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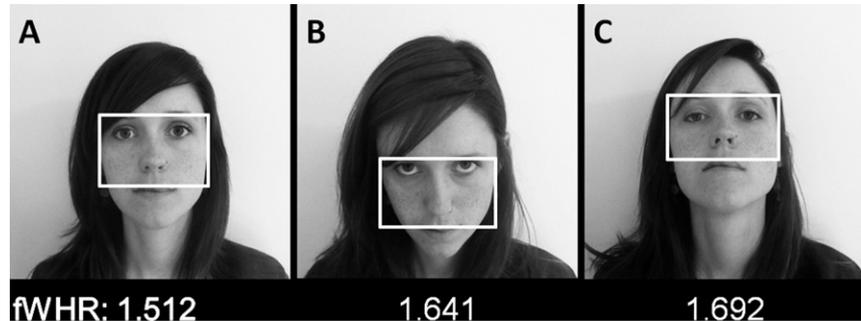
Enhancing static facial features increases intimidation

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HIGHLIGHTS

- Faces that are tilted upward or downward are perceived as more intimidating.
- Tilting one's face increases one's facial width-to-height ratio (fWHR).
- Individuals spontaneously increase their fWHR to appear intimidating.

GRAPHICAL ABSTRACT



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ABSTRACT

Previous research has established that a face's width-to-height ratio (fWHR) is pivotal in influencing observer evaluations, as individuals with a high fWHR are perceived as intimidating along multiple dimensions. Specifically, high-fWHR individuals are considered untrustworthy, aggressive, and prejudiced. Unlike other facial features involved in intimidation, fWHR is dependent upon bone structure and thus static. The current research examines whether individuals, in an effort to appear more intimidating, increase their perceived fWHR by manipulating the angle at which their faces are viewed. In Study 1, participants spontaneously posing as "intimidating" for photos had a greater fWHR compared to when they posed for a baseline photo. Additionally, individuals with smaller baseline fWHRs, who would be particularly likely to benefit from augmenting their perceived fWHR, increased their fWHR more than individuals with larger fWHRs by tilting their heads more sharply. In Study 2 participants evaluated targets posed with their faces tilted or non-tilted. When targets were presented with their faces tilted they were evaluated as more intimidating than non-tilted baseline photos of the same target. This effect was greater for targets with larger baseline fWHRs. Up- or down-tilt and target gender differentially moderated this relationship. The current research presents evidence that individuals behaviorally manipulate their perceived fWHR in order to appear more intimidating.

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Introduction

A behavior consistent across many species is to increase apparent physical size to be more intimidating. Feline hair stands on end, frilled lizards extend their frills, and bears rear up on their hind legs to appear more physically imposing. These expressions of dominance can intimidate would be challengers, thereby protecting an individual's

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access to valuable resources without need for physical confrontation (Guilford, 1987). As a form of protection, prey species sometimes intimidate potential predators by either looking or acting similar to more dangerous species, a phenomenon known as Batesian mimicry (Bates, 1862). The current study examines a potential variant of Batesian mimicry in humans, whereby individuals manipulate their face in order to appear more intimidating.

Signals conveying power and dominance in humans can be dynamic or static. For instance, the All Blacks, a New Zealand rugby team, have popularized a Maori war dance by performing it prior to matches. This dance was originally intended to physically intimidate opposing tribal groups (Jackson & McRobie, 2005) and can involve vigorous yelling, leaps, and stomps. Research has demonstrated that various elements of this dance, such as angry facial expressions (Dunning, Auriemma, Castille, & Hajcak, 2010; Stins et al., 2011) and expansive body posture (Carney, Cuddy, & Yap, 2010; Huang, Galinsky, Gruenfeld, & Guillory, 2011) are associated with perceptions of power and intimidate others. These signals of dominance are dynamic, easily manipulated or enhanced by the acting individual. There are other features associated with perceived intimidation, however, that are more static. The current research focuses on one of these features, the width-to-height ratio of a face (fWHR), and how the manner in which individuals present themselves can influence perceptions of intimidation.

Facial width-to-height ratio

fWHR is a face's bizygomatic width (i.e., the distance between the left and right zygion, or cheekbones) divided by the upper facial height (i.e., the distance between the upper lip and mid-brow). Some have speculated that fWHR may act as an "honest signal" of testosterone levels in males (Carré, McCormick, & Mondloch, 2009), since adolescent testosterone is related to human male cranial growth (Verdonck, Gaethofs, Carels, & de Zegher, 1999), and a high testosterone-to-estrogen ratio facilitates lateral bone growth, including the cheek-bones, mandibles, chin, and forward growth of eye-brow ridges (Enlow, 1996; Farkas, 1994).

