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Age Similarities in Recognizing Threat From Faces and Diagnostic Cues

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Background. Previous research indicates that younger adults (YA) can identify men's tendency to be aggressive based merely on their neutral expression faces. We compared older adults (OA) and YA accuracy and investigated contributing facial cues.

Method. In Study 1, YA and OA rated the aggressiveness of young men depicted in facial photographs in a control, distraction, or accuracy motivation condition. In Study 2, YA and OA rated how angry, attractive, masculine, and baby-faced the men looked in addition to rating their aggressiveness. These measures plus measured facial width-to-height ratio (FWHR) were used to examine cues to aggressiveness.

Results. Accuracy coefficients, calculated by correlating rated aggressiveness with the men's previously measured actual aggressiveness, were significant and equal for OA and YA. Accuracy was not moderated by distraction or accuracy motivation, suggesting automatic processing. A greater FWHR, lower attractiveness, and higher masculinity independently influenced rated aggressiveness by both age groups and also were valid cues to actual aggressiveness.

Discussion. Despite previous evidence for positivity biases in OA, they can be just as accurate as YA when it comes to discerning actual differences in the aggressiveness of young men.

Key Words: Accuracy—Aging—Attractiveness—Facial masculinity—Facial width-to-height ratio—Trait impressions.

IT has recently been suggested that a positivity bias in older adults' (OA) judgments of trustworthiness from faces may contribute to increased vulnerability to fraud and scams in later adulthood (Castle et al., 2012). Indeed, there is substantial evidence for an OA positivity bias in several domains that has been attributed to OA emotion regulation, although whether the bias actually influences affective outcomes remains an open question (Isaacowitz & Blanchard-Fields, 2012; Isaacowitz, Wadlinger, Goren, & Wilson, 2006; Mather & Carstensen, 2003, 2005). The positivity bias includes a tendency for OA to perceive faces not only as more trustworthy but also less hostile, and less dangerous, with the bias most marked for the most threatening-looking faces (Castle et al., 2012; Ruffman, Sullivan, & Edge, 2006; Zebrowitz, Franklin, Hillman, & Boc, 2013). However, an OA positivity bias in impressions from faces does not necessarily imply lower accuracy in detecting relative variations in threatening traits. Indeed, YA judgments of trustworthiness are often inaccurate (Rule, Krendl, Ivcevic, & Ambady, 2013). The present research compared the accuracy of OA and younger adults (YA) in judging aggressiveness from faces and investigated the facial cues that contribute to accuracy in each age group.

YA show a remarkable accuracy in judging the retaliatory aggressiveness of men based solely on facial photographs (Carré, McCormick, & Mondloch, 2009). Given the OA positivity bias, one might expect them to be less accurate than YA in detecting potential threat from faces insofar as any tendency for OA to engage in greater emotion regulation yields less attention to negatively valenced facial cues that may signal aggressiveness, such as facial resemblance to anger (Malatesta, Fiore, & Messina, 1987). However, other research indicates that OA may be able to detect danger in faces. Like YA, OA were quicker to locate an angry schematic face in an array of neutral faces than to identify a happy face (Hahn, Carlson, Singer, & Gronlund, 2006). Also, OA impressions of hostility and untrustworthiness in neutral faces were predicted by resemblance to anger expressions, indicating sensitivity to threatening information (Franklin & Zebrowitz, 2013). These results suggest that OA may be able to accurately detect relative variations in threat among faces despite their more positive overall impressions and their greater difficulty labeling anger (Ruffman, Henry, Livingstone, & Phillips, 2008).

Two studies examined the accuracy of OA and YA impressions of the aggressiveness of the young male faces from the study by Carré and colleagues (2009). Study 1 examined accuracy of impressions when the faces were presented with varying instructions. Study 2 utilized a lens model (Brunswik, 1955) to examine the facial qualities utilized by each age group and those that were valid indicators of aggressiveness.

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Study 1

In the research by Carré and colleagues (Carré & McCormick, 2008; Carré et al., 2009), the relative aggressiveness of young men was assessed by their behavior in the Point Subtraction Aggression Paradigm, a well-validated measure of reactive aggression (Cherek, Schnapp, Moeller, & Dougherty, 1996; Golomb, Cortez-Perez, Jaworski, Mednick, & Dimsdale, 2007). In this paradigm, the men were able to accumulate points to be exchanged for money. Throughout the game, these men had points stolen from them by another fictitious player. Although they could retaliate, they were told that any points that they stole would not be added to their own point total. Thus, stealing points would hurt the other player, without helping themselves. The number of times that the men stole from the other player was considered a measure of aggression when provoked. When YA were shown photographs of the men and asked to judge how aggressive each would be when provoked, their ratings were significantly correlated with the men's actual aggression scores. This research further demonstrated that automatic face processing is sufficient for YA to achieve accuracy, as it was sustained when the photographs were shown for only 39 ms (Carré et al., 2009).

