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Age-related differences in spontaneous trait judgments from facial appearance

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Abstract

We tested whether there are age-related declines in detecting cues to trustworthiness, a skill that has been demonstrated to be rapid and automatic in younger adults. Young (age M = 21.17 years) and older (age M = 70.15 years) adults made criminal appearance judgments to unfamiliar faces, which were presented at a duration of either 100, 500, or 1000-ms. Participants' response times and judgment confidence were recorded. Older compared to young adults were poorer at judging trustworthiness at 100-ms, and were slower overall in making their judgments. Further, the cues (i.e., perceptions of anger, trustworthiness, and happiness) underlying criminality judgments were the same across age groups. Judgment confidence increased with increasing exposure duration for both age groups, while older adults were less confident in their judgments overall than their young counterparts. The implications are discussed.

Keywords: ageing, first impressions, trait inferences, face perception, criminality

Age-related differences in spontaneous trait judgments from facial appearance

Life expectancy has significantly increased in recent decades (Peters, Hess, Västfjäll, & Auman, 2007). One challenge arising from this demographic shift is that a greater number of older adults are victims of crime and abuse compared to younger generations (e.g., Acierno, Hernandez-Tejada, Muzzy, & Steve, 2010; Bennett, Jenkins, & Asif, 2000). Older adults' perceived vulnerability could be a reason why they are deliberately targeted as victims (e.g., Thornton, Hatton, Ralph, & Owen, 2005). Age UK has found that 53% of older adults have been targeted by criminals in relation to fraud, with social isolation and cognitive impairment noted as two other possible reasons for the specific targeting of older adults (George & Lennard Associates, 2015). Older adults may also be more likely to suffer victimisation because they are poorer at determining the intentions of others. While past research has demonstrated that young adults rapidly ($\leq$100 ms) infer trustworthiness, dominance and criminality (e.g. Klatt et al., 2016; Willis & Todorov, 2006) from facial appearance, research to date has not tested older adults' ability to make these rapid inferences. The research reported in this paper addresses this gap in the literature.

Age-related differences in the processing of facial cues that underlie social perceptions have been reported (Castle et al., 2012). Compared to young adults, older adults tend to judge faces as more trustworthy and more approachable (Castle et al., 2012). Conversely, with faces already rated as trustworthy, older and younger adults do not appear to significantly differ in their attributions of trustworthiness. This pattern of findings has been linked to a reduction in activation in the anterior insula (AI) region of the cerebral cortex for older compared to younger adults. The AI has been implicated in the formation of a sense of intuition, which can be indicative of expected risk and risk-avoidant behaviours

(Castle et al., 2012). Age-related decreases in emotion-recognition ability (Malatesta, Izard, Culver, & Nicolich, 1987) could also be linked to the brain regions that underlie the processing of different types of emotions, such as the bilateral amygdala and the medial prefrontal cortex (Mende-Siedlecki, Said, & Todorov, 2013). These regions are reportedly affected by ageing, with older adults (aged 62 to 76) reported to be less accurate compared to younger adults (aged 18 to 24) when distinguishing between low intensity negative emotions (Mienaltowski, Johnson, Wittman, Wilson, Sturycz, & Norman, 2013). Older and younger adults also differ with respect to how they utilise cues to emotion when evaluating faces shown in neutral emotional expression. Younger adults' (aged 19 to 29) trustworthiness judgments are based on how happy the face appears, whereas older adults' (aged 56 to 74) judgments are based on evaluations of how happy and/or angry the face appears (Ethier-Majcher, Joubert, & Gosselin, 2013). Their results suggest older adults use a greater range of cues in making trait judgments compared to younger adults, which may indicate younger adults process facial cues to emotion more efficiently. In older adults, this, combined with age-related decreases in cognitive processing speed (Salthouse, 1985; Salthouse & Babcock, 1991) and working memory capacity (Salthouse, Mitchell, Skovronek, & Babcock, 1989), may result in an incomplete execution of the processes that are required for judging trustworthiness. The foregoing suggests older compared to young adults require longer exposure durations to faces in order to make social judgments. The processing of emotion from facial cues occurs within the first 100-ms of stimulus exposure (Utama, Takemoto, Koike, & Nakamura, 2009). At this level of exposure duration, older adults may take longer to detect facial cues that are indicative of emotion compared to young adults. In other cognitive domains, such as mental processing and reasoning, age-related declines

have been reported (e.g., Calder et al., 2003). Ageing is associated with a decline in processing speed across perceptual, motor, and decision-making tasks (Salthouse, 1985).

