Age Differences in the Differentiation of Trait Impressions From Faces

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Objectives. We investigated whether evidence that older adults (OA) show less differentiation of visual stimuli than younger adults (YA) extends to trait impressions from faces and effects of face age. We also examined whether age differences in mood, vision, or cognition-mediated differentiation differences. Finally, we investigated whether age differences in trait differentiation mediated differences in impression positivity.

Method. We used a differentiation index adapted from previous work on stereotyping to assess OA and YA likelihood of assigning different faces to different levels on trait scales. We computed scores for ratings of older and younger faces’ competence, health, hostility, and untrustworthiness.

Results. OA showed less differentiated trait ratings than YA. Measures of mood, vision, and cognition did not mediate these rater age differences. Hostility was differentiated more for younger than older faces, while health was differentiated more for older faces, but only by OA. Age differences in differentiation mediated age differences in impression positivity.

Discussion. Less differentiation of trait impressions from faces in OA is consistent with previous evidence for less differentiation in face and emotion recognition. Results indicated that that age-related dedifferentiation does not reflect narrow changes in visual function. They also provide a novel explanation for OA positivity effects.

Key Words: Aging—Differentiation—Face perception—Positivity bias—Trait impressions.

PEOPLE readily form first impressions of others’ psychological qualities from their facial appearance. Indeed, after only 39 ms of exposure to a face, people’s impressions are no different than after prolonged exposure (Bar, Neta, & Linz, 2006; Willis & Todorov, 2006). While trait impressions from faces show strong agreement across raters of various ages and cultural backgrounds (Zebrowitz, Franklin, Hillman, & Boc, 2013; Zebrowitz, Montepare, & Lee, 1993; Zebrowitz et al., 2012), some differences exist. In particular, older adults (OA) form more positive trait impressions than do younger adults (YA) (Castle et al., 2012; Ruffman, Sullivan, & Edge, 2006; Zebrowitz, Franklin, Hillman, & Boc et al., 2013). This and other positivity biases have been attributed to age-related changes in motivation. According to the socioemotional selectivity theory (Carstensen, 1995; Carstensen & Mikels, 2005), OA are more motivated than YA to maintain a positive mood due to a shorter future time perspective, which yields less processing of negative stimuli or greater processing of positive stimuli (Carstensen, Isaacowitz, & Charles, 1999; Murphy & Isaacowitz, 2008; Isaacowitz et al., 2007; Kellough & Knight, 2012). This study tested an alternative hypothesis based on the dedifferentiation hypothesis of cognitive aging which posits that cognitive processes become less distinct in older adulthood (Balinsky, 1941; Baltes, Cornelius, Spiro, Nesselroade, & Willis, 1980; Salthouse, Hancock, Meinz, & Hambrick, 1996). Specifically, we predicted that OA would show less differentiation in their trait ratings than do YA—that is OA would perceive faces as less different from one another—and that these age differences would contribute to more positive trait ratings by OA.

Rater Age and Differentiation

The hypothesis that OA will show less differentiation in trait impressions of faces is supported by evidence that OA show a reduced ability to perceive other differences among visual stimuli. For example, accurate detection or recall of stimuli by OA requires greater levels of visual contrast and greater differences in their orientation or pattern (Betts, Sekuler, & Bennett, 2007; Toner, Pirogovsky, Kirwan, & Gilbert, 2009). Most pertinent to this study, OA showed reduced accuracy in face recognition and higher false recognition of new faces (Bartlett, Leslie, Tubbs, & Fulton, 1989). They also showed reduced ability to perceive differences in faces that are revealed in changed expressions, reversed photos, or changed poses (Bartlett & Leslie, 1986), and they required greater differences between face pairs in order to discriminate faces (Goh, Suzuki, & Park, 2010). In addition, OA have shown poorer recognition of emotional expressions (Ruffman, Halberstadt, & Murray, 2009; Ruffman, Henry, Livingstone, & Phillips, 2008), including many intensities of sadness, fear, and anger (Ortega & Phillips, 2008), as well as smaller differences in their behavioral responses to enjoyment versus non-enjoyment smiles (Slessor, Miles, Bull, & Phillips, 2010). Given that OA are less able to perceive differences in the identity or...
emotion expressions of faces, they may also be less likely to perceive differences in their traits.