As discussed earlier, previous evidence that OA are less responsive to negative stimuli, including facial cues, suggests that they may show less accuracy in judging aggressiveness compared with YA. On the other hand, we have also cited evidence that, under some circumstances, OA are still sensitive to negative facial qualities. Automatic processing seems to be one factor that increases OA sensitivity to negative cues. In particular, distraction increases OA recall of negatively valenced pictures (Mather & Knight, 2005) as well as visual attention to negatively valenced pictures and faces (Knight et al., 2007). These results have been attributed to distraction reducing the opportunity for OA to engage in emotion regulation processes that are presumed to underpin their positivity bias. The argument that positivity serves emotion regulation is also supported by a reduction in the OA positivity bias by situational or dispositional factors that decrease the likelihood of emotion regulation processes (Kellough & Knight, 2012; Li, Fung, & Isaacowitz, 2011). In addition to the possibility that distraction may increase OA sensitivity to negative cues, the motivation to be accurate may also do so. Instructions that emphasize accurate judgments reduced the OA positivity bias on a memory task (Kennedy, Mather, & Carstensen, 2004), and self-reported engagement in an impression task increased OA sensitivity to the strength of arguments that supported the attribution of guilt to an accused criminal (Hess, Leclerc, Swaim, & Weatherbee, 2009). Extrapolating these results to the present study suggests that instructions emphasizing that impressions of aggressiveness can be accurate may increase OA sensitivity to diagnostic facial cues, even if negatively valenced.

We predicted that OA ratings of aggressiveness would be less accurate than those of YA. We further predicted that age differences in accuracy would be more pronounced in a control condition than in a high distraction, automatic processing condition, or a condition emphasizing the accuracy of judgments.

Method

Participants.—Fifty-six YA student participants (26 men) aged 18–25 ($M = 20.2$, $SD = 1.6$) and 51 community-dwelling OA participants (23 men) aged 65–90 ($M = 75.6$, $SD = 6.4$) were randomly assigned to the control condition ($N = 32$, 16 OA), the distraction condition ($N = 32$, 16 OA), or the accuracy condition ($N = 43$, 19 OA). YA were paid $20 and OA were paid $25. OA were screened using the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975), all scoring above 26 out of 30 ($M = 28.3$, $SD = 4.3$).

Stimuli.—Twenty-four photographs of Caucasian young men ($M = 19.1$ years, $SD = 1.4$ years) were obtained from the stimulus set of Carré and colleagues (2009). We used these faces because perceptions of their aggressiveness had been documented with YA judges (Carré et al., 2009; Geniole, Keyes, Mondloch, Carré, & McCormick, 2012) and because the validity of facial width-to-height ratio (FWHR) as a cue to variations in aggressiveness of these faces had been previously established (Carré & McCormick, 2008). Thus, this set of faces, albeit small, was appropriate both for investigating age differences and for determining whether the effects of FWHR were independent of other facial cues with which it is correlated.

Experimental conditions.—

Control. Participants were told that they would be asked to rate a series of faces. They were further told not to be concerned about whether their judgments were right or wrong and to rate each face based only on their first impression.

Distraction. This condition was identical to the control condition except that a random three-digit number appeared in the middle of the screen for 1 s prior to the appearance of each face. Participants were asked to count backward out loud from that number by three while they viewed the face and to stop counting when the rating scale appeared.

Accuracy. Participants were told that the men they would be rating had all participated in a game. The Point Subtraction Aggression Paradigm described earlier was explained to them, and they were informed that "men who stole lots of points are considered more aggressive than men who did not steal many points." In addition, they were told: "As you are rating these men, please keep in mind that they actually do vary in how aggressive they were when provoked, and judge as accurately as you can."

Dependent measures.—

Actual aggressiveness. The tendency to engage in aggressive behavior shown by the men whose faces were rated had been previously quantified in the Point Subtraction Aggression Paradigm (Carré & McCormick, 2008).

Face ratings. Following the procedure employed by Carré and colleagues (2009), participants were asked to rate how aggressive a person would be if provoked on 7-point scales with end points labeled 1 (*not at all* aggressive) and 7 (*very* aggressive).

