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# The Face of Fear and Anger: Facial Width-to-Height Ratio Biases Recognition of Angry and Fearful Expressions

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The ability to rapidly and accurately decode facial expressions is adaptive for human sociality. Although judgments of emotion are primarily determined by musculature, static face structure can also impact emotion judgments. The current work investigates how *facial width-to-height ratio* (fWHR), a stable feature of all faces, influences perceivers' judgments of expressive displays of anger and fear (Studies 1a, 1b, & 2), and anger and happiness (Study 3). Across 4 studies, we provide evidence consistent with the hypothesis that perceivers more readily see anger on faces with high fWHR compared with those with low fWHR, which instead facilitates the recognition of fear and happiness. This bias emerges when participants are led to believe that targets displaying otherwise neutral faces are attempting to mask an emotion (Studies 1a & 1b), and is evident when faces display an emotion (Studies 2 & 3). Together, these studies suggest that target facial width-to-height ratio biases ascriptions of emotion with consequences for emotion recognition speed and accuracy.

*Keywords:* anger, emotion perception, face perception, facial width-to-height ratio, fear



Facial expressions are integral to human sociality. Facial expressions contain information pertinent to others' affective states, motivations, intentions, and personalities (Ekman, 2003; Parkinson, 2005). Humans are able to efficiently decode facial expressions with great consensus (Ambady, Bernieri, & Richeson, 2000; Zebrowitz & Montepare, 2015), which is unsurprising given the benefits of accuracy and the costs of inaccuracy in decoding facial expressions. Further, most facial expressions have a biological basis in facial musculature movements (Ekman et al., 1987; Ekman, 1993). Indeed, both congenitally blind and sighted individuals demonstrate similar facial expressions in reaction to emotional events (Matsumoto & Willingham, 2009). Despite the functionality of accurate decoding, the interpretation of an expressive signal depends on multiple factors, including nonexpressive facial cues of targets. Indeed, neotenous or feminine faces appear to more easily signal happiness and fear relative to mature or masculine faces (e.g., Becker, Kenrick, Neuberg, Blackwell, & Smith, 2007; Craig, Koch, & Lipp, in press; Craig & Lipp, 2017; Hugenberg & Sczesny, 2006; Marsh, Adams, & Kleck, 2005; Sacco & Hugenberg, 2009; see Hess, Adams, & Kleck, 2009; Zebrowitz & Montepare, 2008, for reviews).

In the current work, we build on this research tradition of investigating how target face characteristics can influence how facial expressions of emotion are decoded. In particular, we focus on a facial dimension of recent interest across multiple laboratories: facial width-to-height ratio (fWHR). Specifically, we investigate how faces that vary in fWHR differentially signal facial expressions of anger, fear, and happiness. To this end, we first discuss research on how target characteristics can influence the interpretation of expressive signals, with a particular focus on how facial structures affect inferences about expressions. We then move to a discussion of recent research on facial width-to-height ratio, demonstrating that high fWHR men are judged to be more aggressive, as well as evidence suggesting that fWHR may share phenotypic overlap with emotions. Finally, we present four studies demonstrating that perceivers more readily see anger on faces with relatively higher fWHR and more readily see fear and happiness on faces with relatively lower fWHR.

## Target Characteristics Influence the Interpretation of Expressive Signals

The same expression on a different face is often perceived differently, even holding the expression itself constant.[1] For example, social categories can influence how an expression is decoded. In the United States, White perceivers often see anger more easily on Black than White faces (Dunham & Banaji, 2006; Hugenberg & Bodenhausen, 2003, 2004; Hutchings & Haddock, 2008). Similarly, White Dutch participants see anger more readily on the faces of stigmatized Moroccans than on the faces of fellow Whites (Bijlstra, Holland, & Wigboldus, 2010; Bijlstra, Holland, Dotsch, Hugenberg, & Wigboldus, 2014). Expressers' sex also influences how facial expressions of emotions are interpreted. People detect anger more quickly and accurately on male than

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[1] We also acknowledge that different groups or cultures can often express even basic emotions differently as well (e.g., Beaupré & Hess, 2005; Elfenbein & Ambady, 2002; Elfenbein, Beaupré, Lévesque, & Hess, 2007), although, in the current work, we hold cultures of expressers and decoders constant.

female faces, and detect happiness more easily on female than male faces (Adams, Hess, & Kleck, 2015; Becker et al., 2007; Craig & Lipp, 2017). Although there is continuing debate as to whether these intergroup effects are due to specific stereotypes about groups (e.g., Bijlstra et al., 2014) or a domain-general disliking of some (e.g., Dunham, 2011), it is clear that social categories can influence how we interpret expressions (see Hugenberg & Wilson, 2013).

Beyond this top-down influence of social categories, it is also the case that some facial structures resemble expressions. For example, Becker and colleagues (2007) argue that the association between target sex and facial expression recognition is not merely a property of sex stereotypes. Rather, facial expressions of anger and fear may have coevolved with characteristics of facial sexual dimorphism (see also Adams, Franklin, Nelson, & Stevenson, 2011; Hess et al., 2009; Marsh et al., 2005; Slepian, Weisbuch, Adams, & Ambady, 2011). Indeed, masculine and feminine features have a profound effect on how facial displays of emotion are understood (Adams et al., 2015; Zebrowitz, Kikuchi, & Fellous, 2010). Masculine features, such as a prominent jaw and lowered brow ridge, are associated with dominance. And, dominance expressions facilitate recognition of anger (Montepare & Dobish, 2003). Conversely, feminine features, such as large eyes and round faces, are associated with neonates and lead to judgments of submissiveness (e.g., Le Gal & Bruce, 2002; Penton-Voak, Wisbey, & Pound, 2007; Zebrowitz & Montepare, 2015). Indeed, lowering one's brow and narrowing one's eyes can be used to signal anger. As noted above, facial maturity covaries with expressions of anger and fear as well. It is perhaps unsurprising then, that facial maturity also covaries with gender appearance, with faces that are structurally more mature appearing more masculine (Keating, 1985; Keating, Mazur, & Segall, 1977; Senior et al., 1999).

In the current work, we focus on another target-level facial feature of recent research interest: facial width-to-height-ratio. As we outline below, fWHR has been both stereotypically associated with aggression (i.e., high fWHR targets are seen as aggressive), and may share phenotypic overlap with emotional expressions related to aggression (i.e., anger). Thus, we have reason to believe that targets' fWHR may bias how expressions are decoded.

## Facial Width-to-Height Ratio: Biasing Judgment and Predicting Behavior

We propose that facial width-to-height ratio (fWHR) may influence how facial expressions of emotions are perceived and interpreted. Facial width-to-height ratio is typically measured as the ratio between bizygomatic width (i.e., distance between left to right zygion) to upper face height (i.e., distance between midbrow and upper lip; see Figure 1). Facial width-to-height ratio is a static component of faces derived from underlying bone structure, rather than changes in facial musculature (Hehman, Flake, & Freeman, 2015; Hehman, Leitner, & Freeman, 2014). Although early work indicated that fWHR might be sexually dimorphic (Weston, Friday, & Lio, 2007), more recent work has found little evidence for this putative relationship between fWHR and sex (Kramer, Jones, & Ward, 2012; Lefevre et al., 2012; Özener, 2012), suggesting that high versus low fWHR is likely not a strongly sex typical feature.

In the current work, we hypothesize that participants will more readily see threatening facial expressions such as anger on faces

*Figure 1.* Facial width-to-height ratio is measured as the distance between the left and right zygion divided by the distance between the midbrow and upper lip. Stimuli obtained from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015) and reprinted with permission.

with relatively greater fWHR whereas participants will more readily see submissive expressions such as fear or prosocial expressions such as happiness on relatively lower fWHR faces. We believe there is good reason for this hypothesis, stemming both from research demonstrating that targets higher in fWHR are perceived as more aggressive than targets lower in fWHR, as well as from research suggesting that fWHR may share phenotypic resemblance to emotional expressions. We first outline research on how targets' fWHR biases person perception before turning to work suggesting that fWHR may have phenotypic overlap with specific emotions.

## FWHR-Linked Facial Stereotypes

Compared with their low fWHR counterparts, men with high fWHR are perceived to be behaviorally aggressive (Carré, McCormick, & Mondloch, 2009), intimidating (Hehman, Leitner, & Gaertner, 2013), dominant (Alrajih & Ward, 2014; Mileva, Cowan, Cobey, Knowles, & Little, 2014), and animalistic (Deska, Lloyd, & Hugenberg, 2017). Regardless of the validity of these facial stereotypes, such associations can have severe consequences. For instance, Wilson and Rule (2015) demonstrated that target fWHR predicted the likelihood that a convicted murderer received the death penalty versus a life sentence; relatively greater fWHR defendants were more likely to be sentenced to death. Indeed, research from multiple laboratories indicates that there is a facial stereotype of fWHR, such that high fWHR (relative to low fWHR) male faces are associated with threat (for a review, see Geniole, Denson, Dixson, Carré, & McCormick, 2015).