Although this study focuses on behavioral indices of differentiation, there also is evidence for less neural differentiation in OA than YA, which may underlie the behavioral effects and provides evidence that they do not merely reflect age differences in response biases. Most relevant to the present research are age-related declines in neural indicators of face differentiation. When OA and YA were asked to make same-different judgments to face pairs that were identical, moderate in similarity, or different, both OA and YA demonstrated a greater decrease in neural responsiveness, or adaptation, in the fusiform face area in the identical as compared to the different face condition. However, OA, but not YA, also showed more adaptation in the moderately similar than the different face condition, indicating less neural sensitivity to subtle facial differences among OA (Goh, Suzuki, & Park, 2010). Research also has found OA dedifferentiation in the ventral visual cortex using multi-voxel pattern analysis (Carp, Park, Polk, & Park, 2011). These deficits in neural differentiation of visual stimuli are only minimally explained by changes in the anatomy of the visual pathway (Spear, 1993). Instead, OA visual deficits may be accounted for by neurological changes in the ventral visual cortex that responds to faces and other categories of stimuli (Kanwisher, McDermott, & Chun, 1997; Haxby et al., 2001).

Face Age and Differentiation

Face age, like perceiver age, may influence the differentiation of trait impressions. Memory for positive first impressions is enhanced for self-similar others (Leshikar, Park, & Gutchess, 2014), and the age similarity of faces moderates age differences in face perception. More specifically, the overall advantage of younger raters is attenuated or reversed for older faces as shown in face recognition (Anastasi & Rhodes, 2005; Fulton & Bartlett, 1991), age recognition (Voelkle, Ebner, Lindenberger, & Riediger, 2011), emotion recognition (Malatesta, Izard, Culver, & Nicolson, 1987), and identifying perpetrators of crimes in lineups (Perfect & Harris, 2003; Wright & Stroud, 2002). It is possible that such an own-age bias also will be shown in the differentiation of trait impressions from faces. Main effects for face age may also exist. For example, both OA and YA may show greater differentiation in trait impressions most relevant to the age of the face. Since older people are more likely to actually vary in health, differentiation of this trait may be greater for older than younger faces. Since younger people are more likely to show criminal behavior (Steffensmeier, Allan, Harer, & Streifel, 1989), differentiation of traits such as hostility and untrustworthy may be greater for younger than older faces.

Rater Age and Positivity

In addition to age differences in behavioral and neural differentiation of visual stimuli, there are also differences in responses to positive and negative stimuli. OA show decreased memory and attention to negative stimuli and/or increased memory and attention to positive stimuli, including faces (Carstensen & Mikels, 2005; Charles, Mather, & Carstensen, 2003; Isaacowitz, Wadlinger, Goren, & Wilson, 2006). OA also give more positive trait and affect ratings to faces than do YA (Castle et al., 2012; Ebner, 2008; Kellough & Knight, 2012; Zebrowitz et al., 2013). Some evidence also exists for an OA positivity effect at the neural level. (Cassidy, Leshikar, Shih, Aizenman, & Gutchess, 2013; Castle et al., 2012).

Whereas OA positivity effects have been attributed to age-related changes in the motivation to avoid negative stimuli, the present study tested the hypothesis that the more positive trait impressions shown by OA are mediated by dedifferentiation. More specifically, we examined whether a tendency for OA to make fewer distinctions among faces when judging their traits—for example to judge faces as more similar to one another on dimensions such as trustworthiness or health—can account for the previously documented greater positivity of OA impressions (Zebrowitz et al., 2013). Evidence for a link between differentiation and positivity is provided by research demonstrating an informational negativity effect: negative stimuli are more cognitively elaborated than positive stimuli. For example, evaluations of negative stimulus persons produce more complex descriptions involving a mixture of both positive and negative terms than do descriptions of positively valued persons (Peeters & Czapinski, 1990). Also, compared with negative trait adjectives, positive trait adjectives are more similar in meaning and more strongly correlated—that is less differentiated (Claeys & Timmers, 1993). (for reviews, see Taylor, 1991; Rozin & Royzman, 2001).