A spate of recent research has demonstrated that individuals with a high fWHR are perceived rather negatively on multiple dimensions. For instance, greater fWHR males were evaluated as more likely to be aggressive (Carré et al., 2009; Geniole, Keyes, Mondloch, Carré, & McCormick, 2012; Short et al., 2012), untrustworthy (Stirrat & Perrett, 2010), and racially-prejudiced (Hehman, Leitner, Deegan, & Gaertner, 2013) than their thinner-faced peers. Importantly, these evaluations are not random or incorrect, as fWHR is indeed positively correlated with greater reactive aggression (Carré & McCormick, 2008; Deaner, Goetz, Shattuck, & Schnotala, 2012),¹ feelings of personal power (Haselhuhn & Wong, 2012), untrustworthiness (Stirrat & Perrett, 2010), and racial-prejudice (Hehman et al., 2013).

Humans may have developed this sensitivity to fWHR in order to avoid the physical danger or loss of resources represented by greater fWHR individuals. Indeed, recent research indicates that wider-faced men may be particularly dangerous in combative situations. For instance, as compared to men with more narrow faces, wider faced men of the Namibian !Kung San had been involved in a greater degree of violence (Christiansen & Winkler, 1992). Furthermore, a forensic sample found that men with greater fWHR were less likely to have been killed by physical contact violence such as stabbings and strangulations (Stirrat, Stulp, & Pollet, 2012). Demonstrating behaviors adaptive to competitive contexts, though greater fWHR males are typically less interpersonally cooperative, they were more likely to sacrifice for and cooperate with ingroup members during intergroup

competition (Stirrat & Perrett, 2012). Finally, neurological work has demonstrated that amygdala reactivity to social challenge is positively correlated with self-reported aggression only in high fWHR males (Carré, Murphy, & Hariri, 2013). Thus, evidence from multiple lines of research converge in indicating that greater fWHR individuals may be more dangerous in social contexts in which they are challenged, and therefore may be perceived as more intimidating.

There are important advantages to appearing physically intimidating. For instance, previous work has speculated that greater fWHR intimidates others, thereby reducing challenges for important resources or retribution for aggressive actions (Stirrat & Perrett, 2010). In order to similarly attain or increase these advantages, individuals might sometimes wish to appear as more physically intimidating. Therefore, just as non-venomous snakes may come to resemble their deadly counterparts, individuals might sometimes behave so as to be perceived with a greater fWHR, and consequently, as more intimidating.

The current research

As fWHR is a static facial feature dependent on the underlying bone structure, the current research examines whether individuals might appear more physically intimidating by manipulating the angle at which their face is perceived (i.e., "tilting" it upwards or downwards). By rotating one's face upward/downward, one decreases the perceived distance between the upper lip and mid-brow component of fWHR while maintaining bizygomatic width, thereby increasing perceived fWHR (Fig. 1).

Anecdotal evidence for the relationship between tilted faces and intimidation exists in the form of various cultural products. Movie, comic book, or video game artwork frequently displays a hero or villain with a tilted face (Fig. 2). These characters may be presented in this manner because tilted faces, compared to non-tilted, appear more physically intimidating. However, these observations have yet to be examined in any systematic manner.

Previous research has examined how the angle of a target's face influences various other judgments, however. For instance, downward and upward head tilts increase perceptions of facial femininity and masculinity, respectively (Burke & Sulikowski, 2010). Additionally, targets with faces perceived at an upward tilt are estimated to be heavier than targets perceived at a downward tilt (Schneider, Hecht, & Carbon, 2012). While perceived weight may be involved in evaluations of intimidation, this previous research provides little information regarding the direct effect of head tilt on intimidation since these targets were presented with averted eye gaze. Averted eye gaze negates the attention capturing effects of angry facial expressions (Adams & Kleck, 2003), while direct gaze increases the perceived dominance of individuals (Burgoon, Coker, & Coker, 1986). Indeed, individuals were sensitive to dominant, masculine facial features only when targets were presented with direct eye gaze (Main, Jones, DeBruine, & Little, 2009). Given that direct gaze is a necessary component for perceived intimidation, whether head tilt influences perceptions of intimidation remains an unanswered question.

Furthermore, as smaller fWHR individuals might naturally appear less intimidating than larger fWHR individuals, smaller fWHR individuals might gain a greater advantage by manipulating their perceived fWHR, and thus have greater motivation to enhance their perceived fWHR. Larger fWHR individuals might have less of a need to or less experience enhancing their perceived intimidation, and therefore be less likely than their thinner faced peers to increase their fWHR in situations where it might be advantageous.

To this end, the current research presents two studies examining the manipulation and subsequent perception of fWHR. In *Study 1*, we examined whether individuals spontaneously increased their baseline fWHR when attempting to appear more intimidating, and whether smaller fWHR individuals would do this more than greater fWHR individuals. In *Study 2*, we tested whether greater fWHR male

¹ Though self-reported aggression was not correlated with fWHR (Özener, 2012), and prisoners convicted of violent vs. non-violent crime did not differ in fWHR (Gómez-Valdés et al., 2013).