Moreover, there is reason to think that stereotypes of high fWHR men as aggressive are not entirely invalid (i.e., the stereotype has a "grain of truth"). Although correlational in nature, evidence suggests that high fWHR men are more likely than their low fWHR counterparts to aggress, both physically (Carré & McCormick, 2008), and socially (Haselhuhn & Wong, 2011; Stirrat & Perrett, 2010). Indeed, a meta-analytic review relating fWHR to behavioral aggression shows a small, yet reliable effect (Haselhuhn, Ormiston, & Wong, 2015). Exactly why this relationship emerges has not yet been fully explicated. One possibility is that fWHR is positively related to testosterone (Lefevre, Lewis, Perrett, & Penke, 2013), although this putative relationship between fWHR and testosterone has not been reliably supported (Bird et al., 2016; Welker, Bird, & Arnocky, 2016). Regardless of whether the fWHR-aggression stereotype is based in behavior, the stereotype itself appears robust. Further, it seems reasonable that this stereotypic fWHR-aggression link might bias the perception of expressions of facial expressions of aggression (i.e., anger), submission (i.e., fear), and prosocial approach (i.e., happiness) much like other stereotypic links (e.g., race; sex) have been shown to bias the interpretation of facial expressions.

## Phenotypic Overlap Between fWHR and Expressions

Our hypothesis that fWHR may bias expression perception is also rooted in the literature in expression-structure overlap. As noted above, a robust literature has demonstrated that some facial phenotypes share structural overlap with some facial expressions. For example, babyish adult faces, with their relatively large eyes and high foreheads, appear to share structural overlap with facial expressions of fear (i.e., submission) but not with facial expressions of anger (i.e., dominance).

In line with this argument, Marsh et al. (2005) argue expressions of fear and anger coevolved with facial maturity. In essence, by mimicking a babyish face (with large eyes and a high forehead) fear elicits a succor response that might otherwise be reserved for helpless infants. Similarly, by mirroring a mature face (with small eyes and a low brow), anger may elicit deference and avoidance typically reserved for powerful adults. Supporting this argument, the physical appearance of facial immaturity and maturity naturally resembles expressions of fear and anger. Adopting this same perspective, Sacco and Hugenberg (2009) demonstrated that the signal of anger present on faces is enhanced when combined with relatively mature features (i.e., small eyes) whereas the signal of fear is enhanced when combined with relatively babyish features (i.e., large eyes), resulting in more rapid and accurate expression categorization. Consistent with Marsh and colleagues, Sacco and Hugenberg (2009) argue that babyish features signal submission, which facilitates the recognition of submissive facial expressions, such as fear. Conversely, mature faces appear more dominant, and anger is therefore enhanced in combination with mature face structure.

Might high fWHR share physical overlap with anger (but not with fear or happiness)? Indirect support for this hypothesis comes from recent research by Neth and Martinez (2010), who demonstrated that manipulations of targets' fWHR can influence the perceived resting state of faces. They demonstrate that otherwise identical faces (even when displaying neutral expressions) appear sadder when elongated but angrier when facial height is reduced (thereby manipulating fWHR; see also Neth & Martinez, 2009). Similar effects occur for facial width, with wider faces appearing angrier than narrower faces, which appear relatively sad. Thus, there may be good reason to believe that fWHR may share some structural overlap with expressions.

Taken together, the existing research indicates both that there is a facial stereotype of fWHR (i.e., high fWHR targets are seen as more behaviorally aggressive), and that fWHR may structurally covary with facial expressions. Rooted in these two preexisting observations in the literature, we tested the hypothesis that targets' fWHR may bias how targets' facial expressions of anger, fear, and happiness are interpreted.

# Current Research

In the current work, four studies provide novel evidence that targets' facial width-to-height ratio can influence how facial expressions of emotion are interpreted. In Study 1a, we showed participants male faces displaying neutral expressions and told them the targets were attempting to mask either anger or fear. Participants then guessed which emotion was ostensibly being masked. This allowed us to test whether high and low fWHR faces signal anger and fear, respectively, even in the absence of an overt, musculature-based expression (see Neth & Martinez, 2009). Study 1b served to provide a replication of Study 1a while also extending the previous results by investigating whether the same effects emerged for female faces high and low in fWHR. In Study 2, participants were shown a series of faces high and low in fWHR that were displaying angry and fearful expressions to see if fWHR biases how expressions are decoded even in the presence of actual expressive cues. Finally, Study 3 tested a possible boundary condition by asking people to categorize high and low fWHR faces making angry and happy expressions. Across all four studies, we found a tendency for judgments to be biased such that high fWHR faces were categorized as angry more often and more quickly than low fWHR faces, which were in turn categorized as fearful (Studies 1a, 1b, & 2) and happy (Study 3) more often and more quickly than high fWHR faces. Together, these studies provide consistent evidence that targets' facial width-to-height ratio influences judgments of facial expressions of emotion.

# Study 1a

Study 1a was designed to provide initial evidence demonstrating that targets' fWHR can influence the recognition of facial expressions of anger and fear. Our hypothesis was that high fWHR faces would appear angrier (relative to low fWHR targets) and low fWHR targets would appear more fearful (relative to high fWHR targets). If high fWHR targets are expected to act in a dominant manner, then under situations where expressions are ambiguous, perceivers' judgments should be biased by the facial stereotype linking high fWHR and aggression. Likewise, if high fWHR faces share phenotypic overlap with angry expressions (and low fWHR faces share a phenotypic overlap with fear), then even a resting, neutrally expressive face should be seen as angrier when it is high in fWHR and as more fearful when low in fWHR.

In Study 1a we showed participants faces of men who varied in their fWHR and who were displaying neutral expressions. We provided bogus instructions to participants that the facial stimuli in the study were generated from people who had their photograph taken immediately after watching a short video that made them feel either angry or fearful (i.e., each target was equally likely to be feeling anger or fear). We then told participants that the depicted individuals were asked to mask the emotion they were feeling during their photo. Thus, the participants' task was to determine whether each individual was attempting to hide anger or fear. In actuality, each target simply displayed a neutral expression, without suppression.

If fWHR biases judgments of expressions, then participants should be more likely to believe that otherwise neutral high fWHR faces are masking anger compared with low fWHR faces, which should be seen as masking fear. Of secondary interest was whether the speed with which participants' expression categorizations are made would depend on fWHR. Indeed, insofar as high fWHR facilitates anger categorizations (relative to low fWHR and fear), this could also be observed as quicker anger decisions for high fWHR faces and quicker fear decisions for low fWHR faces.

## Method

**Statistical power and participants.** Because we were uncertain as to the effect sizes we may observe in the current work, we relied on the effect size of the most analogous finding in the literature, which was Sacco and Hugenberg's (2009; Study 1) demonstration that facial maturity facilitates the accurate recognition of fear and anger expressions. Using their reported effect ($d = 0.76$), a power analysis with G*Power (V3.1; Faul, Erdfelder, Lang, & Buchner, 2007) software indicated that we should target 47 participants to obtain 95% power. Consequently, we collected data for as many full weeks were needed to obtain at least 47 participants. Because of the high degree of internal consistency for each study, we used this power analysis and recruiting strategy for each. In this and all studies reported, no analyses were conducted before data collection was complete. All studies were approved by Miami University's Institutional Review Board.

Fifty-five undergraduate participants ($M_{age} = 19.00$, $SD = 0.97$) completed Study 1a in exchange for partial course credit. Most participants identified as White (69.1%). Additionally, 16.7% identified as Asian, 3.7% identified as Black, 1.9% identified as American Indian/Alaskan Native, 1.9% identified as multiracial, and one individual selected the "other" response and self-identified as Indian. Just over half of the sample (52.7%) identified as female. One person did not provide any demographic information. No participants were excluded from analysis.

**Materials.** Our stimuli comprised 12 neutral expression faces from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015). We selected six faces of White men who had high fWHR ($M = 2.06$, $SD = 0.06$) and six faces of White men who had low fWHR ($M = 1.73$, $SD = 0.03$). This division created two target groups whose mean fWHR varied significantly, $t(10) = 11.94$, $p < .001$, 95% CI [0.27, 0.39], $d = 6.96$. Using the norming data included in the Chicago Face Database, these groups did not differ in perceived attractiveness ($p > .82$). We employed male faces because nearly all of the research linking fWHR to either judgments of aggression or actual behavioral aggression has relied on male targets. Further, we employed White faces because the majority of our participant population was White, and as noted above, past research has demonstrated that race can influence judgments of expressions. Images were resized to be 682 × 480 pixels and were presented on monitors that were using a 1,024 × 768 resolution.