Control measures. Several control measures were administered to determine whether any age differences in the accuracy of judging aggressiveness could be attributed to age differences in emotional state, visual abilities, or cognitive function. These included measures assessing visual acuity (Shellen Eye Chart); contrast sensitivity (Mars Letter Contrast Sensitivity Test, Mars Perceptrix, Chappaqua, NY); color vision (Ishihara's Tests for Color Deficiency, Ishihara, 2010); and facial recognition ability (Benton Facial Recognition Test, Benton, Van Allen, Hamsher, & Levin, 1983). Measures of general cognitive and executive abilities included the Shipley Vocabulary Test assessing crystallized intelligence (Shipley, 1946); a timed Pattern Comparison Task assessing processing speed (Salthouse, 1993); a short-form 48-item computerized version of the Wisconsin Card Sort Task assessing executive functioning (the Berg Card Sort Task [BCST] downloaded from http://pebl.sourceforge.net/battery.html and validated by Piper et al., 2012); and the Mind in the Eyes Test assessing the ability to read mental states from variations in the appearance of the eye region (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). Participants also completed a computerized version of the Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988).

*Procedure.—*After obtaining informed consent, participants were seated in front of a computer screen. They first completed a computerized version of the PANAS (Watson et al., 1988). Next, MediaLab software (Empirisoft, New York City, NY) was used to present the trait-rating task. Participants read instructions appropriate for the experimental condition to which they had been assigned on the computer screen. Each face was presented for 3 s after which a rating scale appeared. In the control condition, the face remained on the screen while the rating was made. In the distraction and the accuracy conditions, the face disappeared when the rating scale appeared. Once participants made their rating, a new face was shown. Upon completion of the face rating task, participants completed the BCST and a computerized version of the Eyes Test and then completed the remaining control measures as well as a demographic and health questionnaire.

Results

*Overview of analyses.—*Analyses were performed at the level of individual participant. We computed accuracy coefficients for aggressiveness by correlating each participant's judgments with the men's actual scores. These coefficients were normalized using a Fisher Z transformation for use in inferential statistics (see Franklin & Adams, 2009). The accuracy coefficients were then submitted to a 2 (participant age) × 3 (experimental condition) analysis of variance. We also performed t tests to determine whether accuracy differed from zero. Mean accuracy coefficients are reported as r values for display. Because these means are averaged across many independent z-transformed correlations, they should be regarded like mean effect sizes in a meta-analysis rather than a single correlation effect.

*Accuracy.—*The main effect of participant age was not significant ($F_{(1,101)} = 0.26$, $p = .614$, partial $\eta^2 = 0.003$), and the accuracy coefficients differed significantly from zero both for YA ($M = 0.23$, $SD = 0.20$; $t_{(55)} = 8.53$, $p < .001$, $d = 1.14$) and OA ($M = 0.20$, $SD = 0.18$; $t_{(50)} = 8.20$, $p < .001$, $d = 1.15$). The main effect of condition also was not significant ($F_{(2,101)} = 0.66$, $p = .520$, partial $\eta^2 = 0.013$), and the accuracy coefficients differed significantly from zero in the control condition ($M = 0.22$, $SD = 0.18$; $t_{(31)} = 6.82$, $p < .001$, $d = 1.21$), the distraction condition ($M = 0.18$, $SD = 0.20$; $t_{(31)} = 5.20$, $p < .001$, $d = 0.92$), and the accuracy condition ($M = 0.24$, $SD = 0.19$; $t_{(42)} = 8.36$, $p < .001$, $d = 1.28$). Although the interaction between age and condition was not significant ($F_{(2,101)} = 1.65$, $p = .198$, partial $\eta^2 = 0.032$), we performed planned comparisons to test the specific hypotheses. There were no significant differences in OA accuracy across conditions (all ps > .567, ds ≤ 0.19), whereas YA showed marginally less accuracy in the distraction condition than in either the control condition ($p = .098$, $d = 0.56$) or the accuracy condition ($p = .051$, $d = 0.58$), which did not differ ($p = .884$, $d = 0.05$). Finally, comparisons between OA and YA within each condition revealed no significant differences (all ps > .244, ds ≤ 0.39).

*Control data analyses.—*Because there were no age differences in the accuracy of judging the aggressiveness of men from their faces that our control measures might explain, we report the control data primarily to establish that our OA sample is typical of community-dwelling OA. There were no significant age × condition effects, indicating that age differences on the control variables were the same for participants across conditions. We have therefore reported the age differences collapsed across conditions (see Table 1).

