, and trustworthiness of other OA targets as YA do for other YA targets. Critically, however, OA were more likely to agree with other OA in their impressions than they were to agree with YA, and vice versa, thereby demonstrating ingroup effects in the consensus of their impressions, at least for some traits. Although consensus and accuracy are often related, this is not always the case. Indeed, recent research illustrated that although YA showed high consensus in attributions of trustworthiness to targets, their judgments were not predictive of the targets' actual trustworthy behavior (Rule, Krendl, Ivcevic, & Ambady, 2013). Thus, although aging does not appear to affect consensus in evaluating social cues, it might impair overall accuracy.

## Why Might Aging Affect Older Adults' Impression Formation Accuracy?

Why might aging impair OA accuracy in detecting complex social cues? It has been widely shown that aging impairs OA ability to accurately identify emotional cues (e.g., negative emotions such as anger and fear) from brief exposures to faces (for a review, see Ruffman, Henry, Livingstone, & Phillips, 2008; see also Krendl & Ambady, 2010). Although emotion recognition deficits have been widely shown to predict broader deficits in social processing, such as detecting deceit or social gaffes (Halberstadt, Ruffman, Murray, Taumoepeau, & Ryan, 2011; Ruffman, Murray, Halberstadt, & Vater, 2012; Stanley & Blanchard-Fields, 2008), it remains an open question whether correctly recognizing emotions is a similar process to accurately detecting complex social cues. It is important to determine whether general impression formation accuracy (e.g., emotion recognition accuracy, detecting complex social cues) relies on similar or distinct mechanisms in order to evaluate how, if at all, aging might affect overall accuracy. We investigated this question in the current study.

To determine whether age-related deficits in emotion recognition accuracy rely on a similar mechanism as is used to detect complex social cues, we must first consider what mechanisms might underlie age-related emotion recognition deficits. One possibility is that OA may pay less attention to images portraying negative emotions (e.g., Carstensen, Isaacowitz, & Charles, 1999; Isaacowitz, Wadlinger, Goren, & Wilson, 2006; Mather & Carstensen, 2003; Sullivan, Ruffman, & Hutton, 2007, but see Murphy & Isaacowitz, 2010), or they may allocate attentional resources differently to components of the images (e.g., unique facial structures) as compared with YA (Sullivan et al., 2007). In the case of the former, emotion recognition deficits would only predict impression formation accuracy in response to negative social cues. In the case of the latter, however, emotion recognition deficits would predict general deficits in impression formation accuracy based on facial cues. In a direct test of these theories, Murphy and Isaacowitz used eye tracking to evaluate the looking patterns of YA and OA when they examined faces displaying emotional expressions. The authors found that, overall, YA attended more to the eye region as compared to OA, but there were no age differences in attention toward the mouth region. Critically, however, the differences in eye gaze patterns did not universally predict age-related differences in emotion recognition accuracy.

Alternatively, OA may be impaired at recognizing some negative emotions due to age-related frontal lobe decline (Cabeza, 2001; Raz et al., 2005). Indeed, the frontal lobes play a central role in accurately identifying anger (Adolphs, 2002; Blair & Cipolotti, 2000; Blair & Curran, 1999; Murphy, Nimmo-Smith, & Lawrence, 2003; Sprengelmeyer, Rausch, Eysel, & Przuntek, 1998). In a recent study, Krendl and Ambady (2010) found that age-related deficits in emotion recognition accuracy for anger were predicted by declines in executive function, which relies on frontal lobe function. It is important to note that this study also found that frontal lobe decline did not predict deficits for recognizing fear (even though OA were impaired relative to YA in fear judgments). Fear recognition relies on the amygdala (e.g., Adolphs, Tranel, Damasio, & Damasio, 1994; Davis, 1992), a brain structure that is relatively preserved with age (Kensinger & Schacter, 2008; Mather et al., 2004; but see St. Jacques, Dolcos, & Cabeza, 2010). Interestingly, increasing evidence from neuroimaging suggests that the amygdala may play a central role in forming first impressions (Rule et al., 2011; Schiller, Freeman, Mitchell, Uleman, & Phelps, 2009; Todorov & Engell, 2008; Winston, Strange, O'Doherty, & Dolan, 2002), although it remains an open question whether it is involved in impression formation accuracy (but see Rule et al., 2011). Thus, if detecting complex social cues engages the prefrontal cortex, then age-related cognitive decline should predict deficits in detecting both anger (emotion recognition) and social categorization accuracy. However, if detecting complex social cues relies on the amygdala, then age deficits in recognizing fear (emotion recognition) should predict social categorization accuracy. Finally, if aging does not affect categorization accuracy, then it would suggest that detecting complex social cues is a unique process from emotion recognition.