**Procedure.** After providing informed consent, participants completed an emotion categorization task. Participants were informed that we were interested in their ability to detect emotions that others are trying to hide. Participants were told that they would see a series of faces and that these individuals had previously watched a video that made them feel either angry or fearful. Participants were told that these targets were asked to hide their video-induced emotion before their photo was taken. The participants' task was to determine whether they believed that the individual was attempting to hide fear or anger. None of the individuals in our stimuli photos were actually attempting to mask any emotions—they were simply photos of neutrally expressive faces.

This categorization task consisted of 108 trials over 3 blocks, with 36 trials per block. Every trial began with a fixation cross (1,000ms) that was followed by an image of a face (200ms). The face was then occluded with a white box after which participants were asked to render an anger-versus-fear decision via keystroke. There was a 500-ms intertrial interval. Within every block, participants saw all 12 stimulus faces three times. Presentation order of stimuli was randomized separately for each participant. After completing the categorization task, participants were asked to provide demographic information (e.g., sex, age, race), were debriefed, and thanked for their participation.

## Results and Discussion

Of primary interest was the extent to which targets' facial width-to-height ratio biased perceivers' categorizations of the expressions that targets were ostensibly attempting to hide. To investigate this, we recorded the proportion of anger categorizations relative to total categorizations separately for high and low fWHR targets.[2] These values were submitted to a paired samples $t$ test. This analysis revealed that the proportion of anger categorizations was higher for high fWHR faces ($M = 0.69$, $SD = 0.12$) than low fWHR faces ($M = 0.41$, $SD = 0.18$), $t(54) = 9.16$, $p < .001$, 95% CI [0.22, 0.34], $d = 1.23$.

Of additional interest was the speed at which participants rendered fear and anger categorizations on high and low fWHR faces. Here, we expected to see an interaction such that high fWHR faces would facilitate the rapid categorization of anger relative to low fWHR faces, which would facilitate the rapid categorization of fear compared with high fWHR faces. To test this, we separately computed RTs for participants' categorizations of high and low fWHR faces as angry and fearful. We first eliminated responses with latencies faster than 200 milliseconds and slower than 1,500 milliseconds (15.57% of trials). Preliminary analyses indicated that the data were skewed (as often occurs in response latency data). Therefore, analyses were conducted on log10 transformed data; descriptive statistics reflect untransformed data for ease of interpretation. Mean response latencies were submitted to a 2(fWHR: high vs. low) × 2 (categorization: angry vs. fearful) repeated-measures ANOVA. This analysis yielded only the anticipated interaction, $F(1, 53) = 16.22$, $p < .001$, $\eta_p^2 = .23$ (see Figure 2). Among high fWHR faces, perceivers were quicker to make anger categorizations ($M = 547.14$, $SD = 140.84$) than fear categorizations ($M = 617.62$, $SD = 140.84$), $t(53) = 3.81$, $p < .001$, 95% CI [0.03, 0.08], $d = 0.52$. Among low fWHR faces, perceivers were slower to make anger categorizations ($M = 609.62$, $SD = 178.02$) than fear categorizations ($M = 566.30$, $SD = 135.95$), $t(54) = -2.20$, $p = .033$, 95% CI [−0.05, −0.00], $d = -0.30$. Considered another way, when making anger categorizations, participants were faster for high fWHR faces ($M = 547.14$, $SD = 140.84$) than for low fWHR faces ($M = 609.62$, $SD = 178.02$), $t(54) = 4.47$, $p < .001$, 95% CI [0.03, 0.08], $d = 0.60$. Conversely, when making fear categorizations, participants

[2] Because this design makes the proportion of fear categorizations the additive inverse of the anger categorizations, the effect for proportion of fear categorizations as a function of fWHR produces an identical result.

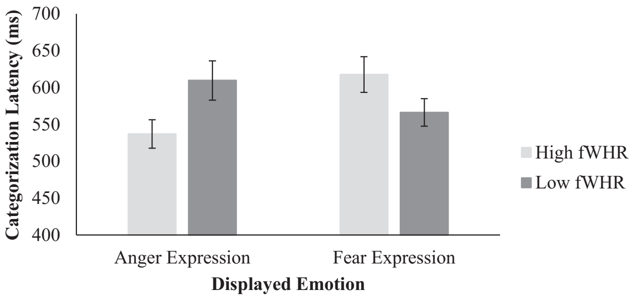


*Figure 2.* Categorization latency (in milliseconds) as a function of target facial width-to-height ratio and expression in Study 1a. Errors bars represent standard error of the mean. fWHR = facial width-to-height ratio.

were slower for high fWHR faces ($M$ = 617.62, $SD$ = 140.84) than for low fWHR faces ($M$ = 566.30, $SD$ = 135.95), $t(53) = -2.54$, $p$ = .014, 95% CI [−0.05, −0.01], $d = -0.35$.

The results from the current Study demonstrate that fWHR influences the expressions targets are presumed to be masking. Specifically, high fWHR targets were generally believed to be hiding anger rather than fear compared with low fWHR targets, who instead were thought to be hiding fear rather than anger. Further, participants were quicker to associate anger with high fWHR than low fWHR faces and faster to associate fear with low fWHR than high fWHR faces.

## Study 1b

Much work on facial width-to-height ratio has focused on how men behave or are perceived differentially depending on their fWHR with relatively little research examining the associations between fWHR and behavior or person perception for women (Geniole et al., 2015; Haselhuhn et al., 2015). Nonetheless, female faces do naturalistically vary in fWHR, and recent research has found that the effects of fWHR on judgments of female faces may be similar to the effects of fWHR on judgments of male faces (Deska et al., 2017). Thus, it is reasonable to expect that fWHR might have similar effects on female faces as it does on male faces. Study 1b included male faces as in Study 1a, allowing us to test for a close replication of the previous study, while also including female faces as targets.

**Participants.** Forty-nine participants ($M_{age}$ = 37.12, $SD$ = 11.93) completed this study online and were remunerated $0.40 for their participation. Most participants identified as White (71.4%). Additionally, 14.3% identified as Asian, 8.2% identified as Black, 4.1% identified as Latino/a, and 2.0% identified as multiracial. Women comprised 42.9% of the sample. No participants were excluded from analysis.

**Materials.** We used the same stimuli that we did in Study 1a; however, instead of using the six White male individuals with the highest and lowest fWHR, we used the five White male individuals and the five White female individuals with the highest and lowest fWHR, for a total of 20 stimuli. Pretesting revealed that the high fWHR individuals had greater fWHR than the low fWHR individuals, $F(3, 16) = 188.52$, $p < .001$, $\eta_p^2 = .92$, but that there was no effect of target sex (i.e., fWHR was not sexually dimorphic among these stimuli). An analysis of attractiveness ratings (obtained from the Chicago Face Database) revealed that the low fWHR individuals were not significantly more attractive than high fWHR individuals, $F(1, 16) = 3.46$, $p = .081$, $\eta_p^2 = .18$, nor did male and female targets differ on attractiveness, $F(1, 16) = 0.55$, $p = .47$, $\eta_p^2 = .03$. As before, images were resized to be 682 × 480 pixels and were presented on monitors that were using a 1,024 × 768 resolution.

**Procedure.** The procedure of Study 1b was identical to that of Study 1a, except as noted. Participants viewed each of the 20 stimuli one at a time, in a randomized order. All stimuli were displayed onscreen for 500 milliseconds. Although participants were instructed faces would appear only briefly, responses were not timed because of the online nature of the study.

### Results and Discussion

Of primary interest was the extent to which fWHR interacted with target sex to bias people's beliefs about the expressions that an individual was purportedly attempting to hide. To investigate this, we recorded the proportion of anger categorizations out of total categorizations as a function of high and low fWHR, separately for male and female targets. These values were submitted to a 2(fWHR: high vs. low) × 2(target sex: male vs. female) repeated-measures ANOVA. This test yielded a main effect of fWHR, $F(1, 48) = 39.27$, $p < .001$, 95% CI [0.13, 0.26], $\eta_p^2 = .45$. Consistent with Study 1a, people were more likely to categorize a high fWHR face ($M$ = 0.61, $SD$ = 0.16) as displaying anger than a low fWHR face ($M$ = 0.41, $SD$ = 0.14). This analysis also yielded a main effect of target sex, $F(1, 48) = 12.90$, $p = .001$, 95% CI [0.04, 0.15], $\eta_p^2 = .21$. Participants were more likely to believe a male face was hiding anger ($M$ = 0.56, $SD$ = 0.14) than a female face ($M$ = 0.46, $SD$ = 0.14). These lower order effects were not qualified by a fWHR by target sex interaction, $F(1, 48) = 1.99$, $p = .16$, $\eta_p^2 = .04$.