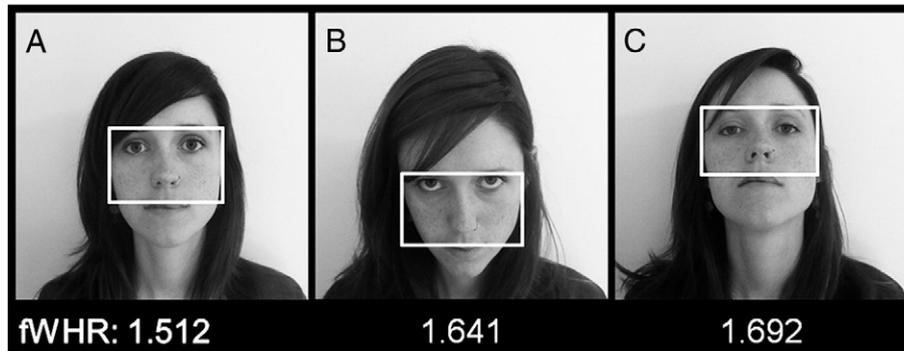


Fig. 1. Example A) Baseline, B) Down-tilted, and C) Up-tilted faces and corresponding fWHR. Note. Baseline, Down-, and Up-tilted images are angled at 0°, –30°, and 30°, respectively.

and female faces, due to upward or downward tilting, were perceived as more intimidating when controlling for all other characteristics of a face. Given the historically male role in physical aggression and dominance (Daly & Wilson, 1988), in each study we additionally explored whether fWHR manipulation and perception would vary by target and participant gender.

Study 1

Study 1 examined whether participants would spontaneously increase their fWHR when posing as intimidating. Participants posed for a photo in which they maintained a neutral expression, and then a photo in which they tried to appear intimidating. The fWHR of each face was coded and compared.

Method

Participants and design

Fifty-seven White participants (26 females) participated for partial course credit in a 2-level (Photo: Baseline, Intimidating) repeated measures design.

Procedure

Participants posed for two photos. A tripod-mounted camera was adjusted for each participant's height, centered on the nose-tip. After removing hats, glasses, or hair hanging in front of the face, participants stood against a wall two meters from the camera and were instructed to look directly at it while maintaining a neutral expression. Following this "Baseline" photo, participants were then given the following instructions for the "Intimidating" photo:

"For the next photo, we'd like you to try to appear as tough, dominating, or intimidating as possible, but without changing your facial expression. We are only taking a picture of your face, so again, without

changing your facial expression, please pose as intimidating-looking as possible."

For all photos, if participants made facial expressions, the instructions were repeated and another photo was taken.

Photo coding

Photos were flagged by raters, then inspected and removed from analysis by the authors, if emotional expressions were evident in either the baseline or intimidating photos ($n = 10$). The 94 photos of the remaining 47 participants were then coded for fWHR by raters blind to both the target condition and the hypotheses. Using Irfanview (Skiljan, 2011) and following the procedure used in previous studies (Carré et al., 2009) each face's bizygomatic width was divided by its upper facial height to estimate fWHR. Each rater saw faces in only one condition to maintain naiveté regarding the hypotheses. Each target was coded four times. fWHR was consistent across coders (Baseline faces: $\alpha = .85$; Intimidating faces: $\alpha = .82$) and ratings were averaged.

Results

Participants' fWHR in each condition was subjected to a 2(gender: male, female) \times 2(Photo: Baseline, Intimidating) mixed-model analysis of variance (ANOVA) with repeated measures on the second factor. Results revealed a single main effect of Photo in the expected direction, $F(1, 45) = 44.16, p < .001, \eta_p^2 = .50$. Participants in Intimidating photos ($M = 1.67, SD = .02$) displayed a greater fWHR than in Baseline photos ($M = 1.59, SD = .02$) (Fig. 3).

We had no a priori hypotheses regarding whether individuals would be more likely to tilt their faces upward or downward in the Intimidation condition, as both strategies would increase fWHR. Therefore, exploratory analyses addressed this question by comparing each



Fig. 2. Cultural products demonstrating fWHR-enhanced faces in A) the Star Trek movie B) X-Men comic book art and C) the Prince of Persia video game.