## Current Study and Predictions

In the present research, we examined whether aging impairs OA first impression accuracy on traits related to predicting real-world outcomes and categorizing social groups. Of interest was whether accurately identifying complex social cues, such as traits that predict real-world outcomes and social groups, is distinct from emotion recognition accuracy. We therefore considered impression formation accuracy as a function of age, emotion recognition accuracy, and age-related cognitive decline (which has been shown to predict deficits in emotion recognition accuracy; Krendl & Ambady, 2010). OA and YA completed a modified version of the Diagnostic Analysis of Non-Verbal Accuracy (DANVA)—a widely validated measure of emotion recognition—as well as two first impression accuracy measures. The first predicted real-world outcomes (i.e., a company's financial success). The second evaluated whether OA first impressions are accurate for judgments of a well-known social group distinction (political affiliation) and examined whether the age of the targets might moderate any effects; thus, they categorized the political party membership of both older and younger targets. Together, the results of this investigation may contribute to better understanding the effects of aging on person perception and social cognition, particularly with regard to its accuracy and distinctions across specific domains of judgment.

## Method

### Participants

Thirty OA ($M_{age}$ = 70.7 years, $SD$ = 6.8; 21 female; 29 White) and 32 YA ($M_{age}$ = 23.1 year, $SD$ = 3.0; 26 female; 23 White) completed a series of four tasks: a modified version of the adult faces portion of the DANVA2, judgments of the leadership success of CEOs, judgments of the political affiliation of older (professional political candidate) and younger (college student) individuals, and a battery of tests to measure executive function. All participants scored at least a 26 on the Mini-Mental State Exam ($M_{OA}$ = 28.7, $SD$ = 1.1; $M_{YA}$ = 29.1, $SD$ = 1.0), and reported comparable years of education ($M_{OA}$ = 16.7 years, $SD$ = 4.7; $M_{YA}$ = 16.2 years, $SD$ = 2.5).

All of the YA participants were students at the University of Indiana-Bloomington who participated for either monetary compensation or partial course credit. All of the OA were recruited through newspaper and e-mail advertisements in the Bloomington, Indiana municipal area and suburbs. All participants (both YA and OA) underwent a health screening to ensure that they did not have a physical affliction that could affect cognitive function (e.g., recent head trauma, untreated high blood pressure, diabetes, history of stroke; Arvanitakis, Wilson, Li, Aggarwal, & Bennett, 2006; Heflin et al., 2005; O'Sullivan, Morris, & Markus, 2005).[1]

### Stimuli and Procedure

Participants completed a host of tasks in random order. To measure emotion recognition ability, participants completed a modified version of the DANVA2 task (Nowicki & Duke, 1994), in which they viewed 24 static photographs of men and women posing happy, sad, angry, or fearful expressions (six targets per emotion). Each face was presented for 2 s, during which participants were asked to indicate via button press whether the person had been conveying joy (i.e., "happiness"), sadness, anger, or fear.

In the leadership judgment task, participants viewed faces of the CEOs of the 25 highest and 25 lowest ranked companies from the 2006 listing on the Fortune 1,000 Web site (http://money.cnn.com/magazines/fortune/fortune500). Only male CEOs' faces were used for this study, as there was only a single female CEO. Photos of the CEOs' faces were obtained from their companies' respective Web sites, converted to grayscale, cropped to the limits of the head, and standardized in size. Information about each company's financial performance (i.e., profits) for fiscal year (FY) 2005 was obtained from the aforementioned website, Google finance (http://finance.google.com), or the companies' annual reports. Two companies were acquired by other companies during FY 2005 and were excluded from the analysis, and one CEO was excluded because pretesting showed him to be an outlier (see Rule & Ambady, 2008). In addition, one CEO's company reported profits that were greater than four standard deviations from the mean of the group; we therefore removed this outlier from the analysis.[2] Participants were asked to rate each target as to how successful they thought he would be as the CEO of a company (1 = *not at all successful*, 7 = *very successful*; interrater reliabilities: Cronbach's $\text{alpha}_{OA}$ = .84; Cronbach's $\text{alpha}_{YA}$ = .81). All participants were naïve to the fact that the images they were rating were of actual CEOs. Nevertheless, we asked participants after the task to indicate whether they had recognized any faces and the names of anyone that they might have recognized. In cases where participants positively identified a CEO, we removed their rating of that target from the analysis (<1% of data removed).