Replicating Study 1a, participants were more likely to believe that high fWHR individuals were attempting to mask an anger expression than low fWHR targets. Moreover, this effect was unqualified by an interaction with target sex, suggesting that fWHR may have similar effects on both male and female faces. Although smaller, we also observed a main effect of sex, such that participants believed male faces were more likely to be hiding anger than female faces. This finding is consistent with past literature associating male faces and anger (e.g., Adams et al., 2015). Together, the findings of Study 1a and 1b demonstrate that fWHR can bias judgments about the emotions an individual is experiencing. When perceivers encounter a relatively high fWHR (relative to low fWHR) face, they are more likely to judge that face as angry (relative to fearful).

## Study 2

Studies 1a and 1b demonstrated that fWHR can bias the judgments people make about the emotions others are experiencing. In these initial studies, we used neutrally expressive faces to demonstrate the existence of this bias. However, it is an open question as to whether this bias remains in the presence of unambiguous expressive information. People are remarkably adept at decoding facial expressions (Ambady et al., 2000; Zebrowitz & Montepare, 2015). Thus, participants should readily use the expressive content of the face when categorizing expressions, demonstrating a robust ability to correctly categorize angry faces as angry (and fearful faces as fearful). Often, decision biases (e.g., from stereotypes) can be at their strongest in highly ambiguous situations, and can be attenuated by clear diagnostic information (Krueger & Rothbart, 1988). Thus, perhaps the effects of fWHR on judging expressions may be eliminated by the presence of an unambiguous expression. However, past research has demonstrated that judgments of even unambiguous expressions (e.g., strong facial signals of anger) can be distorted by target-level characteristics (e.g., Plant, Hyde, Keltner, & Devine, 2000; Sacco & Hugenberg, 2009). Of interest, then, is whether fWHR continues to exert an influence even in the presence of a strong musculature-based signal of emotion.

To investigate this question, participants completed a speeded expression categorization task for faces displaying angry and fearful musculature-based expressions. Participants were shown a series of faces that varied naturally in their fWHR such that half were relatively high fWHR and half were relatively low fWHR. Each face displayed either an angry or a fearful expression. Participants' task was to decide, as quickly and as accurately as possible, whether each target was displaying an angry or fearful expression. If fWHR continues to exert an influence on judgments of expression even in the presence of actual expressions, participants should be less accurate when decoding fear (compared with anger) on high fWHR faces and anger (compared with fear) on low fWHR faces. Similarly, the speed with which participants' categorizations are rendered may also depend on target fWHR. Participants may be slower when categorizing fear (compared with anger) on high fWHR faces and anger (compared with fear) on low fWHR faces.

## Method

**Participants.** In Study 2, 56 undergraduate students ($M_{age}$ = 19.05, $SD$ = 1.24) participated in exchange for partial course credit. Most participants identified as White (69.6%). Additionally, 23.2% identified as Asian, 5.4% identified as Black, and 1.6% identified as multiracial. Fifty percent of participants identified as female. No participants were excluded from analysis.

**Materials.** Stimuli were the same as those used in Study 1a except that instead of using neutrally expressive faces, we instead used the same face identities displaying angry and fearful expressions. Images were resized to be 682 × 480 pixels and were presented on monitors that were using a 1,024 × 768 resolution.

**Procedure.** After providing informed consent, participants completed a speeded emotion categorization task (adapted from Sacco & Hugenberg, 2009). Participants were informed that we were interested in their ability to recognize facial expressions of emotion. Their task was to simply categorize each face as angry or as fearful as quickly and as accurately as possible.

This categorization task consisted of 216 trials over 3 blocks. Every trial began with a fixation cross (presented for 1,000ms) that was followed by an image of a face (presented for 200ms), which was then occluded by a white box. Participants rendered a categorization decision via keystroke as quickly and accurately as possible. Incorrect categorizations elicited a red "ERROR" message (1,000ms). There was a 500-ms intertrial interval. Each block consisted of 72 trials. Within every block, participants saw all six faces from each of the four categories of the design (i.e., high fWHR-angry; high fWHR-fearful; low fWHR-angry; low fWHR-fearful) three times. Presentation order of the stimuli was randomized separately for each participant. After completing the categorization task, participants were asked to provide demographic information (e.g., sex, age, race), were debriefed, and were thanked for their participation.

## Results and Discussion

Of primary interest was the extent to which fWHR facilitated the accurate recognition of angry and fearful facial expressions. To investigate this, we computed mean accuracy separately for high and low fWHR faces displaying angry and fearful expressions. These values were submitted to a 2(fWHR: high vs. low) × 2 (expression: angry vs. fearful) repeated-measures ANOVA. This analysis yielded a main effect of fWHR, $F(1, 55) = 8.70$, $p = .005$, 95% CI [0.03, 0.07], $\eta_p^2 = .14$, such that participants were more accurate at recognizing emotions on low fWHR faces ($M = 0.90$, $SD = 0.08$) than high fWHR faces ($M = 0.88$, $SD = 0.06$). More importantly, this main effect was qualified by the predicted fWHR by expression interaction, $F(1, 55) = 69.19$, $p < .001$, $\eta_p^2 = .56$ (see Figure 3).

Pairwise comparisons indicated that participants were more accurate at recognizing anger on high fWHR faces ($M = 0.90$, $SD = 0.07$) than on low fWHR faces ($M = 0.87$, $SD = 0.11$), $t(55) = 3.78$, $p < .001$, 95% CI [0.02, 0.06], $d = 0.51$. Additionally, participants were less accurate at recognizing fear on high fWHR faces ($M = 0.85$, $SD = 0.08$) than on low fWHR faces ($M = 0.92$, $SD = 0.08$), $t(55) = -7.73$, $p < .001$, 95% CI [−0.10, −0.06], $d = -1.03$. Considering this interaction another way, pairwise comparisons revealed that among high fWHR faces, anger ($M = 0.90$, $SD = 0.07$) was more accurately categorized than fear ($M = 0.85$, $SD = 0.08$), $t(55) = 4.96$, $p < .001$, 95% CI [0.03, 0.07], $d = 0.66$. Among low fWHR faces, anger ($M = 0.87$, $SD = 0.11$) was less accurately categorized than fear ($M = 0.92$, $SD = 0.08$), $t(55) = -5.37$, $p < .001$, 95% CI [−0.08, −0.04], $d = -0.72$.

Of additional interest was the speed with which participants rendered categorizations of anger and fear on high and low fWHR faces. Here, we expected to see an interaction such that high fWHR faces would facilitate the rapid categorization of anger relative to low fWHR faces, which instead would facilitate the rapid categorization of fear. To test this, we separately computed RTs for participants' categorizations of high and low fWHR faces

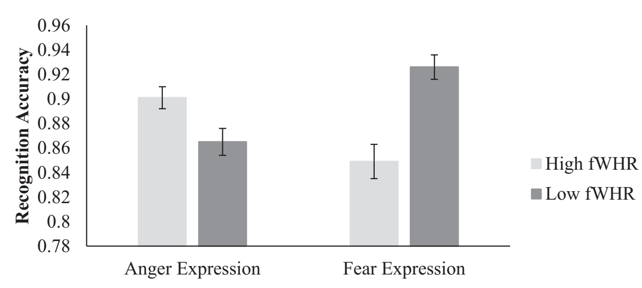


*Figure 3.* Recognition accuracy of angry and fearful expressions across high and low facial width-to-height ratio (fWHR) targets in Study 2. Errors bars reflect standard error of the mean.