In young adults, spontaneous social evaluations of trustworthiness are made based on facial cues (e.g., Hassin & Trope, 2000; Todorov, Mandisodza, Goren, & Hall, 2005) following very minimal exposure durations (Bar, Neta & Linz, 2006; Todorov, Pakrashi, & Oosterhof, 2009; Willis & Todorov, 2006). Willis and Todorov (2006) demonstrated that judgments of trustworthiness are made following 100 ms exposure time, and more recently, Todorov and colleagues (2009) have suggested this length of exposure could be as small as 33 ms. Faces that have a positive valence and appear happy are more likely to be perceived as trustworthy (Said, Sebe, & Todorov, 2009). According to the 2D model of face evaluation, valence, along with social perceptions of physical dominance, are inferred from faces to determine whether a person should be approached or avoided (Oosterhof & Todorov, 2008), for instance judgements of trustworthiness and criminality (Ethier-Majcher et al., 2013). Recently, researchers have also demonstrated that young adults also spontaneously make criminality attributions following minimal exposure to a face (Klatt et al., 2016). From an evolutionary perspective, we may be predisposed to make these rapid social inferences to determine a person's intentions towards us, and to assess whether they can cause us harm (Cosmides & Tooby, 1992; Willis & Todorov, 2006). Yet, the potential impact of ageing on these rapid social evaluations following minimal exposure to faces has yet to be investigated. This study therefore examined whether older adults are also able to spontaneously infer criminal appearance from faces.

The dual process theory framework (Evans, 1984; see also Todorov et al., 2005; Willis & Todorov, 2006) may account for age-related differences in emotion processing. According to this framework, system 1 processes encompass the rapid, effortless mechanisms

associated with initial judgments of faces. In contrast, system 2 processes are slow and effortful, and may be particularly engaged with lengthy or repeated exposures to a stimulus, such as a face. With increased age, system 1 processes take longer, which may also have a 'knock-on effect' on system 2 processes (Peters et al., 2007). Delays in system 1 processing are further exacerbated by older adults being less effective in being able to deliberatively process task-relevant information, and ignore task irrelevant information, for instance (Hasher & Zacks, 1988).

Previous research has found that young adults' confidence in their social judgments increases along with increasing exposure duration to a face (Klatt et al., 2016; Todorov et al., 2009). In this research, judgment accuracy—which is measured by whether a judgment made under a time restriction accords with judgments other people made to the face when there was no viewing time restriction—significantly increases as face exposure duration increases from 100 ms to 500 ms. Accuracy does not differ, however, as exposure duration increases from 500 to 1000 ms. Nevertheless, participants' judgement confidence shows a linear increase across exposure duration. Thus, even though participants' judgments were no more likely to be accurate with further increases in exposure duration, participants increasingly perceive their judgments to be accurate with longer display times. It is unclear whether older adults will exhibit a similar pattern. Findings across studies are mixed with regard to age-related differences in confidence (e.g. Crawford & Stankov, 1996; Kovalchik, Camerer, Grether, Plott, & Allman, 2005; Marquie, Jordan-Boddaert, & Huett, 2002; Searcy, Bartlett, & Memon, 1999), and may be task dependent (see Peters et al., 2007).

To summarise, we predicted age-related differences in criminality judgements when faces are presented for a minimal length of time (i.e., 100 ms) based on research with older adults demonstrating age-related decreases in processing speed. Further, we predicted that

older adults would take longer to make trait judgments than young adults, and use different cues to underpin their judgments. Finally, we investigated the effects of exposure time on judgement confidence to explore whether there are age-related differences.

Method

Design

In the restricted viewing time experiment, participants made criminal attributions to 30 faces, presented for either 100, 500 or 1000 ms. Each face was presented only once and exposure time was manipulated between participants. The dependent variables were *criminal attribution*, which was whether or not the given face was evaluated as criminal-looking, *response time* (ms), which was the length of time that it took to make the criminal attribution, and *response confidence*, which was the level of confidence the participants expressed in the criminal attribution that they made, measured on a 7-point Likert-type scale, ranging from 1, not at all confident, to 7, completely confident.