In the political affiliation categorization task, participants were instructed that they would be seeing a series of faces on a computer

[1] A similar set of studies was run previously with YA undergraduate and OA community samples in the Boston metropolitan area several years prior. Although these data show parallel results to those reported here, additional data collection was not possible from this population due to changes in the authors' institutional affiliations. We therefore repeated the investigation in the current location in order to address editorial comments that required additional data collection. Related to this, additional participants completed one or more but not all of the tasks reported here and a very small number of participants also completed judgments of men's sexual orientation. Although we focus on the core 62 participants who completed all of our measures in our primary Indiana-based sample, extended analyses incorporating the larger set of all participants mirrored the effects reported here.

[2] Notably, the results of none of the analyses change whether the outlier is removed, retained, or replaced with either the group mean or the Winsorized third standard deviation from the group mean. Similarly, transforming the data using the natural logarithm returned the same results. We therefore opted to remove the score following reviewer feedback.

screen and that they were to categorize each person as either a Democrat or a Republican. Participants rated faces in two, randomly ordered blocks of older and young targets, respectively. The older targets consisted of photos of the Democrat and Republican candidates from the 2004 and 2006 Senate elections, which were downloaded from the website of the Cable News Network (CNN; http://www.cnn.com/ELECTION/) or from the candidates' campaign Web sites and converted to grayscale. To avoid race-based stereotypes, racial minority candidates were excluded from the study. In total, there were 118 candidates: 59 Democrats ($n = 15$ women) and 59 Republicans ($n = 5$ women). Images were taken portrait-style such that only the target's head was visible. Similar to the leadership judgment task, participants were asked to report any target recognitions immediately following the task and the trials of positively identified targets were excluded prior to analysis (<1% of data removed).

The young targets consisted of photos of self-identified Democrat ($n = 30$; $n = 15$ women) and Republican ($n = 30$; $n = 9$ women) undergraduates that were digitally scanned from the senior yearbooks spanning years 2000–2008 of a private northeastern U.S. college. All photos were of the targets' senior portraits and targets had indicated their membership in either the college's Democrat or Republican student group (Rule & Ambady, 2010a). Images were prepared similarly to the older targets, as described above.

Finally, participants completed a battery of cognitive tests to assess frontal lobe function that included the Wisconsin Card Sorting Task, FAS word fluency, mental arithmetic from WAIS–R, WMS-R mental control, and WMS-R backward digit span (Glisky, Polster, & Routhieaux, 1995). Each individual's performance on these tasks was $Z$-scored, given an assigned weight, and then combined to determine his or her executive function score (see Glisky et al., 1995, for details on scoring).

All of the perceptual judgments were completed on a computer. Participants sat directly in front of the computer's monitor, seated at a comfortable distance of approximately 105 cm. The images presented on-screen ranged between 100 and 300 pixels in height, subtending approximately 1.7°–5.1° of visual angle. The cognitive tests used to measure executive function were administered on paper by a highly trained research assistant.

## Results

Participants' executive function scores were calculated using the method described by Glisky, Polster, and Routhieaux (1995). Perhaps unsurprisingly, OA ($M = .17$, $SD = .57$) executive function scores were lower overall compared with YA ($M = .56$ $SD = .49$); $t(60) = 2.92$, $p = .005$, $r = .35$. More important was how individual differences in these executive function scores related to each of the measures of social perception described below.