as angry and fearful. We first eliminated incorrect responses and responses with latencies faster than 200 milliseconds and slower than 1,500 milliseconds (16.34% of trials). As in Study 1a, analyses were conducted on log10 transformed data; descriptive statistics reflect untransformed data for ease of interpretation. These values were submitted to a 2(fWHR: high vs. low) × 2(expression: angry vs. fearful) repeated-measures ANOVA. This analysis yielded a marginally significant main effect of fWHR, $F(1, 55) = 3.67$, $p = .061$, 95% CI [−0.00, 0.02], $\eta_p^2 = .06$. Participants responded to high fWHR faces ($M = 492.19$, $SD = 93.18$) marginally more slowly than they did to low fWHR faces ($M = 483.64$, $SD = 97.87$). This analysis also yielded a main effect of expression, $F(1, 55) = 14.18$, $p < .001$, 95% CI [−0.03, −0.01], $\eta_p^2 = .21$. Participants categorized anger expressions ($M = 475.20$, $SD = 93.04$) faster than they categorized fear expressions ($M = 500.63$, $SD = 101.93$). However, these effects were qualified by an interaction, $F(1, 55) = 104.08$, $p < .001$, $\eta_p^2 = .65$ (see Figure 4). Pairwise comparisons demonstrated that participants were faster to categorize high fWHR faces as angry ($M = 460.21$, $SD = 88.69$) than as fearful ($M = 524.16$, $SD = 108.12$), $t(55) = -7.68$, $p < .001$, 95% CI [−0.07, −0.04], $d = -1.02$. Participants were marginally slower to categorize low fWHR faces as angry ($M = 490.19$, $SD = 102.32$) than as fearful ($M = 477.10$, $SD = 99.88$), $t(55) = 1.98$, 95% CI [−0.00, 0.02], $p = .052$, $d = 0.26$. Considered another way, when faces displayed angry expressions, participants made categorizations more quickly on high fWHR faces ($M = 460.21$, $SD = 88.69$) than on low fWHR faces, ($M = 490.19$, $SD = 102.32$), $t(55) = -4.83$, 95% CI [−0.04, −0.02,], $p < .001$, $d = -0.65$. Conversely, when faces displayed fearful expressions, participants made categorizations slower on high fWHR faces ($M = 524.16$, $SD = 108.12$) than on low fWHR faces, ($M = 477.10$, $SD = 99.88$), $t(55) = 8.42$, 95% CI [0.03, 0.05], $p < .001$, $d = 1.13$.

Consistent with predictions, the results of Study 2 show that the accurate recognition of angry and fearful facial expressions is moderated by targets' fWHR. Specifically, participants categorized anger on high fWHR faces more quickly and accurately than on low fWHR faces. Conversely, participants categorized fear on low fWHR faces more quickly and accurately than on high fWHR faces. Thus, even in the presence of unambiguous facial expressions of emotion, fWHR continues to exert an influence on emotion categorizations.

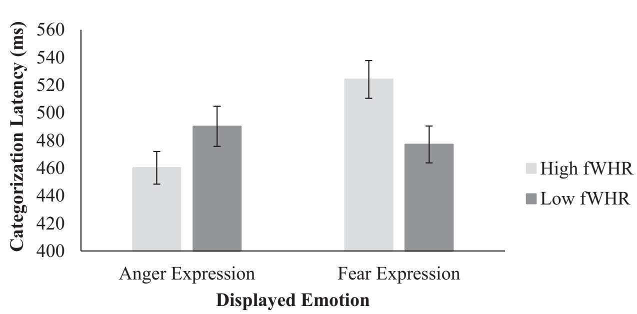


*Figure 4.* Categorization latency (in milliseconds) as a function of target facial width-to-height ratio and expression in Study 2. Errors bars represent standard error of the mean. fWHR = facial width-to-height ratio.

## Study 3

Study 2 demonstrates that fWHR influences how quickly and accurately perceivers recognize facial expressions of anger and fear. We had interpreted this as a product of the differential signal value of expressions—anger signals dominance whereas fear signals submission. However, anger and fear differ in another important way—anger is an approach-oriented emotion whereas fear is an avoidance-oriented emotion (Adams, Ambady, Macrae, & Kleck, 2006). Thus, it may be the case that, more generally, high fWHR signals approach and low fWHR signals avoidance, rather than being about the specific emotions. Study 3 was designed to begin to address questions about whether these effects are emotion-specific or are about the more general approach-avoidance signaling of emotions.

Specifically, Study 3 focused on facial expressions of happiness instead of expressions of fear. Employing happy and angry stimuli affords two key benefits. First, both happiness and anger are approach-related emotions. If the effect observed in the previous studies is due to anger being approach-related and fear being avoidance-related, the fWHR by emotion interaction should be eliminated in an anger-versus-happiness judgment. Second, both fear and happiness are prosocial emotions (Marsh, Kozak, & Ambady, 2007). Whereas fear signals the need for pro-social behavior from others, happiness signals the desire for prosocial interaction from others. Because of this, if the fWHR-expression effects observed in the previous studies are about the specific signal value of the emotions (i.e., for dominant vs. prosocial interactions), the fWHR by emotion interaction should be obtained in an anger-versus-happiness judgment.

Thus, in Study 3, we focused on the extent to which fWHR influences the ability for perceivers to categorize anger and happiness, both of which are approach emotions that differ in their prosocial orientation. Although we expected to replicate the effects of anger, of interest was whether happiness would function more like anger (another approach emotion) or whether happiness would function more like fear (because high fWHR targets are seen as aggressive).

### Method

**Participants.** Fifty-eight undergraduate participants ($M_{age} = 19.24$, $SD = 1.14$) completed this study in exchange for partial course credit. Most participants identified as White (84.6%). Additionally, 10.3% identified as Asian, and 1.7% identified as Black. Two participants stated that they did not wish to disclose their racial identity. Female identified participants comprised 46.6% of this sample. No participants were excluded from analysis.

**Materials.** Stimuli were the same as those used in Study 2 except that we substituted faces from the Chicago Face Database displaying happy expressions for the fearful expression faces. Face identities remained the same.

**Procedure.** The procedure for the current Study was identical to that employed in Study 2 with the notable exception that participants categorized whether faces were displaying angry or happy expressions instead of angry and fearful categorizations.

## Results and Discussion

Of primary interest was the extent to which fWHR facilitated the accurate recognition of angry and happy facial expressions. To investigate this, we computed mean accuracy separately for high and low fWHR faces displaying angry and happy expressions. These values were submitted to a 2(fWHR: high vs. low) × 2 (expression: angry vs. happy) repeated-measures ANOVA. This analysis yielded a marginally significant main effect of fWHR, $F(1, 57) = 3.04$, $p = .086$, 95% CI [−0.02, 0.00], $\eta_p^2 = .05$, such that participants were more accurate at recognizing emotions on low fWHR faces ($M = 0.91$, $SD = 0.05$) than high fWHR faces ($M = 0.92$, $SD = 0.05$). This lower order effect was qualified by an interaction, $F(1, 57) = 21.60$, $p < .001$, $\eta_p^2 = .28$ (see Figure 5). Pairwise comparisons indicated that participants were more accurate at recognizing anger on high fWHR faces ($M = 0.92$, $SD = 0.06$) than on low fWHR faces ($M = 0.91$, $SD = 0.08$), $t(57) = 2.06$, $p = .044$, 95% CI [0.00, 0.03], $d = 0.27$. Additionally, participants were less accurate at recognizing happiness on high fWHR faces ($M = 0.90$, $SD = 0.06$) than on low fWHR faces ($M = 0.94$, $SD = 0.06$), $t(57) = -4.95$, $p < .001$, 95% CI [−0.05, −0.02], $d = -0.66$. Considering this interaction another way, among high fWHR faces, anger ($M = 0.92$, $SD = 0.06$) was categorized marginally more accurately than happiness ($M = 0.90$, $SD = 0.06$), $t(57) = 1.84$, $p = .071$, 95% CI [−0.00, 0.04], $d = 0.66$. Among low fWHR faces, anger ($M = 0.91$, $SD = 0.08$) was categorized less accurately than happiness ($M = 0.92$, $SD = 0.08$), $t(55) = -2.88$, $p = .006$, 95% CI [−0.05, −0.01], $d = -0.38$.

Of additional interest was the extent to which participants' categorizations of high and low fWHR faces angry or fearful was differentially speeded. To test this, we separately computed RTs for participants' categorizations of high and low fWHR faces as angry and happy. We first eliminated responses with latencies faster than 200 milliseconds and slower than 1,500 milliseconds (19.42% of trials). As in the previous studies, analyses were conducted on log10 transformed data, although, for ease of interpretation, descriptive statistics reflect untransformed data. This analysis yielded a main effect of expression, $F(1, 57) = 19.34$, $p < .001$, 95% CI [0.01, 0.02], $\eta_p^2 = .25$, such that anger ($M = 406.71$, $SD = 92.38$) was categorized slower than happiness ($M = 391.23$, $SD = 84.29$). However, this effect was qualified by an interaction, $F(1, 57) = 30.38$, $p < .001$, $\eta_p^2 = .35$ (see Figure 6). To better understand the nature of this interaction, we computed pairwise comparisons. Participants were equally fast to categorize high fWHR faces as angry ($M = 396.21$, $SD = 90.81$) and happy ($M = 398.44$, $SD = 84.11$), $t(57) = -0.71$, 95% CI [−0.01, 0.01], $p = .48$, $d = -0.09$. Participants were slower to categorize low fWHR faces as angry ($M = 417.20$, $SD = 97.23$) than as happy ($M = 384.02$, $SD = 87.94$), $t(57) = 6.65$, 95% CI [0.02, 0.05], $p < .001$, $d = 0.87$. Looked at another way, when faces displayed angry expressions, participants were faster to categorize high fWHR faces ($M = 396.21$, $SD = 90.81$) than low fWHR faces, ($M = 417.20$, $SD = 97.23$), $t(57) = -4.70$, 95% CI [−0.03, −0.01], $p < .001$, $d = -0.62$. When faces displayed happy expressions, participants were slower to categorize high fWHR faces ($M = 398.44$, $SD = 84.11$) than low fWHR faces, ($M = 384.02$, $SD = 87.94$), $t(57) = 3.40$, 95% CI [0.01, 0.03], $p = .001$, $d = 0.45$.