Table 1. YA and OA Scores on Control Measures in Study 1

	YA		OA		Age		Condition		Age × condition	
Measure	*M*	*SD*	*M*	*SD*	*F* Value	*p* Value	*F* Value	*p* Value	*F* Value	*p* Value
Snellen Visual Acuity (denominator)	24.05	1.85	35.08	1.91	17.14	<.001	0.42	.658	1.82	.167
Mars Letter Contrast Sensitivity	1.70	0.03	1.57	0.03	9.86	.002	0.64	.527	0.17	.843
Benton Facial Recognition Test	46.62	0.56	45.75	0.58	1.18	.280	0.46	.630	1.76	.177
Pattern Comparison Test	43.21	0.89	26.58	0.92	170.29	<.001	0.40	.669	0.99	.374
Shipley Vocabulary Test	33.34	0.49	34.95	0.50	5.25	.024	3.68	.029	1.20	.307
PANAS positive affect	29.28	0.93	34.59	0.96	15.68	<.001	0.44	.643	0.39	.680
PANAS negative affect	15.31	0.52	12.16	0.53	18.05	<.001	3.06	.052	2.25	.110
Mind in Eye Test	25.11	0.94	25.20	0.97	<0.01	.950	3.63	.030	1.32	.272
BCST correct responses	34.92	1.49	25.49	1.54	19.43	<.001	1.90	.155	2.52	.085
BCST perseverative errors	5.15	0.77	8.24	0.80	7.82	.006	0.08	.925	1.64	.199
BCST nonperseverative errors	4.60	1.08	13.43	1.11	32.45	<.001	2.09	.129	2.66	.075

Notes. BCST = Berg Card Sort Task; OA = older adults; PANAS = Positive and Negative Affect Scale; YA = younger adults.

Discussion

OA, like YA, showed accuracy in their impressions of the aggressiveness of men depicted with neutral expression faces. More specifically, both age groups showed an above-chance ability to differentiate the relative standing of men on aggressiveness simply from their facial appearance. It should be recalled that the reported accuracy coefficients are effect sizes, averaging across the correlations between perceived and actual traits shown by participants of each age, and these effect sizes were large for both OA and YA.

Whereas the results for YA are consistent with previous research, this is the first evidence for OA accuracy in judging aggressiveness from faces. Moreover, participants showed accuracy in judging aggressiveness in a control condition, a distraction condition that required relatively automatic processing of the faces, and an accuracy motivation condition, with no significant moderation by rater age. The possibility of controlled processing of attention away from negative cues by OA in the control condition had led us to expect a greater age difference in that condition than in the distraction condition, which would interfere with such controlled processing. Indeed, OA in the present study showed more positive affect and less negative affect on the PANAS (Table 1), a positivity effect that has been associated with OA greater avoidance of negative stimuli (Isaacowitz et al., 2006; Mather & Carstensen, 2003). However, this did not reduce their accuracy in judging variations in the men's aggressiveness compared with YA. Increasing the motivation to be accurate also did not have a significant effect on accuracy. This pattern of results suggests that the task engaged automatic processing of the facial information across all three conditions. Such a mechanism is consistent with the finding that YA showed accurate impressions of the aggressiveness of the faces used in the present study when the photographs were shown for only 39 ms (Carré et al., 2009). Automaticity also has been demonstrated in other research investigating trait impressions from faces without regard to accuracy. Specifically, YA impressions of threatening traits at very brief exposures are highly correlated with their impressions in the absence of time constraints (Bar, Neta, & Linz, 2006; Todorov, Pakrashi, & Oosterhof, 2009; Willis & Todorov, 2006).

The argument that the present task engaged automatic processing is consistent with the absence of age differences in recognizing variations in aggressiveness because early processing of information tends to be similar in OA and YA, with the OA positivity bias most apparent when information processing is sufficient to enable emotion regulation (Isaacowitz, Allard, Murphy, & Schlangel, 2009; Mather & Knight, 2005; Petrican et al., 2013). Although one might suggest instead that the OA positivity bias was not elicited in the present study because the neutral faces did not engage emotion regulation, previous research did reveal an OA positivity bias in impressions of the hostility and unstrustworthiness of neutral expression faces (Zebrowitz et al., 2013). At the same time, OA and YA showed high agreement in these impressions. That agreement parallels the age equivalence in accuracy in the present study and underscores the fact that an OA positivity bias in impressions does not necessarily imply lower accuracy in detecting relative variations in threat across faces.