### Emotion Recognition

We first examined participants' scores on the modified DANVA2, as a volume of previous research has shown that OA and YA differ in emotion recognition (for review, see Ruffman et al., 2008, but see Noh & Isaacowitz, 2013) and two studies (Krendl & Ambady, 2010; Murphy & Isaacowitz, 2010) specifically used a nearly identical measure. The emotion recognition scores therefore served as a functional baseline for our subsequent comparisons between OA and YA on the more complex social perceptual inferences captured by the measures that follow. To analyze the data, we conducted a 4 (Emotion: joy, sadness, fear, anger) × 2 (Age: OA, YA) repeated-measures ANOVA using each participant's accuracy for each emotion category as the dependent measure (see Table 1 for descriptive statistics).

Consistent with previous work (Krendl & Ambady, 2010), we observed main effects of emotion, $F(3, 180) = 81.21$, $p < .001$, $\eta^2_{\text{partial}} = .58$; and age, $F(1, 60) = 13.57$, $p = .001$, $\eta^2_{\text{partial}} = .18$, but the interaction did not reach statistical significance, $F(3, 180) = 2.04$, $p = .11$, $\eta^2_{\text{partial}} = .03$. Given our strong a priori hypothesis that age would interact with emotion type, we bypassed the null omnibus effect and conducted Bonferroni-corrected ($\alpha = .008$) simple effects analyses (see Rosenthal & Rosnow, 2007). These tests showed that joy was recognized better than sadness, anger, and fear; that sadness was recognized better than anger and fear; and that anger was recognized better than fear (all $t$s $\geq 3.18$, all $p$s $\leq .002$, all $r$s $\geq .38$). More important, YA performed significantly better than OA in recognizing anger and fear ($t$s $\geq 3.38$, $p$s $\leq .001$, $r$s $\geq .40$) but not sadness or joy ($t$s $\leq 1.79$, $p$s $\geq .08$, $r$s $< .23$).

Table 1
*Descriptive Statistics for Older Adult (OA) and Young Adult (YA) Judgments*

| | Emotion recognition | | | | Leadership judgments | Political affiliation judgments: Older targets | | Political affiliation judgments: Younger targets | |
|---|---|---|---|---|---|---|---|---|---|
| | Joy | Sadness | Anger | Fear | | *A'* | *B"* | *A'* | *B"* |
| OA | | | | | | | | | |
| *M* | .74 | .61 | .30 | .22 | .12 | .61 | .03 | .63 | −.05 |
| *SD* | .19 | .26 | .25 | .20 | .13 | .08 | .06 | .12 | .12 |
| YA | | | | | | | | | |
| *M* | .82 | .72 | .54 | .24 | .13 | .54 | .07 | .63 | .02 |
| *SD* | .20 | .26 | .26 | .21 | .18 | .10 | .18 | .11 | .20 |

*Note*. $M$ = mean, $SD$ = standard deviation. The descriptive statistics for Leadership Judgments refer to Fisher's $z$ scores of the relationship between participants' ratings and each CEO's company profits.

These differences between OA and YA were further explained by differences in executive function. Among OA, accuracy in recognizing anger was significantly correlated with overall scores for executive function, $r(28) = .38$, $p = .04$, but not fear, $r(28) = .18$, $p = .35$, as in previous research (Krendl & Ambady, 2010). Among YA, however, executive function was not significantly related to either emotion recognition score: $r$s $< .25$, $p$s $> .18$.

## Leadership Judgments

Participants' judgments of CEOs' leadership ability from their faces were analyzed using sensitivity correlations in which each participant's scores are correlated individually with the criterion for leadership performance (here, company profits) and the resultant $r$-values are converted to Fisher's $z$ scores for use in inferential tests (see Rule & Ambady, 2010b). On average, both OA, $t(29) = 4.79$, $p < .001$, $r = .66$, and YA, $t(29) = 4.02$, $p < .001$, $r = .59$, impressions of leadership from the CEOs' faces predicted their actual success, but did not significantly differ from each other, $t(60) = 0.24$, $p = .81$, $r = .03$ (see Table 1). Moreover, neither OA nor YA accuracy was associated with their measured levels of executive function: $|r|$s $\leq .09$, $p$s $\geq .64$.