Summary and Hypotheses

In summary, OA show decreased differentiation of faces as evidenced by a lesser ability to recognize subtle variations in facial stimuli as well as deficits in recognizing specific emotions and identities, effects that are paralleled by age-related neural dedifferentiation. We extended these findings to the differentiation of trait impressions from faces, examining effects for both older and younger faces as well as implications for the OA positivity effect. We tested the following hypotheses

1. Previous evidence for poorer differentiation of faces among OA would extend to less differentiated trait impressions.

2. Previous evidence for an own-age bias in face recognition would extend to more differentiated impressions of own-age faces.

3. Differentiation of impressions of health would be greater for older than younger faces, while differentiation of impressions of trustworthiness and hostility would be greater for younger than older faces.
4. Given evidence that positive judgments tend to be less differentiated than negative ones, the less differentiated trait impressions shown by OA would mediate their tendency to report more positive impressions.

5. Finally, we conducted exploratory analyses to determine whether any observed age differences in trait differentiation could be explained by differences in mood, vision, or cognitive function.

**METHOD**

**Participants**

Forty-eight young adults (23 males) and 48 OA (24 males) participated in the study. YAs were recruited from a local university and were ages 18–22 ($M = 18.8, SD = 1.0$). They completed the study for course credit or payment of $15. OAs, ages 65–86 ($M = 76.3, SD = 6.4$), were recruited from the local community through fliers, paid $25 for completing the study and screened through the Mini-Mental State Examination (Folstein et al., 1975) all scoring above $9.5$. A total of 69 YAs (41 men) were assigned two randomly chosen individuals to different levels on a rating scale. The more levels on a rating scale of a trait that a perceiver uses when rating a series of faces, the higher the differentiation score. This measure was initially developed to investigate stereotype category differentiation (the ability to perceive many types within a given category), and has also been used to investigate differentiation of impressions of own-race versus other-race faces to determine whether other-race faces tend to “all look alike” (Linville, Salovey, & Fischer, 1986). This index captures the probability that a perceiver will assign two randomly chosen individuals to different levels on a rating scale. The more levels on a rating scale of a trait that a perceiver uses when rating a series of faces, the higher the differentiation score. This measure was initially developed to investigate stereotype category differentiation (the ability to perceive many types within a given category), and has also been used to investigate differentiation of impressions of own-race versus other-race faces to determine whether other-race faces tend to “all look alike” (Linville et al., 1986; Zebrowitz, Montepare, & Lee, 1993). We calculated each rater’s differentiation scores for older male, younger male, older female, and younger female faces. These scores were calculated separately to control for the possibility that participants in one age group could have higher differentiation scores simply because their trait impressions showed greater differentiation among faces that varied in sex or age. The final differentiation scores for each participant averaged scores for older male and female faces to create a score for all old faces, and scores for younger male and female faces to create a score for all young faces. One OA female participant was dropped from analyses on healthy and untrustworthy ratings because her ratings did not vary across faces.

**Facial Stimuli**

Three sets of facial images were used to assess the generalizability of our results. One set was taken from a Boston sample of individuals who participated in the study of Midlife Development in the United States (MIDUS) funded by the John D. and Catherine T. MacArthur Foundation (Lachman, 1997). The images used were color frontal facial photographs of people displaying neutral expressions and wearing a grey cape to mask their clothing. A total of 69 YAs (41 men) between the ages of 25 and 39 ($M = 32.7, SD = 4.2$), and 68 OAs (44 men) between the ages of 60 and 74 ($M = 66.1, SD = 4.1$) were included. Images were displayed at an approximate size of $7.5 \times 9.5$ cm. Two additional sets of grayscale images were taken from the Intergenerational Studies (IGS) archive, a longitudinal study of representative samples of individuals who were born in Berkeley, California, in the late 1920s or attended school in Oakland, California, in the 1930s (Eichorn, 1981). The images included two photographs of 148 individuals (74 men). One photo was taken when the person was between ages 17–18 and a second when the person was between ages 52–62, for a total of 296 images. To reduce the face rating task to a reasonable length, the IGS images were divided into two sets, each of which was rated by different participants. Each set contained equal numbers of older and younger male and female faces. In addition, the images in each set were matched within demographic group on previously collected attractiveness ratings by YA (for more information about the photographs and the ratings, see Zebrowitz, Olson, & Hoffman, 1993).