Study 2

Having demonstrated that OA, like YA, show accuracy in judging aggressiveness from faces, Study 2 investigated the facial qualities that each group uses to form their impressions and the facial qualities that are valid indicators of aggressiveness for each. More specifically, we used a lens model (Brunswik, 1956) to assess the utilization and validity of measured FWHR and rated facial appearance qualities (resemblance to anger, facial unattractiveness, facial masculinity, and facial maturity). Although we have attributed the lack of age differences in recognizing variations in aggressiveness in Study 1 to the engagement of automatic processes that undercut the OA positivity bias, it is also possible that the two age groups use different cues to achieve accuracy, with YA using more negatively valenced cues than OA do.

Research demonstrating YA accuracy in judging aggressiveness from faces has focused on FWHR as a diagnostic cue (Carré et al., 2009). FWHR is measured by dividing the distance between the left and right zygion (bizygomatic width) by the distance between the upper lip and midbrow (upper facial height; Weston, Friday, & Lio, 2007). Facial structure changes in response to testosterone (Verdonck, Gaethofs, Carels, & de Zegher, 1999), a hormone that contributes to higher levels of aggression and violence (Dabbs, 2000). Thus, FWHR may be a valid cue to aggressiveness because the neural circuitry underlying social behavior (Sick, Schulz, & Zehr, 2003) and facial structure (Weston et al., 2007) is shaped by rising testosterone concentrations at puberty. Indeed, FWHR has been positively correlated not only with observed behavioral aggressiveness (Carré & McCormick, 2008; Carré, Morrissey, Mondloch, & McCormick, 2010; but see Deaner, Goetz, Shattuck, & Schnotala, 2012) but also with other antisocial behaviors, including deceitfulness and cheating (Haselhuhn & Wong, 2012) and exploiting the trust of others (Stirrat & Perrett, 2010; Experiment 1).

Not only is FWHR a valid cue to aggressiveness but also separate experiments have shown that it is positively correlated with YA perceptions of aggressiveness (Carré et al., 2009) as well as untrustworthiness (Stirrat & Perrett, 2010; Experiment 2). Study 2 adds to the FWHR literature in two ways. First, we used the same set of faces to examine both the utilization of FWHR to judge aggressiveness and the validity of FWHR as an indicator of aggressiveness. Second, we examined the contribution of FWHR to accuracy in judging aggressiveness while controlling several other facial qualities with which it may be correlated.

A higher FWHR may convey aggressiveness to perceivers because it covaries with facial attractiveness, resemblance to anger, masculinity, or maturity. Moreover, these facial qualities also may be associated with variations in actual aggressiveness. Consistent with this possibility, research has found that FWHR is negatively correlated with attractiveness (Stirrat & Perrett, 2010), and less attractive people are judged to be more aggressive (Zebrowitz, Bronstad, & Lee, 2007). Although variations in attractiveness could therefore account for the tendency to attribute more antisocial traits to those high in FWHR, Stirrat and Perrett (2010) found that attractiveness and FWHR each had an independent effect on the perceived trustworthiness of faces. Research has not investigated whether the relationship between FWHR and actual aggressiveness is independent of attractiveness, and the present study will fill this gap in the literature.

FWHR also covaries with resemblance to anger, as decreasing the distance between the brow and lip in emotionally neutral faces, which would increase FWHR, increases the perception of anger (Neth & Martinez, 2009). In addition, neutral expression faces that show more objective resemblance to anger are perceived as more aggressive and hostile (Said, Sebe, & Todorov, 2009; Zebrowitz, Kikuchi, & Fellous, 2010), and one study suggests that resemblance to anger may be a valid cue to aggressiveness: Older women whose neutral expression faces looked more angry had more hostile personalities (Malatesta et al., 1987).

FWHR also may convey aggressiveness because it covaries with facial masculinity, as some research has found a higher FWHR in male than female faces (Weston et al., 2007; but see Lefevre et al., 2012), and people use facial masculinity when making judgments about a proclivity for violence (Stillman, Maner, & Baumeister, 2010). Inasmuch as perceived facial masculinity and facial maturity are positively correlated (Boothroyd et al., 2005; Pivonkova, Rubesova, Lindova, & Havlicek, 2011), FWHR also may covary with higher facial maturity, which is associated with perceptions of greater threat (Berry & McArthur, 1985; Franklin & Zebrowitz, 2013).

Although we know that use of variations in FWHR foster accurate YA impressions of aggressiveness when judging the faces used by Carré & McCormick (2008), it is uncertain whether this will also be true for OA. In addition, previous research has not examined whether low attractiveness, high anger resemblance, facial masculinity, or facial maturity provide valid cues to the men's aggressiveness. Thus, we can only predict that if any of these cues are diagnostic of aggressiveness, the negatively valenced facial qualities of low attractiveness and high resemblance to anger should have a stronger impact on YA than OA if a positivity bias is deflecting OA attention from these cues.