## Judgments of Political Affiliation

As categorizations of targets' political affiliations were made dichotomously (Democrat or Republican), we analyzed these data using analyses based on signal detection theory, as in extensive previous research on the social perception of groups (e.g., Sporer, 2001; Tskhay & Rule, 2013). To measure the accuracy of participants' categorizations, we calculated the sensitivity statistic $A'$; and to measure participants' tendency to assign targets to one group over another, we calculated the response bias statistic $B''$ (Macmillan & Creelman, 2005). Consistent with standard approaches to using signal detection theory in dichotomous perception tasks (e.g., Rule, Ishii, Ambady, Rosen, & Hallett, 2011), we arbitrarily selected one response type (Democrats) to represent signal, meaning that Republicans were arbitrarily considered noise. Hits therefore consisted of correct categorizations of Democrats as Democrats and false-alarms consisted of incorrect categorizations of Republicans as Democrats.[3]

One-sample $t$ tests comparing accuracy against chance guessing ($A' = .5$) showed that OA and YA categorized all of the older and younger targets significantly better than chance guessing: all $t$s $>$ 2.43, all $p$s $< .02$, all $r$s $\geq .40$ (see Table 1). To test for age differences, we conducted a 2 (Participant Age: OA, YA) $\times$ 2 (Target Age: older, younger) ANOVA with repeated measures on the second factor. In line with previous findings on judgments of political affiliation (Rule & Ambady, 2010a), the younger targets were perceived more accurately than the older targets: $F(1, 60) = 10.15$, $p = .002$, $\eta^2_{\text{partial}} = .15$. More relevant to the present investigation, although OA did not differ from YA in their overall accuracy in categorizing political affiliation, $F(1, 60) = 2.82$, $p = .098$, $\eta^2_{\text{partial}} = .05$, there was a significant interaction between participant age and target age, $F(1, 60) = 4.81$, $p = .03$, $\eta^2_{\text{partial}} = .07$. Simple effects analyses showed that OA were significantly more accurate in judging ingroup (older) targets than were YA, $t(60) = 3.08$, $p = .003$, $r = .37$, but that the two groups showed nearly identical levels of accuracy in their judgments of younger faces, $t(60) = 0.01$, $p = .99$, $r < .01$. Thus, although YA were significantly more accurate in judging younger versus older faces, this is not necessarily indicative of an ingroup effect because accuracy overall for the younger faces did not differ between groups. Similarly, OA were more accurate than YA in judging other older faces but OA accuracy was nearly the same for older and younger faces, perhaps because of differences in the baseline accuracy for judgments of the younger targets (i.e., OA may have shown enhancements for categorizing political affiliation from older faces but political affiliation is judged more easily from younger faces overall).

To help explain the differences between OA and YA in their judgments of the targets, we correlated the participants' executive function scores with their accuracy in categorizing the older and younger targets. Although executive function did not relate to the accuracy scores of YA for either target group ($r$s $\leq .11$, $p$s $\geq .54$), it did correspond to the levels of accuracy observed for OA. Performance in categorizing older targets was not significantly related to OA executive function: $r(28) = .25$, $p = .18$. In contrast, performance in categorizing younger targets was significantly correlated with OA executive function: $r(28) = .39$, $p = .03$. Meta-analytic comparisons of these relationships showed that they did not significantly differ in magnitude, however, $Z = 0.57$, $p = .28$.

Parallel analyses were conducted for the measures of response bias. Importantly, response bias scores are negative for participants who tend to classify targets as signal (e.g., Democrats) and positive for participants who tend to classify targets as noise (e.g., Republicans); a response bias score equal to zero indicates no proclivity in either direction (see Macmillan & Creelman, 2005, for additional explanation). Given our arbitrary assignment of Democrats as signal and Republicans as noise, positive response bias scores indicated a tendency to categorize more targets as Republicans and negative response bias scores indicated a tendency to categorize more targets as Democrats.

A 2 (Participant Age: OA, YA) $\times$ 2 (Target Age: older, younger) ANOVA with repeated measures on the second factor showed that response bias was significantly greater for older versus younger targets, $F(1, 60) = 18.37$, $p < .001$, $\eta^2_{\text{partial}} = .23$, but revealed neither a main effect of participant age, nor an interaction between the two factors: $F$s $\leq 2.56$, $p$s $\geq .12$, $\eta^2_{\text{partial}}$'s $\leq .04$ (see Table 1). Thus, older targets were significantly more likely than younger targets to be categorized as Republicans, but this did not significantly vary between OA and YA.[4]

[3] Because the assignment of signal and noise in a two-choice task analyzed using signal detection methods is arbitrary, the reverse pairing (such that hits consist of correct categorizations of Republican targets and false-alarms consist of incorrect categorizations of Democrats as Republicans) returns identical results for accuracy and simply opposite-sign results for response bias; see Macmillan and Creelman (2005) for additional details on signal detection analysis.