**Dependent Measures**

**Trait ratings.**—The ratings used to calculate age differences in trait impression differentiation were taken from a previous study investigating age differences in agreement and positivity of trait impressions (Zebrowitz et al., 2013). Each participant rated faces from one of the three sets on four 7-point scales with endpoints labeled (1) not at all (healthy, competent, untrustworthy, aggressive or hostile) to (7) very (healthy, competent, untrustworthy, aggressive or hostile). MIDUS faces were rated on “aggressive” which was replaced by “hostile” for participants rating IGS faces, because ratings of the aggressiveness of the MIDUS faces showed lower agreement among OA than YA. This suggested that OA may have varied in their interpretation of the term, some construing it as “assertive” and others as “hostile” The term hostile yielded comparable agreement in impressions formed by OA and YA, and we therefore included ratings of hostile in the differentiation analyses, but not ratings of aggressiveness. Significant age differences in positivity were found for impressions of hostility, untrustworthiness, and health, with OA rating faces as less hostile, less untrustworthy, and more healthy, but not for impressions of competence. (Appearance ratings of attractiveness and babyfakeness were made after the trait ratings, but will not be discussed here as they are not relevant to our hypotheses regarding trait differentiation.)
**Control measures.** Control measures of mood, vision, and cognition were included to examine whether any of these measures could explain the predicted age differences in trait impression differentiation. Participants completed control measures for assessing mood (PANAS; Watson, Clark, & Tellegen, 1988), visual acuity (Snellen Eye Chart), contrast sensitivity (Mars Letter Contrast Sensitivity Test, Mars Perceptrix, Chappaqua, NY), color vision (Ishihara’s Tests for Color Deficiency, Ishihara, 2010), facial matching (Benton Facial Recognition Test, Benton, Van Allen, Hamsher, & Levin, 1983), crystallized intelligence (Shipley’s Vocabulary Test, Shipley, 1946), and processing speed (Pattern Comparison Test, Salthouse, 1993).

To assess executive functioning, participants who rated MIDUS faces completed a Letter-Number Sequencing Task (LNST, Wechsler, 1997) and those who rated the IGS faces completed a computerized version of the Wisconsin Card Sort Task [Berg Card Sort Task (BCST); downloaded from http://pebl.sourceforge.net/battery.html and validated by Piper et al., 2012]. The significant age differences shown in Table 1 are consistent with previous studies comparing YAs with community dwelling OAs. Specifically, OA showed poorer visual acuity and contrast sensitivity than YA as well as slower processing speed and poorer executive function, and OA showed better vocabulary scores than YA.

**Procedure**

Participants came into the laboratory and gave informed consent. Next, they completed a computerized version of the Positive and Negative Affect Schedule (PANAS). They then rated either MIDUS faces or one of the two sets of IGS faces, using MediaLab software (Empirisoft, New York City, NY). Faces were shown individually for either 4 seconds (MIDUS faces) or 3 s (IGS faces) after which the trait rating scale appeared and stayed on screen until the participant made a rating. (IGS faces were rated after data collection had been completed for MIDUS faces. We reduced the exposure time both because MIDUS participants reported that the exposure duration was long and also because there were more faces in the IGS sets, which meant that reducing the exposure time kept the total rating duration more comparable across participants assigned to each of the three face sets.) Participants were randomly assigned to one of two trait orders: healthy, untrustworthy, competent, and hostile or hostile, competent, untrustworthy, and healthy. Faces were shown in one of four orders, counterbalancing age and sex of face, and participants were asked to rate each face in comparison to the other faces of that age/sex grouping. This procedure was employed so that variations in trait impressions would be less likely to reflect sex or age stereotypes, as we were interested in whether the trait differentiation of OA was responsive to variations in facial appearance within demographic groups. Participants rated all faces on one trait rating scale before moving on to the next scale. Following the trait ratings, participants completed the remaining control measures.