Method

The method was identical to the accuracy condition in Study 1 with the following modifications.

Participants.—Participants included those in the accuracy condition in Study 1 plus an additional 16 YA student participants (8 men) aged 18–21 (M = 18.8, SD = 0.91) and 16 community-dwelling OA participants (8 men) aged 65–93 (M = 75.6, SD = 7.3). YA were given course credit or \$15 payment; OA were paid \$25. OA were screened using the MMSE (Folstein et al., 1975), and all scored above 26 out of 30 (M = 28.6, SD = 1.3).

Dependent measures.—

Facial width-to-height ratio. FWHR, measured using NIH ImageJ software and the landmarks originally used by Weston and colleagues (2007), was taken from Carré and McCormick (2008). Specifically, the distance between the left and right zygion (bizygomatic width) was divided by the distance between the upper lip and midbrow (upper facial height).

Face ratings. In addition to rating aggressiveness as described in Study 1, participants rated how attractive, babyfaced (both reverse scored), angry, and masculine each face looked using 7-point scales with end points labeled "*not at all*" and "*very.*" (After rating the current set of faces on aggressiveness, the additional 32 participants in Study 2 rated them on manipulativeness and trustworthiness and then rated a different set of 120 male and female faces on trustworthiness, hostility, naïvete, and warmth for a separate study. Participants then rated all faces on attractiveness and babyfaceness, beginning with the current set of faces with the order of these qualities counterbalanced, followed by ratings of the current set of faces on masculinity, resemblance to anger, and dominance.)

Procedure.—The participants added for this study did not receive the accuracy manipulation. Rather, they were told to just give their first impressions as in the Study 1 control condition.

Results

Overview of analyses.—As shown in Table 2, there were many significant correlations among the facial appearance ratings. To assess the independent influence of each facial cue, we regressed on each facial appearance rating the other three rated facial appearance cues and FWHR to obtain the residual (e.g., anger resemblance, controlling facial attractiveness, masculinity, maturity, and FWHR). We also regressed the four appearance ratings by OA or YA on FWHR scores, and used the residual to test the utilization and validity of FWHR independent of the rated cues.

The validity and utilization of various facial qualities for judging aggressiveness as well as the accuracy of judgments were assessed separately for YA and OA. As in Study 1, we computed an accuracy coefficient for each participant by correlating the participant's ratings of the faces with the measured aggression scores. Cue utilization was assessed by correlations between each participant's ratings of how aggressive, attractive (reverse scored), masculine, and babyfaced (reverse scored) each face looked with their ratings of the faces' aggressiveness. Cue validity was assessed by correlations between each participant's face ratings and the measured aggressiveness of the faces. Finally, we assessed utilization and validity of residualized FWHR by correlating it with ratings of aggressiveness and measured aggressiveness, respectively. The foregoing correlations for each participant were transformed using a Fisher *Z* transformation to normalize them for use in inferential statistics. Adapting the Brunswik (1955) lens model, the bottom path in Figure 1 shows accuracy; the paths on the left of the model show cue utilization; the paths on the right of the model show cue validity—the relationships between facial qualities and actual aggression. YA coefficients are shown above the lines, and OA coefficients are shown below. Correlations are presented as *r* values for display.

Accuracy.—Replicating Study 1, the correlation between rated and actual aggressiveness for the new participants was significant for both YA ($t_{(15)} = 3.23$, $p = .006$, $d = 0.81$) and OA ($t_{(15)} = 3.30$, $p = .005$, $d = 0.83$), with no difference between the age groups ($t_{(30)} = 0.14$, $p = .888$, $d = 0.03$). As the accuracy scores of YA and OA did not differ significantly from the accuracy shown by participants in accuracy condition from