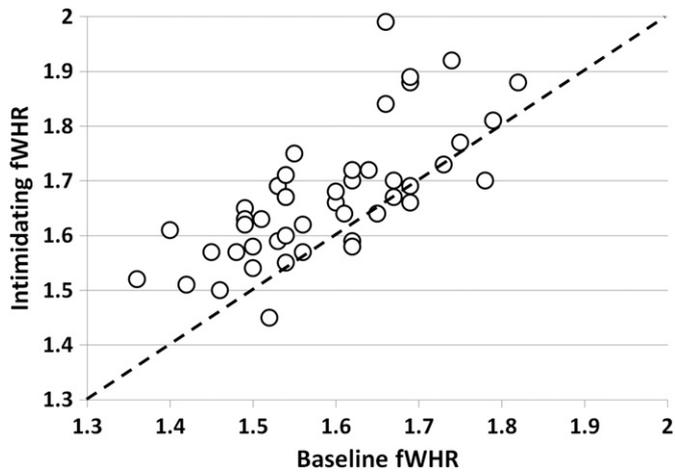


Fig. 3. Participants' fWHR in the Baseline condition with their corresponding fWHR in the Intimidating condition from Study 1. Note. Participants above the dashed line increased their fWHR from the Baseline to Intimidating condition, and those below decreased their fWHR from the Baseline to Intimidating condition.

"Intimidating" face to its "Baseline" counterpart. We adopted a conservative approach by only coding each Intimidating photo as "Up" or "Down" if a difference was clearly evident. A difference was evident for 68% of the sample, and of these photos, participants overwhelmingly tilted their faces downward (84%) as compared to upward (16%). Upward tilting was slightly more effective than downward tilting in increasing fWHR from Baseline, $F(1, 30) = 3.46, p = .073$. However, all those who tilted their heads upward were male.

We next examined whether Intimidation in each condition was influenced by gender and Baseline fWHR. Individuals with a smaller Baseline fWHR might exhibit a greater change in their perceived fWHR between Baseline and Intimidating conditions. As individuals who normally appear less intimidating might be particularly motivated to augment their fWHR through tilting, we expected that participants with smaller fWHR would show greater change in perceived fWHR between the two conditions. Accordingly, each participant's Baseline fWHR was subtracted from their Intimidating fWHR to create a difference score. A greater value on this difference score thus reflected a greater change in fWHR from Baseline to Intimidating conditions. This variable was then regressed on Baseline fWHR and participant gender. Relationships were not moderated by gender, nor were main effects for gender evident. Supporting our hypothesis, individuals with a smaller Baseline fWHR increased their perceived fWHR between Baseline and Intimidation conditions more so than individuals with larger Baseline fWHR ($\beta = -.308, p = .038$). Binary logistic regression revealed that Baseline fWHR did not predict whether participants noticeably tilted their heads, or not ($B = 2.086, SE = 3.04, p = .493$).

Discussion

Confirming our hypotheses, when asked to pose in an intimidating manner, participants in Study 1 spontaneously increased their fWHR. Additionally, individuals with smaller fWHRs especially compensated by increasing their fWHR more than individuals with greater fWHRs, but greater and smaller Baseline fWHR individuals were equally likely to tilt their heads. Considering these two results in conjunction indicates that fWHR affects not the likelihood of tilting one's head, but rather the degree to which the head is tilted among those who do so.

It is important to note that, mathematically, tilting increases fWHR differently for individuals with high and low Baseline fWHRs. For example, suppose two individuals, with fWHRs of 1.5 (6 width:4 height) and 2.0 (8 width:4 height) tilt their heads equally, reducing perceived

upper facial height by .5 units. The higher Baseline fWHR individual, now with a 2.29 fWHR (8 width:3.5 height), changes their perceived fWHR more so than the individual lower in Baseline fWHR, now with a 1.71 fWHR (6 width:3.5 height). Thus, for the same angle of tilt, the higher Baseline fWHR individual has increased their perceived fWHR by .08 units more than the lower Baseline fWHR individual. In light of this differential change, we posit that higher Baseline fWHR targets tilted their heads even less than the current results suggest.²

Participants were instructed to exhibit a neutral expression and we omitted photos where an emotional facial expression was detected. Accordingly, we maintain that participants' primary method of conveying intimidation was by increasing fWHR through a face tilt. However, previous research has revealed that even faces perceived as neutral at a macro level convey emotion through micro-expressions (Ekman & Friesen, 1969; Said, Haxby, & Todorov, 2011). We collected more controlled stimuli for evaluation in Study 2 to eliminate the possibility that participants increased their fWHR through some subtle facial property change other than face tilting.

Study 2

Previous research has revealed that when evaluating individuals with varying baseline fWHR, those with a greater fWHR are evaluated more negatively upon multiple dimensions (Carré et al., 2009; Hehman et al., 2013; Stirrat & Perrett, 2010). Unknown, however, was whether an increased fWHR due to tilting one's face was similarly perceived as more intimidating. Study 2 employed a yoked design in order to test whether tilt alone was associated with increased perceptions of intimidation. Participants in three conditions made evaluations regarding each target individual. Every participant evaluated every target, but saw each target in only one of the three face tilt positions, as target face tilt was manipulated on a between subject basis. Thus an effect of target face tilt on participant evaluation could be attributed with more certainty to the facial tilt and increased fWHR.