Participants

A total of 63 people took part in the viewing time experiment, including 30 young (age *M* = 21.20 years, *SD* = 3.00 years; 63% female) and 33 older adults (age *M* = 70.15 years, *SD* = 6.20 years; 72% female). A further 145 participants (age *M* = 31.5 years, *SD* = 10.8 years; 44% female) evaluated the faces under conditions in which viewing time was not restricted.

Materials and Procedure

The photographic stimuli were 30 photographs from the Karolinska Directed Emotional Faces set (Lundqvist, Flykt, & Öhman, 1998). This database consists of photographs of both male and female actors; only the male faces were used as crimes are predominantly committed by men (Office for National Statistics, 2013). A total of 33 photographs of male actors aged between 20 and 30 years were selected. All photographs were head and shoulder shots taken against the same coloured background. Each photograph depicted an individual showing an emotionally neutral facial expression in a full-frontal pose, and all actors wore a grey coloured t-shirt. Photographs were free from distinguishing facial features such as facial hair or tattoos, and facial accessories such as jewellery and glasses. Three of the photographs were used as the stimuli for practice trials, the remaining photographs (30) served as the main experimental stimuli. The dimensions of the photographs used were 195 x 300 pixels.

Phase 1, unrestricted viewing time. Each participant was randomly assigned to rate each of the 30 faces, in a random order, on one type of characteristic, using a 9-point scale, with 1 indicating “not at all [characteristic]”, and 9 indicating “extremely [characteristic]”. The face remained onscreen while the participant rated it, and the length of time that the participant had to make the rating was not restricted. These judgments produced the criterion ratings and were deemed reliable (criminal $\alpha = .954$, trustworthy $\alpha = .949$, dominant $\alpha = .967$, happy $\alpha = .977$, angry $\alpha = .941$).

Phase 2, restricted viewing time. People participating in this phase of the study were told that their task was to make judgments about faces as quickly as possible. E-prime controlled the presentation of the faces. Each trial began with a fixation cross at the centre

of the screen for 500 ms, followed by the presentation of a face, which was displayed for either 100, 500 or 1000 ms. After the face disappeared, a prompt appeared, asking the participant whether or not the face was criminal-looking. The participant indicated his or her response, via the keyboard, striking a key that we had labelled with 'yes' or the one we had labelled with 'no'. Another prompt then appeared, asking the participant to rate their response confidence on a scale from 1, not at all confident, to 7, completely confident. There were three practice trials, followed by 30 test faces. The three faces that served as practice stimuli and the 30 faces that served as test stimuli were the same across participants. We randomly assigned each face to an exposure duration level, with ten of the faces shown for 100 ms, ten shown for 500 ms, and ten faces shown for 1000 ms. Participants saw each face once.

The order in which the faces were evaluated was randomised for each participant by the programme. The inter-trial interval was 1500 ms. The program recorded for each face whether the participant made a criminal attribution, response confidence, and response time, which was defined as the length of time (in ms) that it took the participant to make the dichotomous ('yes' or 'no') criminal appearance response.

Data Analysis

For each face, we calculated the proportion of participants who made a criminal attribution (i.e., indicated "yes" that the face appeared criminal). For each exposure duration, the mean proportion of participants who made a criminal attribution, mean

confidence, and mean response time were calculated for each age group. The dependent variables were individually analysed with mixed ANOVAs, with age group and exposure duration as the independent variables. We also performed correlation and regression analyses to examine relationships between variables.

For each of the attributes that were evaluated without viewing time restriction, we averaged the ratings for a given face across participants. The average criminal appearance rating served as the criminal appearance criterion measure for each face. We utilised the other mean ratings (i.e., trustworthiness, dominance, happiness, anger) to explore which face attributes drive criminal appearance attributions in young and older adults.

Results

Criminal Attributions

Our first analysis examined whether restricted viewing time differentially affected criminal attributions depending on age group. For young and older adults, we correlated across faces the criminal attribution proportions with the criterion criminal appearance ratings, conditioning the results on exposure time. Table 1 presents the zero-order correlation coefficients obtained from the analysis. As can be seen, for both young and older adults, time restricted criminal attributions were significantly correlated with the criterion measure at every exposure duration. This indicates that the faces given higher criminal appearance ratings also tended to have a larger proportion of participants making criminal appearance attributions. Additionally, this pattern held for both young and older adults.