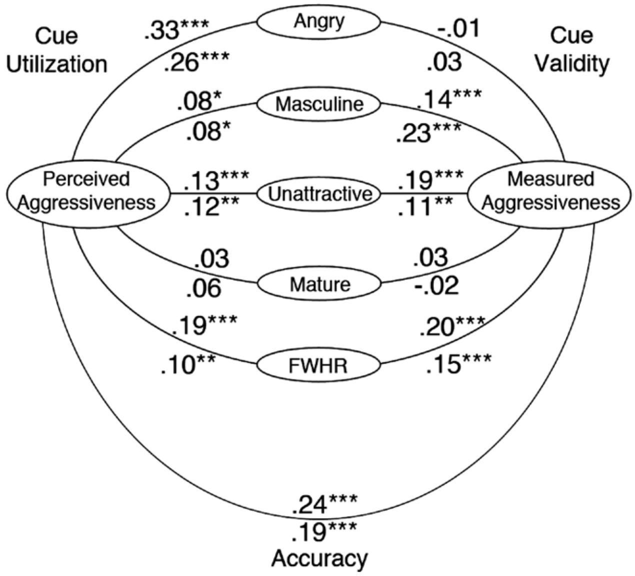

Figure 1. Accuracy, cue utilization, and cue validity for ratings of aggressiveness by younger adults (correlations shown above the lines) and older adults (correlations shown below the lines) in Study 2. *p < .05, **p < .01, ***p < .001.

Table 2. Zero-Order Correlations Among Rated Aggressiveness and All Facial Qualities for YA (Values Above the Diagonal) and OA (Values Below the Diagonal)

	Aggressive	Angry	Unattractive	Masculine	Mature	FWHR
Aggressive	1.00	.91***	.65**	.60**	.37+	.73***
Angry	.93***	1.00	.60**	.55**	.43*	.56**
Unattractive	.77***	.72***	1.00	.13	.37+	.47*
Masculine	.65**	.70***	.58**	1.00	.59**	.30
Mature[a]	.65**	.69***	.76***	.56**	1.00	−.10
FWHR	.47*	.45*	.32	.41*	−.09	1.00

Notes. FWHR = facial width-to-height ratio; OA = older adults; YA = younger adults.
[a]We use the label "mature" instead of "babyfaced" for ease of exposition so that higher values on all facial qualities are associated with higher perceived aggressiveness.
+p < .1. *p < .05. **p < .01. ***p < .001.

Study 1 (YA: $p = .284$, $d = 0.39$; OA: $p = .651$, $d = 0.19$), we combined the two sets of data for the remaining analyses.

Utilization and validity of facial cues.—As shown in Figure 1, both YA and OA ratings of aggressiveness utilized the residualized ratings of anger resemblance (YA: $t_{(44)} = 13.46$, $p < .001$, $d = 2.01$; OA: $t_{(34)} = 6.96$, $p < .001$, $d = 1.18$), unattractiveness (YA: $t_{(44)} = 4.98$, $p < .001$, $d = 0.74$; OA: $t_{(34)} = 3.50$, $p = .001$, $d = 0.59$), masculinity (YA: $t_{(44)} = 2.04$, $p = .048$, $d = 0.30$; OA: $t_{(34)} = 2.05$, $p = .048$, $d = 0.35$), as well as the residualized FWHR (YA: $t_{(44)} = 6.94$, $p < .001$, $d = 1.03$; OA: $t_{(34)} = 2.74$, $p = .009$, $d = 0.46$), whereas neither age group utilized maturity (YA: $t_{(44)} = 1.31$, $p = .196$, $d = 0.20$; OA: $t_{(34)} = 1.61$, $p = .118$, $d = 0.27$). The only significant age difference in cue utilization was that YA showed significantly greater utilization of FWHR ($t_{(78)} = 2.06$, $p = .043$, $d = 0.47$).

Lower attractiveness ratings by both YA and OA provided a valid cue to actual aggressiveness (YA: $t_{(44)} = 6.59$, $p < .001$, $d = 0.98$; OA: $t_{(34)} = 3.09$, $p = .004$, $d = 0.52$), although, as predicted, validity was marginally greater for YA ($t_{(78)} = 1.82$, $p = .072$, $d = 0.41$). Higher masculinity ratings by both age groups also provided a valid cue to actual aggressiveness (YA: $t_{(44)} = 4.46$, $p < .001$, $d = 0.66$; OA: $t_{(34)} = 7.66$, $p < .001$, $d = 1.29$), with validity marginally greater for OA ($t_{(78)} = 1.88$, $p = .064$, $d = 0.43$). A larger FWHR was also a valid cue to aggressiveness for YA ($t_{(44)} = 7.86$, $p < .001$, $d = 1.17$) and OA ($t_{(34)} = 4.93$, $p < .001$, $d = 0.83$) with no significant age difference ($t_{(78)} = 1.18$, $p = .241$, $d = 0.27$). Neither maturity (YA: $t_{(44)} = 0.96$, $p = .342$, $d = 0.14$; OA: $t_{(34)} = 0.52$, $p = .607$, $d = 0.09$) nor anger resemblance (YA: $t_{(44)} = 0.32$, $p = .749$, $d = 0.05$; OA: $t_{(34)} = 0.76$, $p = .454$, $d = 0.13$) was a valid cue for either of the age groups. (The FWHR validity coefficients differ for OA and YA because they are residualized based on each age group's face ratings. The control measure results for Study 2 were identical to Study 1 except that there were no age differences in contrast sensitivity (Mars Letter Contrast Sensitivity Test), and YA performed better on Benton Facial Recognition Test.)