Study 2 additionally allowed participants to evaluate each target face on multiple dimensions. This approach lets us evaluate whether fWHR remained predictive of intimidation when controlling for other important impression formation variables. Participants evaluated targets on perceived creativity, as well as attractiveness and friendliness, important characteristics in impression formation (Cuddy, Fiske, & Glick, 2007; Lorenzo, Biesanz, & Human, 2010; Rhodes, Proffitt, Grady, & Sumich, 1998). Including these valenced evaluations allowed us to determine whether fWHR predicted perceptions of intimidation above and beyond general negative and positive perceptions of the target. The dependent variable of interest was created from two items, participant ratings of meanness and intimidation.

Furthermore, the role of both target and participant gender in evaluations of intimidation was examined. In Study 1 both males and females equally increased their fWHR when trying to appear intimidating, but whether this was equally effective in intimidating perceivers remained an open question. Given the historically male association with aggression and violence (Daly & Wilson, 1988), we examined whether participants' evaluations of intimidation were more strongly influenced by the tilt of male or female targets.

Similarly, we examined whether individuals varying in Baseline fWHR were perceived as equally intimidating across different conditions. Several different possibilities were viable. For instance, smaller fWHR individuals might not be perceived as intimidating, regardless of head tilt. Additionally, similar to the result in Study 1 in which smaller fWHR individuals tilted their heads to a greater degree, smaller fWHR individuals, though perceived as less intimidating than greater fWHR targets in Baseline photos, might receive a sharper increase in

² We thank an anonymous reviewer for this insight.

perceived intimidation between conditions, such that they are equally intimidating as greater fWHR individuals when tilting their heads. Finally, greater fWHR individuals might be seen as particularly intimidating in head tilt conditions, exacerbating the effect of fWHR.

Method

Participants and design

101 White participants (50 females) reported evaluations of faces for partial course credit in a 3-level (Photo: Baseline, Up, Down) repeated measures yoked design.

Stimuli

Targets were photos of participants from Study 1 with faces posed as Baseline, Up, and Down. Following the two photos taken for Study 1, research assistants posed participants for two subsequent, more controlled photos to act as stimuli for Study 2: Up and Down. For the Up photo, participants' faces were tilted upward $30^\circ \pm 5^\circ$ from baseline using a protractor, and instructed to look at the camera with a neutral expression while the photo was taken. For Down photos, participants' faces were tilted downward $30^\circ \pm 5^\circ$ from baseline, again maintaining a neutral expression for the photo. The Baseline photo in Study 1 provided the Baseline condition. Targets were utilized as stimuli in Study 2 only if photos of all three conditions were suitable (i.e., no emotional expression, no hair partially covering faces). Of the 31 photo sets meeting these criteria, 10 male and 10 female sets were randomly selected, resulting in 60 total photos (20 Baseline, 20 Up, 20 Down). The fWHR of each target face was again coded by 4 raters. Each rater coded target faces in only a single condition (i.e., Baseline: $\alpha = .79$, Up: $\alpha = .95$, or Down: $\alpha = .73$) to maintain naiveté. fWHR was consistent across coders and ratings were averaged.

Procedure

Participants were presented with a series of 20 faces in random order posing with Baseline, Up, or Down faces. Each participant saw one photo of each target, but depending upon randomly assigned block, the photo might be Baseline, Up, or Down. No participant ever saw a single target posing in multiple conditions. Participants were told that targets were instructed to pose spontaneously in a manner that captured their personality, but while maintaining a neutral facial expression. For each target, ratings were made on five dimensions in random order: "Please report your impression of this person on the following characteristics: How [mean, intimidating, attractive, friendly, creative]?" Participants responded on a 1 (*Not at all*) to 7 (*Very much*) response scale. Following all target evaluations, participants reported their gender.

Data analytic strategy

Participant evaluations of "mean" and "intimidating" were strongly correlated ($r = .70$), as expected, and averaged into a single variable, henceforth called Intimidating. To account for the interdependence of target ratings within each participant we analyzed data using hierarchical linear modeling (Raudenbush, Bryk, & Congdon, 2004). Participants were treated as random, and thus the relationships between group-mean centered Target gender, Target fWHR, two effects-codes representing the three experimental conditions (Up: Baseline = $-.5$, Up = $.5$; Down: Baseline = $-.5$, Down = $.5$), and evaluations were examined within each participant. Participant gender was entered as a grand-centered level-2 predictor. Slopes and intercepts of each variable were random. The intraclass correlation coefficient of the primary dependent variable, Intimidation ($ICC = .224$), indicated that 22% of the variance in Intimidation was accounted for by between-participant variation, and 78% by within-participant variation, highlighting the importance of using hierarchical linear modeling in this context.

Table 1

Means and standard deviations (in parentheses) of Intimidation and fWHR in each condition for males and females.