**Results**

**Overview of Analyses**

Differentiation scores for each trait impression scale were analyzed using 2 (rater age: OA vs. YA) × 2 (face age: older vs. younger) × 3 (face set: MIDUS, IGS set 1, IGS set 2) mixed-factor ANOVAs, where face age was a within-subjects factor and rater age and face set were between-subjects factors. Since face set effects have no theoretical

<table>
<thead>
<tr>
<th>Measure</th>
<th>Older adults</th>
<th>Younger adults</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PANAS (PA) (Watson, Clark, &amp; Tellegen, 1988)</td>
<td>2.90 ± .70</td>
<td>2.78 ± .84</td>
<td>.79</td>
<td>.434</td>
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<td>PANAS (NA) (Watson, Clark, &amp; Tellegen, 1988)</td>
<td>1.73 ± .67</td>
<td>1.92 ± .66</td>
<td>1.37</td>
<td>.173</td>
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<tr>
<td>Mars Letter Contrast Sensitivity</td>
<td>34.69 ± 14.27</td>
<td>19.75 ± 5.47</td>
<td>6.77</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Ishihara’s Test for Color Deficiency (Ishihara, 2010)</td>
<td>13.46 ± 1.87</td>
<td>13.48 ± 1.65</td>
<td>.06</td>
<td>.954</td>
</tr>
<tr>
<td>Benton Facial Recognition Test (Benton, Van Allen, Hamsher, &amp; Levin, 1983)</td>
<td>41.35 ± 9.31</td>
<td>42.21 ± 8.58</td>
<td>.468</td>
<td>.641</td>
</tr>
<tr>
<td>Timed Pattern Comparison Test (Salthouse, 1993)</td>
<td>28.17 ± 5.16</td>
<td>42.56 ± 5.85</td>
<td>12.79</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Shipley Vocabulary Test (Shipley, 1946)</td>
<td>35.48 ± 3.37</td>
<td>31.77 ± 3.89</td>
<td>4.99</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Wisconsin Card Sorting Test (the Berg Card Sort Task (BCST validated by Piper et al., 2012; <a href="http://pebl.sourceforge.net/battery.html">http://pebl.sourceforge.net/battery.html</a>)</td>
<td>29.03 ± 8.92</td>
<td>36.40 ± 5.56</td>
<td>3.59</td>
<td>.001</td>
</tr>
<tr>
<td>Letter-Number Sequencing Test (Wechsler, 1997)</td>
<td>8.19 ± 1.52</td>
<td>12.56 ± 2.80</td>
<td>5.49</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Education*</td>
<td>5</td>
<td>3</td>
<td>2–3</td>
<td></td>
</tr>
</tbody>
</table>

*Level of Education was coded for highest level attained: 1 = no high school diploma, 2 = high school diploma, 3 = some college, 4 = Bachelor’s degree, 5 = some graduate work, 6 = Masters degree, 7 = Doctorate degree.
meaning, we report them only when an effect involving a variable of theoretical interest (rater age, face age) did not hold true across all face sets, indicating a qualification to generalizability. (Note that face set had only two levels for hostile ratings, which were collected only for IGS faces.)