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insert Table 1 about here

Our next analysis tested whether the rate of criminal attributions varied by age group and duration of exposure. Toward this end, the criminal attribution data were entered into a 2 (age group) x 3 (exposure duration) mixed ANOVA. Neither the main effect for age group, $F(1, 29) = 1.29$, $p > .05$, nor the main effect for exposure duration, $F(2, 58) = 1.17$, $p > .05$, was significant. However, there was a significant age group by exposure duration interaction effect, $F(2, 58) = 3.71$, $p < .05$, $\eta_p^2 = .11$. We conducted Bonferroni corrected t-tests ($\alpha = .0162$) to compare older and younger adults at every level of exposure duration to examine why the interaction effect had occurred. As shown in Figure 1, older adults were significantly less likely than young adults to make criminal attributions in the 100 ms condition, $t(29) = -2.54$, $p = .016$, two-tailed ($r = .10$). No other significant differences were found.

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insert Figure 1 about here

Confidence

We next examined whether attribution confidence varied in relation to duration of exposure and age group. The confidence data were entered into a mixed ANOVA, with duration of exposure and age group as the independent variables. Descriptive results are displayed in Figure 2. Confidence significantly varied in relation to exposure duration, $F(2, 78) = 61.03$, $p < .001$, $\eta_p^2 = .61$. Confidence significantly increased linearly as exposure duration increased, $F(1, 29) = 23.38$, $p < .001$, $\eta_p^2 = .45$. Additionally, older compared to

young adults were less confident in their attributions on average (*M* = 4.05, *SEM* = .05, *CI*: 3.94 – 4.15; versus *M* = 4.59, *SEM* = .05, CI: 4.48 – 4.70, respectively), $F(1, 29) = 69.54$, $p < .001$, , $\eta_p^2 = .71$. No other effects were statistically significant.

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insert Figure 2 about here

Response Time

The final analyses examined whether the time that it took participants to make their attributions varied in relation to age group and exposure duration. The mean response time data were entered into a mixed ANOVA, with age group and duration of exposure as the independent variables. Significant main effects were found for age, $F(1, 29) = 137.52$, $p < .001$, $\eta_p^2 = .83$, and exposure duration, $F(2, 58) = 16.79$, $p < .001$, $\eta_p^2 = .37$. The results are shown in Figure 3. Older adults were slower to respond compared to young adults and response times decreased linearly as duration of exposure increased, $F(1, 29) = 38.23$, $p < .001$, $\eta_p^2 = .57$.

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insert Figure 3 about here

Do Trustworthiness and Dominance Contribute to Criminal Attributions?

Table 2 provides the correlations between young and older adults' criminal attributions (collapsed across duration of exposure) and the other attribute ratings, namely dominance, trustworthiness, happiness, and anger. As can be seen, criminal attributions were associated not only with the criminal appearance criterion measure, but also with trustworthiness, happiness, and anger ratings, both for young and older adults, suggesting that these characteristics contributed to participants' criminal appearance attributions regardless of age. Dominance was not significantly related to criminal attributions.

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insert Table 2 about here

Discussion

Our study investigated age-related differences in the process of inferring trustworthiness from faces. For both young and older adults, we found strong correspondence between criterion criminality judgments, which were made when faces were presented for an unlimited length of time, and criminal judgments that were made when faces were viewed in as little as 100 ms. However, older adults were less likely than young adults to make criminal attributions when faces were presented for 100 ms. Age-related differences in response confidence and response times were also found, and the traits that underpinned criminal attributions differed for young compared to older participants. We will now discuss these findings in turn.

Our work significantly extends previous research regarding the automaticity of trait attributions in younger adults (e.g., Todorov et al., 2009; Willis & Todorov, 2006). Our work indicates that this process is also automatic in older adults. At every exposure duration, attributions of criminality made by both groups of participants were significantly correlated with criterion judgments. Older adults, however, were significantly less likely than younger adults to make criminal attributions at the briefest level of exposure of (100 ms. This is particularly interesting considering that criminality judgments for older adults were still highly correlated with criterion judgments at this level of exposure. These results suggest that older adults found the task more difficult at shorter exposure durations, which may be a result of age-related perceptual processing limitations (Evans, 1984; Mienaltowski et al., 2013; Todorov et al., 2005). Older adults may have found it more difficult to extract the facial features needed to make trait judgments.