Tilt	Males		Females	
	Intimidation	fWHR	Intimidation	fWHR
Baseline	2.46 (1.33)	1.61 (.07)	2.37 (1.27)	1.52 (.08)
Up	2.85 (1.51)	1.87 (.14)	2.95 (1.42)	1.76 (.14)
Down	3.28 (1.62)	1.67 (.07)	2.79 (1.50)	1.65 (.05)

Results

Evaluations of Intimidation

We tested our primary hypothesis by entering variables representing Up and Down relative to Baseline faces into a single model predicting ratings of Intimidation (see Table 1 for mean ratings of Intimidation and fWHR by condition). As expected, Creativity was unrelated to evaluations of Intimidation ($\gamma_{40} = .045$, $SE = .034$, $p = .181$) and Friendliness was negatively related ($\gamma_{50} = -.522$, $SE = .030$, $p < .001$). Attractiveness was positively related to greater evaluations of Intimidation ($\gamma_{60} = .080$, $SE = .023$, $p = .001$). Regarding our main hypotheses, when facial photos were tilted both Up ($\gamma_{10} = .460$, $SE = .084$, $p < .001$) and Down ($\gamma_{20} = .642$, $SE = .087$, $p < .001$) they were evaluated as more intimidating. These relationships remained unchanged ($ps < .001$) when controlling for other important impression formation variables by entering them into the model. Participant gender did not influence any results, and will not be discussed further.

fWHR and Intimidation

We next examined whether increased perceived Intimidation from head tilt was moderated by several factors. First, since males are more strongly associated with aggression, we examined whether Target gender moderated these effects. Additionally, we examined whether individuals varying in fWHR were perceived as equally intimidating in these different conditions by examining whether the increase in Intimidation ratings between Baseline and Up- and Down-tilt conditions might vary by Baseline fWHR (i.e., fWHR when individuals were not tilting their heads).

To this end, Baseline fWHR, Target gender, Up and Down conditions, and their corresponding second and third level interactions were entered into a single model predicting Intimidation. Three-way interactions were not significant and removed from the model. Main effects of Baseline fWHR ($\gamma_{10} = 2.705$, $SE = .386$, $p < .001$), Up-tilt ($\gamma_{30} = .458$, $SE = .084$, $p < .001$), and Down-tilt ($\gamma_{40} = .683$, $SE = .093$, $p < .001$) accounted for 17% of the variance in Intimidation ratings. Main effects were qualified by several significant two-way interactions, accounting for an additional 9% of the variance. First, a Target gender \times Up interaction was present ($\gamma_{60} = -.160$, $SE = .071$, $p = .027$). Additionally, both Baseline fWHR \times Up ($\gamma_{80} = 1.716$, $SE = .845$, $p = .045$) and Baseline fWHR \times Down ($\gamma_{90} = 5.036$, $SE = .828$, $p < .001$) interactions predicting Intimidation indicated that Baseline fWHR was differentially influencing Intimidation in each tilt condition.

Interactions were decomposed utilizing techniques specified by Preacher, Curran, and Bauer (2006). Simple slopes for the Target gender \times Up interaction indicated that individuals with Up-tilted heads were perceived as more intimidating than Baseline, but this increase in Intimidation was sharper for females ($\gamma = .618$, $SE = .116$, $p < .001$) than for males ($\gamma = .298$, $SE = .105$, $p = .005$). The simple slopes for the Baseline \times condition interactions revealed that when individuals tilted their heads upward both greater and smaller Baseline fWHR individuals were evaluated as more intimidating, but this increase was sharper for greater Baseline fWHR individuals ($\gamma = .613$, $SE = .124$, $p < .001$) than smaller Baseline fWHR individuals ($\gamma = .304$, $SE = .102$, $p = .004$) (Fig. 4A). Simple slopes in the Down-tilt condition revealed a similar pattern. Both greater and smaller Baseline fWHR individuals