**Differentiation as a Function of Rater Age**

As predicted, OA showed significantly less differentiation than YA for all trait impressions: competence, $F(1,90) = 7.79, p = .006, \eta_p^2 = .08$; health, $F(1,89) = 8.32, p = .005, \eta_p^2 = .09$; hostility, $F(1,60) = 7.66, p = .007, \eta_p^2 = .11$; untrustworthiness, $F(1,89) = 14.19, p < .001, \eta_p^2 = .14$ (see Figure 1). The only qualification by face set was a significant rater age × face age × face set triple interaction for hostility impressions, $F(1,60) = 4.86, p = .03, \eta_p^2 = .08$. Simple effects comparisons revealed that OA hostility ratings showed significantly less differentiation than YA ratings for younger and older faces in IGS set 2, respective ps = .01 and .004, with a trend in the same direction for younger faces in IGS set 1, $p = .12$, but no rater age difference for older faces in set 1, $p = .62$.

**Differentiation as a Function of Face Age**

Raters differentiated the health of older faces more than that of younger faces, $F(1,89) = 9.89, p = .002, \eta_p^2 = .10$. They also differentiated the hostility of younger faces more than that of older faces, $F(1,60) = 17.54, p < .001, \eta_p^2 = .23$, with a similar trend for untrustworthiness, $F(1,60) = 2.75, p = .101, \eta_p^2 = .03$ (See Figure 2).

The effect of face age on the differentiation of health ratings was qualified by a significant face age × rater age effect, $F(1,89) = 5.55, p = .021, \eta_p^2 = .06$. Planned comparisons revealed an own age bias in the differentiation of health ratings by OA, who showed greater differentiation of older faces ($M = .70, SD = .11$) than younger faces ($M = .65, SD = .15$), $p < .001$. Differentiation of health ratings by YA did not vary with face age (younger faces $M = .73, SD = .08$; older faces $M = .74, SD = .06$), $p = .58$. The significant rater age × face age × face set triple order interaction for hostility ratings that qualified the rater age effect also qualified the face age effect. The overall tendency for hostility ratings to be more differentiated for younger than older faces was significant for YA ratings of faces in IGS set 1, $p = .021$ and OA ratings of faces in IGS set 2, $p < .001$, but not for YA ratings of faces in IGS set 2, $p = .32$ or OA ratings of faces in IGS set 1.

**Control Variables as Mediators of Rater Age Differences in Differentiation**

The mediation analyses followed guidelines provided by Kenny (2014): http://davidakenny.net/cm/mediate.htm#BK together with the bootstrapping approach to obtain significant confidence intervals (Preacher & Hayes, 2004) with the macro mediation script version 4.2 (2011) for SPSS designed by Andrew F. Hayes (for more details see Preacher & Hayes, 2008). According to Kenny (2014), necessary conditions for mediation are that the causal variable be significantly related to the mediator (Step 2) and that the mediator be significantly related to the outcome variable with the causal variable controlled (Step 3). He notes that James and Brett (1984) have argued that Step 3 should be modified by not controlling for the causal variable, because there would be no need to control for the causal variable if there were complete mediation. Because complete mediation does not always occur, Kenny argues for controlling the causal variable in Step 3. On the other hand, he acknowledges that it is reasonable to test for mediation even if there is no direct effect of the causal variable on the outcome (Step 1).

We considered control variables on which OA and YA differed as potential mediators (Step 2). These included visual acuity, contrast sensitivity, executive functioning (BCST or LNST), processing speed (Pattern Comparison Task), and vocabulary. Because the measure of executive function differed across participants, we calculated $z$ scores separately for those who completed the BCST and those who completed the LNST and combined the.
values into a single variable. None of these control variables qualified as mediators for any of the four trait ratings using the criterion that they be significantly related to differentiation scores with participant age controlled (Step 3), all $p > .11$. [Testing mediation despite a lack of significance at Step 3 revealed that contrast sensitivity, vocabulary, and processing speed did not mediate age differences in differentiation of any of the trait impressions, with the 95% CI including zero for all four traits. On the other hand, age differences in visual acuity significantly suppressed the differences in hostility differentiation, 95% CI [.0014, .0621], and age differences in executive function significantly suppressed the differences in competence differentiation, 95% CI [.0003, .0365] and health differentiation, 95% CI [.0001, .0266]. Thus age differences in differentiation of these traits would have been even greater had OA and YA not differed on these control variables.]