[4] Given the imbalance between male and female targets across the Democrat and Republican groups, we repeated the analyses using only the male targets. The results were very similar between the two sets of analyses and meta-analytic comparisons of the effect sizes obtained for both sets of results showed no significant differences between the all-male and mixed-sex target samples: all $Z$s $< 1.23$, all $p$s $> .11$.

## Emotion Recognition Versus Social Inferences

To better understand the distinction between judgments of emotion and more complex social inferences, we correlated participants' scores from the modified DANVA2 with those from the leadership and political affiliation judgments. Consistent with our hypothesis that emotion recognition judgments rely on separate processes than do more complex social inferences, we found that none of the accuracy rates for the four emotions significantly correlated with either of the two social inference task scores for either OA or YA after correcting for multiple comparisons ($\alpha = .004$; see Table 2). The strongest relationship was between OA recognition of joy and accuracy in judging the political affiliations of younger targets. Neither this effect nor any other approached significance when individual differences in executive function were controlled via partial correlations.

## General Discussion

There are three key findings in the current study. First, first impression accuracy appears to be preserved with age. Second, accuracy for complex social inferences from first impressions may rely on a process distinct from those involved in accurately recognizing emotions. Third, age-related decline in executive function seems not to substantially affect OA ability to form accurate first impressions. These findings were evident in the fact that OA were as accurate as YA across two first impressions tasks that require accurately detecting complex social cues: predicting a CEO's success from looking at a static picture of his face, and identifying an individual's political affiliation from viewing a facial photograph. Importantly, these judgments were not correlated with individual differences in emotion recognition and age-related executive function decline.

Together, the results from the current study extend research on the effects of aging on first impressions. As previously discussed, first impressions can be examined in two ways: group consensus and overall accuracy (e.g., West & Kenny, 2011). In many cases, consensus and accuracy may be unrelated (e.g., Rule et al., 2013). That is, individuals may have high consensus in their judgments (e.g., who *appears* to be trustworthy), but those judgments may not accurately predict behavior (e.g., who actually *is* trustworthy). Thus, despite the fact the extant research on the role of aging in first impressions suggests that consensus is not affected by age (e.g., Zebrowitz et al., 2013), it remained unknown whether aging affects the *accuracy* of first impression judgments (but see Boshyan, Zebrowitz, Franklin, McCormick, & Carré, 2013). Our findings demonstrate that both accuracy and consensus for complex social inferences are unaffected by aging (see Boshyan et al., 2013 for converging aging effects for judgments of aggressiveness).

The fact that emotion recognition accuracy was not correlated with first impression accuracy for complex social inferences suggests that these two processes may rely on distinct mechanisms. As described above, age-related declines in emotion recognition accuracy may stem from both neural changes (e.g., in the prefrontal cortex; Cabeza, 2001; Raz et al., 2005), as well as different emotional motivations or attentional processes in encoding (e.g., Carstensen et al., 1999; Isaacowitz et al., 2006; Mather & Carstensen, 2003; Sullivan et al., 2007; see also Ruffman et al., 2008, for review on these mechanisms). Given that neither emotion recognition accuracy nor age-related cognitive decline was correlated with first impression accuracy in the current work, it is possible that first impression accuracy relies on a distinct mechanism as compared to emotion recognition. Indeed, neuroimaging studies suggest that the amygdala may be critical for forming first impressions (Rule et al., 2011; Schiller et al., 2009; Todorov & Engell, 2008; Winston et al., 2002). If this is the case, then it is unlikely that age-related neural decline would affect first impression accuracy, as the amygdala is relatively unaffected by aging (Kensinger & Schacter, 2008; Mather et al., 2004). However, the fact that age-related deficits in accurately identifying fear (which relies on the amygdala; Adolphs et al., 1994; Davis, 1992) were not correlated with performance on the social inference tasks raises questions about whether there may be a network of neural regions (that may include the amygdala) that is involved in detecting complex social cues. Future research should examine this question.