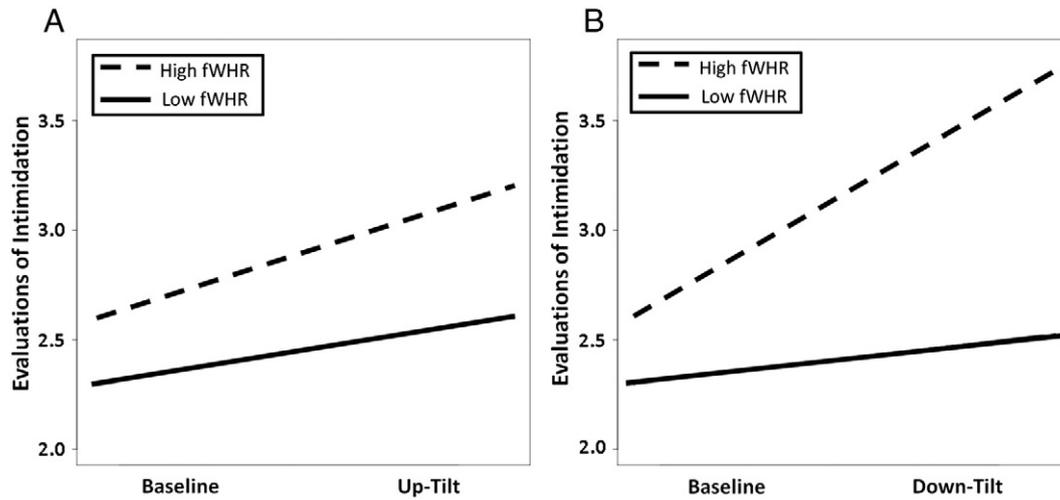


Fig. 4. The relationship between evaluations of intimidation and Up-tilting (A) and Down-tilting (B) and Baseline for both high fWHR (+1SD) and low fWHR (−1SD) individuals.

were evaluated as more intimidating when tilting their heads downward, but this effect was stronger for greater Baseline fWHR individuals ($\gamma = 1.14$, $SE = .138$, $p < .001$) than lower Baseline fWHR individuals ($\gamma = .230$, $SE = .097$, $p = .020$) (Fig. 4B). Thus, tilting one's head up or down was more effective in increasing perceivers' intimidation for greater fWHR individuals, though effective for both high and low fWHR individuals.

Target fWHR as mediator

We have postulated that increased fWHR when faces are tilted is the mechanism responsible for this effect, and our next series of analyses entered coder ratings of Target fWHR in each condition to examine whether fWHR mediated the relationship between target tilt and evaluations of Intimidation. First, confirming that Up and Down tilted faces had greater fWHR than Baseline, target tilt condition predicted the mediator, fWHR, for faces in both Up ($\beta = .781$, $SE = .035$, $p < .001$) and Down ($\beta = .296$, $SE = .035$, $p = .010$) conditions. Further consistent with mediation (MacKinnon, Fairchild, & Fritz, 2007), greater Target fWHR was associated with larger evaluations of Intimidation ($\gamma_{10} = 1.346$, $SE = .272$, $p < .001$) when simultaneously entered into the model with effects-codes representing Up and Down conditions. However, analyses in the previous section found that tilting one's head more dramatically increased evaluations of Intimidation for higher than lower Baseline fWHR individuals. We therefore ran separate mediation models for greater and smaller Baseline fWHR targets to examine whether Target fWHR in each condition mediated the relationship between condition and Intimidation differently for each group. A tertile split was performed by target Baseline fWHR, and mediation was examined separately for the lowest and highest third. As dividing a sample decreases statistical power, we consider this a conservative test of our hypotheses.

As anticipated, and consistent with the results above, for higher fWHR individuals Monte Carlo (Selig & Preacher, 2008) and Sobel (Baron & Kenny, 1986) tests of mediation indicated that fWHR in each condition mediated the relationship between Down-tilted, 95% CI [.133, .817], Sobel: $p = .008$, and Up-tilted, 95% CI [.357, 2.069], Sobel: $p = .006$, photos and evaluations of Intimidation. For lower fWHR individuals, however, fWHR in each condition did not mediate the relationship for either Down-tilted, 95% CI [−1.127, .817], Sobel: $p = .332$, or Up-tilted, 95% CI [−.435, .146], Sobel: $p = .318$, photos and evaluations of Intimidation.

Discussion

Taken together, the above analyses support our original hypotheses that tilted faces are indeed evaluated as more intimidating, but reveal an important caveat: tilting faces upward or downward more effectively increased perceived intimidation for individuals with a relatively greater Baseline fWHR. As Baseline fWHR decreased, the effect of tilting one's head on Intimidation diminished. Thus, though Intimidation ratings across all individuals were higher in both Up- and Down-tilt conditions as compared to Baseline, these increases in perceived Intimidation were particularly sharp for individuals higher in Baseline fWHR.

General discussion

These two studies provide evidence that a) individuals spontaneously increase their fWHR when trying to appear intimidating by modifying the angle at which their faces are perceived, b) smaller fWHR individuals, for whom it would be particularly advantageous to appear more intimidating, spontaneously increase their fWHR more so than greater fWHR individuals, c) faces with increased fWHR due to tilting are indeed evaluated as more intimidating, but d) the increased perceptions of intimidation from tilting are sharper for individuals with greater baseline fWHR.

An emerging literature has demonstrated that individuals with a greater fWHR are evaluated as relatively dangerous to one's physical well-being or resources, and importantly, these evaluations are largely accurate. Sensitivity to fWHR may have developed to facilitate an avoidance of these potentially dangerous individuals. However, being avoided confers advantages to individuals deemed intimidating, such as reduced challenges for resources or decreased retribution for aggressive actions. Thus, individuals may know to enhance their fWHR in situations in which it would be advantageous to be evaluated as more intimidating.