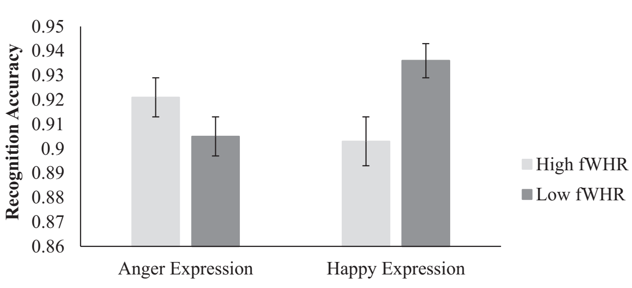


*Figure 5.* Recognition accuracy of angry and happy expressions across high and low facial width-to-height ratio (fWHR) targets in Study 3. Errors bars reflect standard error of the mean.


*Figure 6.* Categorization latency (in milliseconds) as a function of target facial width-to-height ratio and expression in Study 3. Errors bars represent standard error of the mean. fWHR = facial width-to-height ratio.

The observed effects not only replicate the high fWHR-to-anger link, but also demonstrate that the effects of fWHR on facial expressions extend beyond anger and fear. Specifically, replicating the findings of Study 2, participants more accurately and quickly categorized anger on high fWHR compared with low fWHR faces. Furthermore, participants were less accurate and slower at categorizing happy expressions on high fWHR compared with low fWHR faces, mirroring the findings with fear.

## General Discussion

Humans are quite adept at decoding facial emotion. However, various target-level cues, including targets' group memberships and facial structures, can influence how emotional displays are judged. In the current work, we hypothesized that targets higher in fWHR, a facial dimension associated with aggression and sharing phenotypic resemblance to anger, would be more efficiently categorized as angry, relative to low fWHR faces and fear and happiness.

To that end, we provided evidence from four experiments consistent with this hypothesis. Studies 1a and 1b demonstrated that neutrally expressive high fWHR and low fWHR faces are perceived as signaling anger and fear, respectively. Specifically, when shown neutral faces, perceivers were more likely to believe that high fWHR targets were attempting to mask anger and that low fWHR targets were attempting to mask fear, suggesting that face structure sends an emotion-laden signal independent of the expressive intent of the encoder. Moreover, Study 1b provided a close replication of Study 1a while demonstrating that this effect occurs for both male and female faces. Study 2 demonstrated that perceivers' ability to categorize angry or fearful expressions on faces was moderated by target fWHR, with perceivers more accurately and quickly categorizing anger on high fWHR faces relative to low fWHR faces, which facilitated the accurate and quick categorization of fear. Finally, Study 3 replicated and extended the effects of Study 2 to a new expression. Study 3 again demonstrated that perceivers more accurately and quickly categorized anger on high fWHR faces than low fWHR faces, but also categorized happiness more easily on low fWHR than on high fWHR faces. Taken together, these results provide evidence consistent with the hypothesis that facial width-to-height ratio influences the recognition of angry, fearful, and happy expressions.

## Implications

These results may have important implications for both perceiver and target well-being as well as social interaction success. Accurately encoding and decoding facial expressions is adaptive and functional, facilitating social communication and interaction. We believe that the interaction between fWHR and expression can have both costs and benefits for targets and perceivers. When a high fWHR individual intends to signal dominance, or when a low fWHR target intends to signal submission, perceivers quickly and accurately recognize it, facilitating the communicative nature of the expression. However, in situations where high fWHR individuals display fear, or when low fWHR individuals display anger, perceivers may struggle to decode their expression. These biases may have consequences for both perceivers and senders of expressions. Perceivers who misread anger as fear might put themselves in harm's way. For instance, when low fWHR individuals display anger, this may be misread as fear. Individuals might seek to comfort these individuals who they should instead avoid. Such treatment may be seen as confusing, or potentially patronizing, and might lead to acts of aggression. Expressers may also be at risk when their emotions are misread. For example, a high fWHR individual's displayed fear might be misread as anger. Although fear signals submission or a lack of felt safety, others may see that expression as anger, perhaps potentiating unnecessary confrontations. Indeed, in Study 2, participants erroneously categorized fearful faces as angry twice as often (7% of the time compared with 15% of the time; see Figure 3) on high fWHR faces compared with low fWHR faces, a startling difference given participants' overall strong ability to accurately categorize these emotions.

Consistent with past work (Neth & Martinez, 2010), these results suggest that static face structure may send signals of emotion independently from facial expressions. Perceivers may, at a baseline, assume that high fWHR individuals are angry, or that low fWHR individuals are afraid. Extensive work on self-fulfilling prophecy (e.g., Word, Zanna, & Cooper, 1974) shows that expectations of an individual affect how people behave toward that individual, often eliciting the very characteristic (in this case emotion) that was expected. High fWHR people are perceived to be aggressive (Carré et al., 2009). This perception could reflect a veridical representation of reality (Haselhuhn et al., 2015), but it could also be the end-product of a behavioral confirmation process. If we begin an interaction with someone with whom we believe is already angry, it may be easy for that interaction to go awry and generate the anger we might erroneously have assumed was already present.

## Limitations and Future Directions

The results of our studies demonstrated that perceivers tend to see anger on high fWHR faces and fear and happiness on low fWHR faces, respectively. Less clear, however, is precisely why this occurs. One possibility is that perceivers have specific facial stereotypes based on fWHR (i.e., perceivers expect high fWHR targets to act aggressively, relative to low fWHR targets). Indeed, evidence for facial stereotypes have been shown for a variety of traits, such as criminality (a trait related to aggression; Shoemaker, South, & Lowe, 1973; Wilson & Rule, 2015). Another possibility is that high and low fWHR faces share phenotypic overlap with expressions. Indeed, research demonstrates that the shape of a face, including its height and width, is sufficient to bias emotion perceptions even on neutrally expressive faces (Neth & Martinez, 2010; Martinez & Du, 2012; Zhao, Bülthoff, & Bülthoff, 2016). However, we do not see these two possibilities as mutually exclusive, or even necessarily competing. Rather, it is entirely possible that facial stereotypes and phenotypic overlap work together to produce the observed effects. Indeed, theorists have argued that certain facial characteristics, such as facial maturity, coevolved with anger and fear for the socially adaptive purpose of facilitating communication (e.g., Hess et al., 2009; Marsh et al., 2005; Sacco & Hugenberg, 2009). Both high fWHR and anger are signals of behavioral dominance; insofar as anger expressions mimic another signal of dominance (i.e., high fWHR), this could assist in the communicative value of these expressions (Hess et al., 2009). Nevertheless, future research is needed to disentangle these potential mechanisms to precisely pin down how fWHR and other face structures influence the ability to decode expressions.

It is also worth noting that we used faces that naturalistically varied in the fWHR, with some being quite high and some being quite low. This approach was intentional. By treating fWHR categorically we were able to provide unambiguous evidence that high and low fWHR biases emotion recognition. Nevertheless, in vivo fWHR is continuous. Treating fWHR categorically may have inflated the size of the observed effects. Yet, we hypothesize that similar effects may emerge across the fWHR continuum, likely growing larger the further faces deviate from the midpoint of a given population (see Neth & Martinez, 2010). Future work would do well to directly test this possibility.

Finally, the present research used exclusively White faces and primarily White participants to test the hypothesized relationship between fWHR and expressions. However, we know from past research that the expressive content of faces can be biased by race or other social categories, even when the expressions themselves are held constant (e.g., Hugenberg & Bodenhausen, 2003; Hutchings & Haddock, 2008). Of interest in future research is whether the effects of fWHR on judgments of facial expressions occur equivalently for ingroup and outgroup faces. Although we know of no data that test this hypothesis directly, recent research from our own lab investigating how fWHR can influence dehumanization indicates that fWHR effects and race effects are independent (Deska et al., 2017; see also Short et al., 2012). Although it is an open empirical question, it is possible that bottom-up facial structural cues have distinct effects from those of social categories (see Hugenberg & Wilson, 2013 for a review).