**Age Differences in Differentiation as a Mediator of OA Positivity Effects**

Previous research using these faces and raters found that OA showed more positive impressions of hostility, trustworthiness, and health than did YA, with no age differences in the positivity of impressions of competence (Zebrowitz et al., 2013). We tested whether the OA positivity effects for the first three traits were mediated by age differences in trait differentiation using the same criteria for assessing mediation described above. We also tested whether the non-significant OA positivity effect for competence ratings was influenced by age differences in differentiation.

As shown in Figure 3, age differences in the differentiation of trait ratings mediated the greater positivity of OA ratings. Specifically, the direct effect of rater age on the positivity of hostility, health, and untrustworthy impressions lost significance when the age difference in differentiation was added to the models as a mediator, and this change was significant for health, 95% CI [0.04, 0.28], hostility, 95% CI [−0.68, −0.14], and untrustworthy 95% CI [−0.38, −0.03] ratings. Testing for mediation of competence ratings despite no direct effect of age or significant effect of differentiation at Step 3 revealed that controlling age differences in differentiation did not significantly change the direct effect, 95% CI [−0.07, 0.15].

Although the preceding results support our hypothesis that age differences in the differentiation of trait impressions would mediate age differences in the positivity of trait impressions, the correlational nature of our data leaves open the possibility that age differences in positivity mediate age differences in differentiation rather than vice versa. Additional mediation tests revealed that the criteria for this reverse mediation were satisfied for all trait ratings except for competence, where rater age failed to predict the tested mediator, impression positivity, $p > .50$. As shown in Figure 4, the effect of rater age on the differentiation of hostility impressions lost significance when the trait rating positivity mediator was added to the model, a significant change, 95% CI [−0.11, −0.01]. In contrast, the effect of rater age on the differentiation of healthy and untrustworthy ratings remained significant when trait rating positivity was added to the models, although the direct effects did lose strength, 95% CI [−0.05, −0.004] for healthy (Figure 4), and 95% CI [−0.05, −0.001] for untrustworthy (Figure 4). In summary, the same traits showed mediation of age differences in impression positivity by differentiation scores and the reverse mediation of age differences in differentiation scores by impression positivity. However, the latter mediation did not eliminate the significant effect of rater age on health or untrustworthy differentiation scores, whereas rater age differences in the positivity of health, hostility,
and untrustworthy ratings all lost significance when differentiation was entered as a mediator.

**Discussion**

These findings add to previous research documenting less differentiation of faces by OA than YA by investigating age differences in the differentiation of trait impressions and their contribution to an OA positivity effect. Employing a measure developed to investigate whether some groups are stereotyped as highly homogeneous (Linville et al., 1986), we found that OA impressions of hostility, untrustworthiness, health, and competence from faces showed less differentiation than did YA impressions. We further found greater differentiation of younger than older faces' hostility and older than younger faces' health, with the latter effect significant only for OA, consistent with an own-age bias. Finally, we found that age differences in differentiation mediated previously reported tendencies for OA to form more positive impressions of the hostility, trustworthiness, and health of the faces, with these OA positivity effects losing significance when differentiation scores were controlled. Although the reverse mediation effects were also significant, controlling impression positivity reduced, but did not eliminate most age differences in differentiation.

OA lesser differentiation of faces on trait dimensions is consistent with previous behavioral research demonstrating that OAs showed reduced accuracy in face recognition (Bartlett et al., 1989), required larger differences between faces to discriminate them (Goh et al., 2010), and also showed poorer recognition of emotional expressions (Ruffman et al., 2008, 2009). Our evidence for dedifferentiation of trait impressions from faces in OA also is consistent with evidence for less neural differentiation (Carp et al., 2011; Park et al., 2004). The convergence of our results with this literature argues against the possibility that dedifferentiated trait impressions in OA merely reflect age differences in the use of rating scales rather than underlying age differences in trait impressions. Research examining neural correlates of the behavioral differences would corroborate this conclusion. For example, one might predict that multivoxel pattern analysis in face processing and reward regions would show less differentiation of faces varying in trustworthiness for OA than YA. The fact that age differences in visual acuity and contrast sensitivity did not mediate age differences in trait impression differentiation also supports the argument that it is one manifestation of a broader tendency toward cognitive dedifferentiation in aging (Balinsky, 1941; Baltes et al., 1980; Salthouse et al., 1996) rather than reflecting age-related changes on the anatomy of the visual pathway (Spear, 1993).