Initially, there are several seemingly conflictual findings in the current research. In Study 1, smaller fWHR individuals tilted their heads to a greater extent than greater fWHR individuals. However, in Study 2, increased perceptions of intimidation through tilting were evident only for greater fWHR individuals. These findings are not at odds. In Study 1, participants spontaneously posed, and were able to freely move their heads to whatever degree desired. However, in Study 2, the experimenters posed participants using a protractor, and thus this inter-individual variation in the degree to which a face was posed was eliminated. Thus, the results from each study dovetail to

indicate that, outside of the laboratory, smaller fWHR individuals may tilt their heads more to compensate for a decreased impact of head tilt on fWHR and intimidation. In other words, smaller fWHR individuals may have to “fake it” more so than individuals with a greater fWHR, a finding consistent with the hypotheses of the current work.

Additionally, whether participants were intimidated by tilted faces was moderated by targets' Baseline fWHR. Precisely why participants were more intimidated by greater fWHR individuals remains an unanswered question. Previous research has similarly found that perceptions of fWHR are heavily influenced by accompanying identity cues. For instance, the relationship between fWHR and judgments of aggression was weaker regarding female than male faces (Geniole et al., 2012). One possible explanation for this effect is that greater fWHR individuals, who are somewhat naturally intimidating, are perceived as particularly intimidating when tilting their faces because they are perceived as trying to be even more intimidating. Thus, rather than simply a bottom-up perceptual process, the increase in perceived intimidation may result from the social knowledge that presumably dangerous individuals are trying to appear more dangerous, and the activities and behaviors that might imply. Future research might examine whether these perceptions of intimidation are automatic or are driven by inferences of a target's intent.

Alternative explanations for these results exist. This research was conducted in North America. Thus, rather than an evolutionary interpretation, perhaps Western popular culture and media have influenced these results due to how physically intimidating protagonists are typically portrayed (Fig. 2), though this, of course, raises the question of why physically intimidating protagonists are portrayed in such a manner. Regardless, an important extension of this research will be to examine the universality of enhancing fWHR. Cultural differences would support a Western popular culture explanation, whereas participants enhancing their fWHR across multiple cultures would support the evolutionary explanation adopted by the current work.

One unexpected nuance of the current results is that, while both males and female targets in the Up-tilt condition were evaluated as more intimidating than Baseline, this increase was particularly sharp for females. One explanation for this result is that targets with upward tilted faces are perceived to be more masculine (Burke & Sulikowski, 2010). Thus, though appearing feminine and perhaps less intimidating in the Baseline condition, females may have increased their perceived masculinity to a greater extent in the Up-tilt condition than male targets, who already appeared masculine in the Baseline condition. Additionally, we note that while up-tilting was more effective at increasing intimidation for females than males (Study 2), only males spontaneously tilted their heads upward in Study 1. This seeming conflict may actually explain the relationship between these two results. If females are less likely to spontaneously up-tilt their faces outside of the lab, this deviation from the norm might be driving perceived intimidation. Future research might examine the moderating influence of gender and expectations on non-verbal displays of intimidation.

Finally, though both upward and downward tilted faces significantly increased perceived intimidation, the effect sizes for downward tilts were consistently larger. We had no a priori hypotheses regarding whether up- or downward tilting would be more effective, but we also note that in Study 1, individuals were far more likely to spontaneously down-tilt their faces. It may be that though both are perceived as more intimidating than neutral, there are subtle social differences between upward and downward tilting. For instance, downward tilted faces might convey a greater approach orientation, as tilting down one's face lowers the supraorbital brow ridge, theorized to have developed partially to protect the vulnerable eyes (Oyen, Rice, & Cannon, 1979), and a lowered chin protects the neck. Indeed, this protected stance is one frequently adopted by modern-day boxers or mixed martial arts fighters. Thus, such a pose might be more strongly associated with imminent physical threat than upward tilted faces. On the other hand, an upward tilt might be more associated with a superior

attitude or “looking down one's nose” at others. These possibilities are speculative, and future investigations might build on the current research examining the interplay between multiple cues in evaluations of intimidation and body posture.

In conclusion, we provide an example of Batesian mimicry in humans: individuals spontaneously increase their fWHR in order to appear more intimidating, and smaller fWHR individuals, who would receive the largest advantage for appearing more intimidating, are particularly likely to maximize their fWHR. These results provide a possible explanation to an interesting conundrum. If high fWHR is so reliably perceived in a negative manner it should have detrimental effects on the well-being of high fWHR individuals. Evolutionary perspectives would thus dictate that, over time, greater fWHR would select out. This is clearly not the case. Rather, in some contexts it may be advantageous to be perceived as displeasing and intimidating rather than well-liked and quiescent. The current results converge with other recent research (Stirrat & Perrett, 2012) indicating that being perceived as high fWHR is sometimes desirable and confers advantages.

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