Further, in other research, age-related working memory deficits have been shown (Salthouse et al., 1989). These deficits affect upstream higher-order trait attribution processes. Possibly, older adults adopt a relatively conservative response standard in making criminal attributions (i.e., erring on the side of indicating ‘no’, a face does not look criminal) to counter perceptual and working memory deficits.

Both older and young adults reported higher confidence as exposure duration increased. This mirrors and extends findings from previous studies with young adults (e.g., Todorov et al., 2009). At relatively long exposure durations, the resolution, or contrast sensitivity, of visually encoded information is improved (e.g. Nachmias, 1967). The resolution of the face represented in working memory may underpin response confidence,

such that participants gave higher ratings when resolution was relatively high. Further, even though older adults were found to be generally less confident in their attributions compared to younger adults overall, older adults still reported higher confidence with longer exposure durations.

Prior research suggests that system 1 processes are delayed with increasing age (Evans, 1984; Peters et al., 2007), and this may account for our finding that older compared to younger adults took longer to make criminal attributions. Older adults responded more slowly in comparison to younger adults, while both younger and older adults responded more quickly as exposure duration to the face increased. The greater time needed for older adults to respond could be attributed to age-related deficits in processing systems, with participants taking longer to make cognitive judgments with advancing age (Evans, 1984; Humphries, Flowe, Hall, Williams, & Ryder, 2015; Peters et al., 2007). Moreover, age-related declines in motor responses (Ketcham & Stelmach, 2001) could also account for our results in that it may have simply taken older adults longer to indicate an answer to the attribution question via a computer. Future research in this area could focus more closely on the motor capabilities of older adults to disentangle cognitive processes and motor responses in relation to face perception.

We also investigated whether there were age related differences in the cues underlying criminality judgments. For older and younger adults, faces that appeared untrustworthy, unhappy and angry were more likely to be judged criminal. These results correspond with previous research. Faces rated highly in criminal appearance are perceived to be less trustworthy, less happy, and angrier (Flowe, 2012). Perceptions of facial dominance can also contribute towards an overall perception of threat (Todorov, Said, Engell, & Oosterhof, 2008). Faces that have positive valence and appear happy are more

likely to be perceived as trustworthy (Said, Sebe, & Todorov, 2009). As mentioned at the beginning of this paper, ageing is associated with a decline in perceptual, motor, and decision-making processing speed (Salthouse, 1985). Given that older adults also make use of more varied cues in evaluating trustworthiness (e.g. Ethier-Majcher et al., 2013), further studies may wish to examine other aspects of faces that feed into these judgements.

Further work is needed to determine the minimum exposure time needed for older adults to make trait inferences. Todorov and colleagues (2009) demonstrated in young adults that reliable trait judgments can be made in as little as 33 ms. Given that older adults' perceptual processes and cognitive resources are reduced in comparison to young adults, the minimum exposure time required may be greater for older compared to young adults. Future research could also examine the effect of emotional intensity of the faces on criminal attributions made under time constraints, and whether this varies in relation to participant age. To date, this has not been investigated in either young or older adults. Finally, as we used exclusively male stimuli, it would thus be interesting to replicate this study with female faces. Previous research has found that criminal attributions are spontaneously inferred from female faces (Klatt et al., 2016). However, trait evaluations for female faces may vary depending on emotional expression. For instance, faces in neutral emotional expression can still appear criminal looking, and the consequence this has on decision making varies depending on the gender of the face (Flowe, Klatt, & Colloff, 2014).

In summary, in keeping with the basic cognitive literature on processing speed (e.g. Salthouse, 1985; Utama et al., 2009) and working memory capacity (Salthouse et al., 1989) we found that trait attributions based on facial appearance take longer in older compared to younger adults. Nevertheless, both older and young adults appear to make similar spontaneous trait attributions, and these coincide closely with trait evaluations that are

made without any time constraints. Further, we found that the facial appearance features (trustworthiness, happiness, and anger) that underpin criminality attributions in young adults (Flowe, 2012) also underpin the attributions that are made by older adults. Taken together, our findings indicate that older adults are able to make spontaneous trustworthiness evaluations from facial appearance. However, assuming circumstances in which the facial cues are valid signals of social intentions, our data suggest that older adults take longer to make these attributions and have greater difficulty at relatively brief durations of exposure, which may increase their vulnerability to criminal victimisation.

Declaration of Interest

The authors report no declarations of interest.

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