Discussion

Replicating Study 1, the new OA and YA participants in Study 2 showed accurate impressions of aggressiveness from neutral expression faces, with no significant age differences. Study 2 adds to Study 1 by revealing the particular facial cues that OA and YA utilize when judging aggressiveness and which ones are valid.

Cue utilization and cue validity were generally similar for YA and OA. Both age groups utilized FWHR, anger resemblance, attractiveness, and masculinity. Valid cues for both groups included a larger FWHR as well as their perceptions of lower attractiveness and higher masculinity. Anger resemblance was not a valid predictor of actual aggressiveness for either group even though it was utilized, and facial maturity (low babyfaceness) was neither utilized nor valid for either group. Because we used residualized measures, these results demonstrate that the utilization and validity of FWHR as a cue to aggressiveness demonstrated in previous research (Carré & McCormick, 2008; Carré et al., 2009) was not due to its covariation with these other facial qualities, consistent with recent evidence that FWHR accounted for unique variability in ratings of aggression over and above attractiveness and masculinity (Geniole et al., 2012).

Despite overall similarities across age groups, the validity of the facial qualities differed marginally for YA and OA. In particular, the validity of low attractiveness was marginally greater when rated by YA than OA, and the validity of high masculinity was marginally greater when rated by OA than YA. It is noteworthy that attractiveness varies in valence, with low levels a negatively valenced quality, whereas masculinity varies in power, another important dimension on which people are judged (Fiske, Cuddy, & Glick, 2007; Oosterhof & Todorov, 2008; Rosenberg, Nelson, & Vivekananthan, 1968). Thus, the finding that OA accuracy judging aggressiveness from faces reflected their assessments of facial masculinity more than unattractiveness seems consistent with other evidence that OA social judgments are less responsive to negatively valenced stimulus information (Castle et al., 2012; Ruffman, Murray, Halberstadt, & Vater, 2012; Zebrowitz et al., 2013). On the other hand, it also should be noted that OA utilized the negative cue of anger resemblance when rating aggressiveness to the same extent as YA, although these ratings were not valid cues to actual aggressiveness for either group.

The validity of FWHR as a cue to aggressiveness is consistent with previous arguments that it is a testosterone marker (Verdonck et al., 1999; Weston et al., 2007), as testosterone contributes to higher levels of aggression (Dabbs, 2000). The fact that FWHR was a valid cue to aggressiveness even when controlling facial attractiveness, resemblance to anger, maturity, and masculinity strengthens previous evidence for the diagnosticity of FWHR. Specifically, controlling these ratings effectively removes variance associated with other cues that can signal aggressiveness, like lower eyebrows and larger jaws, and thus examines variance unique to FWHR. At the same time, the independent effects of low attractiveness and high masculinity indicate that there are other mechanisms that may yield honest indicators of aggression in the face. Perhaps the negative appearance of unattractive men has elicited negative treatment from others that heightens reactive aggression in a situation where they feel mistreated, and the powerful-looking appearance of masculine men may have taught them that they can exhibit aggressive behavior with relative impunity.

Conclusions

OA and YA showed equal accuracy in their impressions of the aggressiveness of young men based only on their neutral expression faces. Accuracy was not moderated by distraction or accuracy motivation, suggesting that it reflected automatic processing, which is implicated in YA trait impressions from faces (Bar et al., 2006; Carré et al., 2009; Todorov et al., 2009; Willis & Todorov, 2006) and has been shown to be relatively preserved in aging (Mather & Knight, 2006). YA and OA used the same facial cues to judge aggressiveness, although YA showed significantly greater use of FWHR. The face ratings that were valid cues to actual aggressiveness also were the same for YA and OA, although YA attractiveness ratings provided a marginally more valid cue than those of OA, and OA masculinity ratings provided a marginally more valid cue than those of YA. Our results provide an important caveat to the conclusion that OA positivity biases place them at risk for failing to recognize dangerous people (Castle et al., 2012). OA can be just as accurate as YA when it comes to discerning the relative aggressiveness of young men. Whether they use this information to engage in adaptive social interactions is another question that would be worthy of study.

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