## Concluding Remarks

In the current work, we demonstrate that natural variations in facial width-to-height ratio influence how facial displays of emotion are decoded. Specifically, we provide consistent evidence that people perceive anger more quickly and accurately on faces with high facial width-to-height ratio compared with those with low facial width-to-height ratio, which facilitate that rapid and accurate categorization of fear and happiness.

## References


Adams, R. B., Franklin, R. G., Nelson, A. J., & Stevenson, M. T. (2011). Compound social cues in face processing. In R. B. Adams, N. Ambady, K. Nakayama, & S. Shimojo (Eds.), *The science of social vision* (pp. 90–107). New York, NY: Oxford University Press.

Adams, R. B., Jr., Ambady, N., Macrae, C. N., & Kleck, R. E. (2006). Emotional expressions forecast approach-avoidance behavior. *Motivation and Emotion, 30,* 177–188. http://dx.doi.org/10.1007/s11031-006-9020-2

Adams, R. B., Jr., Hess, U., & Kleck, R. E. (2015). The intersection of gender-related facial appearance and facial displays of emotion. *Emotion Review, 7,* 5–13. http://dx.doi.org/10.1177/1754073914544407

Alrajih, S., & Ward, J. (2014). Increased facial width-to-height ratio and perceived dominance in the faces of the UK's leading business leaders. *British Journal of Psychology, 105,* 153–161. http://dx.doi.org/10.1111/bjop.12035

Ambady, N., Bernieri, F. J., & Richeson, J. A. (2000). Toward a histology of social behavior: Judgmental accuracy from thin slices of the behavioral stream. *Advances in Experimental Social Psychology, 32,* 201–271. http://dx.doi.org/10.1016/S0065-2601(00)80006-4

Beaupré, M. G., & Hess, U. (2005). Cross-cultural emotion recognition among Canadian ethnic groups. *Journal of Cross-Cultural Psychology, 36,* 355–370. http://dx.doi.org/10.1177/0022022104273656

Becker, D. V., Kenrick, D. T., Neuberg, S. L., Blackwell, K. C., & Smith, D. M. (2007). The confounded nature of angry men and happy women. *Journal of Personality and Social Psychology, 92,* 179–190. http://dx.doi.org/10.1037/0022-3514.92.2.179

Bijlstra, G., Holland, R. W., Dotsch, R., Hugenberg, K., & Wigboldus, D. H. (2014). Stereotype associations and emotion recognition. *Personality and Social Psychology Bulletin, 40,* 567–577. http://dx.doi.org/10.1177/0146167213520458

Bijlstra, G., Holland, R. W., & Wigboldus, D. H. (2010). The social face of emotion recognition: Evaluations versus stereotypes. *Journal of Experimental Social Psychology, 46,* 657–663. http://dx.doi.org/10.1016/j.jesp.2010.03.006

Bird, B. M., Jofré, V. S. C., Geniole, S. N., Welker, K. M., Zilioli, S., Maestripieri, D., . . . Carre, J. M. (2016). Does the facial width-to-height ratio map onto variability in men's testosterone concentrations? *Evolution and Human Behavior, 37,* 392–398. http://dx.doi.org/10.1016/j.evolhumbehav.2016.03.004

Carré, J. M., & McCormick, C. M. (2008). In your face: Facial metrics predict aggressive behaviour in the laboratory and in varsity and professional hockey players. *Proceedings of the Royal Society of London, Series B: Biological Sciences, 275,* 2651–2656. http://dx.doi.org/10.1098/rspb.2008.0873

Carré, J. M., McCormick, C. M., & Mondloch, C. J. (2009). Facial structure is a reliable cue of aggressive behavior. *Psychological Science, 20,* 1194–1198. http://dx.doi.org/10.1111/j.1467-9280.2009.02423.x

Craig, B. M., Koch, S., & Lipp, O. V. (in press). The influence of social category cues on the happy categorization advantage depends on expression valence. *Cognition and Emotion*.

Craig, B. M., & Lipp, O. V. (2017). The influence of facial sex cues on emotional expression categorization is not fixed. *Emotion, 17,* 28–39. http://dx.doi.org/10.1037/emo0000208

Deska, J. C., Lloyd, E. P., & Hugenberg, K. (2017). *Facing humanness: Facial width-to-height ratio predicts ascriptions of humanity*. Manuscript submitted for publication.

Dunham, Y. (2011). An angry = outgroup effect. *Journal of Experimental Social Psychology, 47,* 668–671.

Dunham, Y. C., & Banaji, M. R. (2006). The "angry = black" effect across the lifespan. *Journal of Vision, 6,* 280. http://dx.doi.org/10.1167/6.6.280

Ekman, P. (1993). Facial expression and emotion. *American Psychologist, 48,* 384–392. http://dx.doi.org/10.1037/0003-066X.48.4.384

Ekman, P. (2003). *Emotions revealed*. New York, NY: Henry Holt.

Ekman, P., Friesen, W. V., O'Sullivan, M., Chan, A., Diacoyanni-Tarlatzis, I., Heider, K., . . . Tzavaras, A. (1987). Universals and cultural differences in the judgments of facial expressions of emotion. *Journal of Personality and Social Psychology, 53,* 712–717. http://dx.doi.org/10.1037/0022-3514.53.4.712

Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: A meta-analysis. *Psychological Bulletin, 128,* 203–235. http://dx.doi.org/10.1037/0033-2909.128.2.203

Elfenbein, H. A., Beaupré, M., Lévesque, M., & Hess, U. (2007). Toward a dialect theory: Cultural differences in the expression and recognition of posed facial expressions. *Emotion, 7,* 131–146. http://dx.doi.org/10.1037/1528-3542.7.1.131

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39,* 175–191. http://dx.doi.org/10.3758/BF03193146

Geniole, S. N., Denson, T. F., Dixson, B. J., Carré, J. M., & McCormick, C. M. (2015). Evidence from meta-analyses of the facial width-to-height ratio as an evolved cue of threat. *PLoS ONE, 10,* e0132726. http://dx.doi.org/10.1371/journal.pone.0132726

Haselhuhn, M. P., Ormiston, M. E., & Wong, E. M. (2015). Men's facial width-to-height ratio predicts aggression: A meta-analysis. *PLoS ONE, 10,* e0122637. http://dx.doi.org/10.1371/journal.pone.0122637

Haselhuhn, M. P., & Wong, E. M. (2011). Bad to the bone: Facial structure predicts unethical behaviour. *Proceedings of the Royal Society of London B: Biological Sciences,* 571–576.

Hehman, E., Flake, J. K., & Freeman, J. B. (2015). Static and dynamic facial cues differentially affect the consistency of social evaluations. *Personality and Social Psychology Bulletin, 41,* 1123–1134. http://dx.doi.org/10.1177/0146167215591495

Hehman, E., Leitner, J. B., & Freeman, J. B. (2014). The face-time continuum: Lifespan changes in facial width-to-height ratio impact aging-associated perceptions. *Personality and Social Psychology Bulletin, 40,* 1624–1636. http://dx.doi.org/10.1177/0146167214552791

Hehman, E., Leitner, J. B., & Gaertner, S. L. (2013). Enhancing static facial features increases intimidation. *Journal of Experimental Social Psychology, 49,* 747–754. http://dx.doi.org/10.1016/j.jesp.2013.02.015

Hess, U., Adams, R. B., Jr., & Kleck, R. E. (2009). The face is not an empty canvas: How facial expressions interact with facial appearance. *Philosophical Transactions of the Royal Society of London, Series B: Biological Sciences, 364,* 3497–3504. http://dx.doi.org/10.1098/rstb.2009.0165

Hugenberg, K., & Bodenhausen, G. V. (2003). Facing prejudice: Implicit prejudice and the perception of facial threat. *Psychological Science, 14,* 640–643. http://dx.doi.org/10.1046/j.0956-7976.2003.psci_1478.x

Hugenberg, K., & Bodenhausen, G. V. (2004). Ambiguity in social categorization: The role of prejudice and facial affect in race categorization.

*Psychological Science, 15,* 342–345. http://dx.doi.org/10.1111/j.0956-7976.2004.00680.x

Hugenberg, K., & Sczesny, S. (2006). On wonderful women and seeing smiles: Social categorization moderates the happy face response latency advantage. *Social Cognition, 24,* 516–539. http://dx.doi.org/10.1521/soco.2006.24.5.516

Hugenberg, K., & Wilson, J. P. (2013). Faces are central to social cognition. In D. Carlston (Ed.), *Handbook of social cognition* (pp. 167–193). New York, NY: Oxford University Press.