The finding that the health of older faces was differentiated more than that of younger ones, with a reverse effect for hostility, is consistent with our suggestion that people may show greater differentiation on trait dimensions most relevant to the faces being judged. Health is arguably an evaluative dimension more relevant to older individuals, while hostility is more relevant to younger ones, who are more likely to engage in violent criminal behavior (Steffensmeier, et al., 1989). However, on this account, only OA perceived health to be more relevant to older than younger faces, since differentiation of the two age groups by YA did not differ significantly. Research that manipulates the relevance of a trait dimension for older and younger faces would provide insight into the face age effects and their moderation by rater age.

Although the evidence for an own-age bias in the differentiation of trait impressions was limited to OA impressions of health, this finding adds to a literature that has shown similar effects in other social judgments, including face recognition (Anastasi & Rhodes, 2005; Fulton & Bartlett, 1991), age recognition (Voelkle, et al., 2011), emotion recognition (Malatesta, et al., 1987), and identifying perpetrators of crimes in lineups (Perfect & Harris, 2003; Wright &
Our limited support for an own age bias may be due to the fact that “own-age” faces were not exactly matched in age to participants, although they were closer in age than the “other-age” faces. Thus, greater differentiation of own-age faces may be shown in other trait impressions when faces more closely match the age of perceivers. We examined trait differentiation across three sets of faces to assess the generalizability of our results. The tendency for OA to show less differentiation than YA in their impressions of competence, health, and untrustworthiness did not vary with face set. However, the lesser differentiation of OA than YA hostility impressions was not significant for faces in one of the two sets for which this trait was rated. Also, the greater differentiation of hostility ratings for younger than older faces was not significant for YA ratings of faces in one set and for OA ratings of faces in the other set. Although we have no theoretical explanation for differences across face sets, it is noteworthy that the face set that failed to show less differentiation of hostility impressions by OA than YA in the present study also failed to show greater positivity of these impressions by OA than YA (Zebrowitz et al., 2013). This result is consistent with the links between impression differentiation and impression positivity discussed below.

Our finding that age differences in the differentiation of trait impressions from faces mediated the tendency for OA to form more positive impressions provides a novel explanation for OA positivity effects. In contrast to a motivational explanation whereby OA focus on positive information in the service of emotion regulation (Carstensen, 1995; Carstensen & Mikels, 2005), our results indicate that OA positivity effects can reflect a failure to make fine distinctions among stimuli, consistent with previous evidence that positive judgments are less differentiated than negative ones (Taylor, 1991; Rozin & Royzman, 2001). At the same time, reverse mediation effects also showed that age differences in the positivity of trait impressions mediated the differences in differentiation. Although the latter effects tended to show partial rather than full mediation, experimental research is needed to manipulate differentiation or positivity of impressions in order to demonstrate a causal influence of one on the other.

CONCLUSIONS

We found that previous evidence for less perceptual differentiation in OA, as indexed by behavioral measures of face and emotion recognition as well as neural measures, extends to less differentiation of trait impressions from faces. These results could not be explained by age differences in mood, vision, processing speed, vocabulary, or executive function. We also found that differentiation of the trait impressions of younger and older faces varied with the relevance of the trait to faces of that age as well as the relevance of the faces’ age to the perceiver. Finally, age differences in the differentiation of trait ratings mediated the tendency for OA to show more positive impressions of faces than YA. It would be useful for future research to investigate the neural mechanisms associated with age differences in trait impression differentiation in order to provide a closer link between our findings and the dedifferentiation hypothesis of cognitive aging (Balinsky, 1941; Baltes et al., 1980; Salthouse et al., 1996).

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