It is important to note that OA in the current study categorized social groups that are generally respected (e.g., political leaders, financially successful individuals). Thus, an important question is whether OA are equally accurate in categorizing undesirable social groups (e.g., stigmatized outgroup members).

Table 2
*Relationships Between Emotion Recognition Accuracy and Accuracy in Judging Leadership and Political Affiliation (Younger and Older Targets) for OA (N = 30) and YA (N = 32) Participants*

| | Zero-order correlations | | | | | | Partial correlations controlling for executive function | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OA | | | YA | | | OA | | | YA | | |
| | | Political affiliation judgments | | | Political affiliation judgments | | | Political affiliation judgments | | | Political affiliation judgments | |
| | Leadership judgments | Older targets | Younger targets | Leadership judgments | Older targets | Younger targets | Leadership judgments | Older targets | Younger targets | Leadership judgments | Older targets | Younger targets |
| Joy | .07 | .29 | .39* | −.02 | −.28 | .06 | .06 | .19 | .23 | −.01 | −.30 | .04 |
| Sadness | .09 | .08 | .03 | .17 | −.05 | .09 | .08 | .06 | −.01 | .27 | −.11 | .03 |
| Anger | −.08 | .11 | .31 | .19 | −.11 | −.20 | −.10 | .02 | .19 | .20 | −.11 | .22 |
| Fear | −.26 | .13 | .33 | .06 | −.11 | .05 | −.28 | .09 | .29 | .08 | −.14 | .02 |

* $p < .05$.

Indeed, the extant research on impression formation and aging has demonstrated that OA process negative cues less than positive cues (see Franklin & Zebrowitz, 2013; Zebrowitz et al., 2013). It is therefore possible that OA may be less accurate than YA in perceiving negative outgroup members, such as individuals who belong to stigmatized social groups. Indeed, a somewhat surprising finding in the current study was that OA accuracy for predicting political affiliation for young targets (who, due to their age, are outgroup members) was correlated with cognitive decline. Future research should examine whether cognitive decline plays a dissociable role in predicting accuracy when the target being judged is an ingroup or outgroup member. This question may be particularly relevant for social cognition and aging, as previous research suggests that age-related cognitive decline predicts increased bias toward outgroup members (Gonsalkorale et al., 2009; Stewart et al., 2009; von Hippel et al., 2000). Thus, if OA are less accurate in identifying outgroup members, they may misattribute bias to individuals that they incorrectly identify as being outgroup members.

Another possibility is that the preserved first impression accuracy among OA may reflect increased social expertise. Indeed, numerous studies have demonstrated that OA form more accurate and thorough impressions as compared with YA (e.g., Hess & Auman, 2001; Hess et al., 1999; Hess & Pullen, 1994). Increased interpersonal experience and social wisdom might therefore also enhance the ability to accurately form social judgments, such as quickly categorizing complex social groups. One caveat to this interpretation is that if social expertise is correlated with increased accuracy, then we would expect OA to be more accurate than YA in making social judgments. This was not the case. However, it is worth noting that OA were more accurate than YA in identifying the political affiliations of older targets. This finding could reflect domain-specific expertise (e.g., OA may have more social expertise in some domains as compared with others, and are only enhanced compared with YA in those domains). Future research should investigate this possibility as well.

The fact that this current investigation revealed that first impression accuracy is relatively preserved over the life span suggests that OA can glean both subjective and objective information from targets as accurately as YA. However, we do not wish to suggest that this is a spontaneous process. That is, by prompting OA to focus on very specific, dichotomous judgments (Democrat or Republican) or even on a specific trait (leadership success), we perhaps directed them to focus on particular elements of the target faces. Thus, our results suggest that, when pointed to specific attributes, OA form accurate impressions of targets across multiple domains. However, it is unknown whether OA spontaneously focus on the same cues as YA during first impression tasks. Future research may benefit from testing this question.

The present findings contribute to the growing social cognition literature on person perception and aging. Specifically, these results indicate that first impressions are formed with equal accuracy irrespective of age, suggesting that automatic aspects of person perception may remain automatic as individuals age. Finally, these findings suggest that declines in executive function over the life span do not necessarily impair all social inferences and may potentially be restricted to judgments that rely on frontal lobe function, such as emotion recognition.

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