Hutchings, P. B., & Haddock, G. (2008). Look Black in anger: The role of implicit prejudice in the categorization and perceived emotional intensity of racially ambiguous faces. *Journal of Experimental Social Psychology, 44,* 1418–1420. http://dx.doi.org/10.1016/j.jesp.2008.05.002

Keating, C. F. (1985). Gender and the physiognomy of dominance and attractiveness. *Social Psychology Quarterly, 48,* 61–70. http://dx.doi.org/10.2307/3033782

Keating, C. F., Mazur, A., & Segall, M. H. (1977). Facial gestures which influence the perception of status. *Sociometry, 40,* 374–378.

Kramer, R. S., Jones, A. L., & Ward, R. (2012). A lack of sexual dimorphism in width-to-height ratio in white European faces using 2D photographs, 3D scans, and anthropometry. *PLoS ONE, 7,* e42705. http://dx.doi.org/10.1371/journal.pone.0042705

Krueger, J., & Rothbart, M. (1988). Use of categorical and individuating information in making inferences about personality. *Journal of Personality and Social Psychology, 55,* 187–195. http://dx.doi.org/10.1037/0022-3514.55.2.187

Lefevre, C. E., Lewis, G. J., Perrett, D. I., & Penke, L. (2013). Telling facial metrics: Facial width is associated with testosterone levels in men. *Evolution and Human Behavior, 34,* 273–279. http://dx.doi.org/10.1016/j.evolhumbehav.2013.03.005

Lefevre, C. E., Lewis, G. J., Bates, T. C., Dzhelyova, M., Coetzee, V., Deary, I. J., & Perrett, D. I. (2012). No evidence for sexual dimorphism of facial width-to-height ratio in four large adult samples. *Evolution and Human Behavior, 33,* 623–627. http://dx.doi.org/10.1016/j.evolhumbehav.2012.03.002

Le Gal, P. M., & Bruce, V. (2002). Evaluating the independence of sex and expression in judgments of faces. *Perception & Psychophysics, 64,* 230–243. http://dx.doi.org/10.3758/BF03195789

Ma, D. S., Correll, J., & Wittenbrink, B. (2015). The Chicago face database: A free stimulus set of faces and norming data. *Behavior Research Methods, 47,* 1122–1135. http://dx.doi.org/10.3758/s13428-014-0532-5

Marsh, A. A., Adams, R. B., Jr., & Kleck, R. E. (2005). Why do fear and anger look the way they do? Form and social function in facial expressions. *Personality and Social Psychology Bulletin, 31,* 73–86. http://dx.doi.org/10.1177/0146167204271306

Marsh, A. A., Kozak, M. N., & Ambady, N. (2007). Accurate identification of fear facial expressions predicts prosocial behavior. *Emotion, 7,* 239–251. http://dx.doi.org/10.1037/1528-3542.7.2.239

Martinez, A., & Du, S. (2012). A model of the perception of facial expressions of emotion by humans: Research overview and perspectives. *Journal of Machine Learning Research, 13,* 1589–1608.

Matsumoto, D., & Willingham, B. (2009). Spontaneous facial expressions of emotion of congenitally and noncongenitally blind individuals. *Journal of Personality and Social Psychology, 96,* 1–10. http://dx.doi.org/10.1037/a0014037

Mileva, V. R., Cowan, M. L., Cobey, K. D., Knowles, K. K., & Little, A. C. (2014). In the face of dominance: Self-perceived and other-perceived dominance are positively associated with facial-width-to-height ratio in men. *Personality and Individual Differences, 69,* 115–118. http://dx.doi.org/10.1016/j.paid.2014.05.019

Montepare, J. M., & Dobish, H. (2003). The contribution of emotion perceptions and their overgeneralizations to trait impressions. *Journal of Nonverbal Behavior, 27,* 237–254. http://dx.doi.org/10.1023/A:1027332800296

Neth, D., & Martinez, A. M. (2009). Emotion perception in emotionless face images suggests a norm-based representation. *Journal of Vision, 9,* 5. http://dx.doi.org/10.1167/9.1.5

Neth, D., & Martinez, A. M. (2010). A computational shape-based model of anger and sadness justifies a configural representation of faces. *Vision Research, 50,* 1693–1711. http://dx.doi.org/10.1016/j.visres.2010.05.024

Özener, B. (2012). Facial width-to-height ratio in a Turkish population is not sexually dimorphic and is unrelated to aggressive behavior. *Evolution and Human Behavior, 33,* 169–173. http://dx.doi.org/10.1016/j.evolhumbehav.2011.08.001

Parkinson, B. (2005). Do facial movements express emotions or communicate motives? *Personality and Social Psychology Review, 9,* 278–311. http://dx.doi.org/10.1207/s15327957pspr0904_1

Penton-Voak, I. S., Wisbey, N., & Pound, N. (2007). *Judgments of sex and emotional expression of faces are not independent at brief presentation times, or in a speeded response task*. 19th Annual Meeting of the Human Behavior & Evolution Society, College of William and Mary, Williamsburg, Virginia, May 30–June 3.

Plant, E. A., Hyde, J. S., Keltner, D., & Devine, P. G. (2000). The gender stereotyping of emotions. *Psychology of Women Quarterly, 24,* 81–92. http://dx.doi.org/10.1111/j.1471-6402.2000.tb01024.x

Sacco, D. F., & Hugenberg, K. (2009). The look of fear and anger: Facial maturity modulates recognition of fearful and angry expressions. *Emotion, 9,* 39–49. http://dx.doi.org/10.1037/a0014081

Senior, C., Barnes, J., Jenkins, R., Landau, S., Phillips, M., & David, A. (1999). Attribution of social dominance and maleness to schematic faces. *Social Behavior and Personality, 27,* 331–337. http://dx.doi.org/10.2224/sbp.1999.27.4.331

Shoemaker, D. J., South, D. R., & Lowe, J. (1973). Facial stereotypes of deviants and judgments of guilt or innocence. *Social Forces, 51,* 427–433. http://dx.doi.org/10.2307/2576687

Short, L. A., Mondloch, C. J., McCormick, C. M., Carré, J. M., Ma, R., Fu, G., & Lee, K. (2012). Detection of propensity for aggression based on facial structure irrespective of face race. *Evolution and Human Behavior, 33,* 121–129. http://dx.doi.org/10.1016/j.evolhumbehav.2011.07.002

Slepian, M. L., Weisbuch, M., Adams, R. B., Jr., & Ambady, N. (2011). Gender moderates the relationship between emotion and perceived gaze. *Emotion, 11,* 1439–1444. http://dx.doi.org/10.1037/a0026163

Stirrat, M., & Perrett, D. I. (2010). Valid facial cues to cooperation and trust: Male facial width and trustworthiness. *Psychological Science, 21,* 349–354. http://dx.doi.org/10.1177/0956797610362647

Welker, K. M., Bird, B. M., & Arnocky, S. (2016). Commentary: Facial width-to-height ratio (fWHR) is not associated with adolescent testosterone levels. *Frontiers in Psychology, 7,* 1745. http://dx.doi.org/10.3389/fpsyg.2016.01745

Weston, E. M., Friday, A. E., & Liò, P. (2007). Biometric evidence that sexual selection has shaped the hominin face. *PLoS ONE, 2,* e710. http://dx.doi.org/10.1371/journal.pone.0000710

Wilson, J. P., & Rule, N. O. (2015). Facial trustworthiness predicts extreme criminal-sentencing outcomes. *Psychological Science, 26,* 1325–1331. http://dx.doi.org/10.1177/0956797615590992

Word, C. O., Zanna, M. P., & Cooper, J. (1974). The nonverbal mediation of self-fulfilling prophecies in interracial interaction. *Journal of Experimental Social Psychology, 10,* 109–120. http://dx.doi.org/10.1016/0022-1031(74)90059-6

Zebrowitz, L. A., Kikuchi, M., & Fellous, J. M. (2010). Facial resemblance to emotions: Group differences, impression effects, and race stereotypes. *Journal of Personality and Social Psychology, 98,* 175–189. http://dx.doi.org/10.1037/a0017990

Zebrowitz, L. A., & Montepare, J. M. (2008). Social psychological face perception: Why appearance matters. *Social and Personality Psychology Compass, 2,* 1497–1517. http://dx.doi.org/10.1111/j.1751-9004.2008.00109.x

Zebrowitz, L. A., & Montepare, J. M. (2015). Social psychological face perception: Why appearance matters. In M. Mikulincer, P. R. Shaver, E. Borgida, & J. A. Bargh (Eds.), *APA handbook of personality and social psychology* (Vol. 1, pp. 251–276). Washington, DC: American Psychological Association.

Zhao, M., Bülthoff, H. H., & Bülthoff, I. (2016). A shape-based account for holistic face processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 42,* 584–597. http://dx.doi.org/10.1037/xlm0000185

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