

Further Evidence for Links Between Facial Width-to-Height Ratio and Fighting Success: Commentary on Zilioli et al. (2014)

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Recent research has reported an association between facial width-to-height ratio (fWHR) and both fighting performance and judgments of formidability in a sample of mixed martial arts (MMA) combatants. The results provide evidence of fWHR being associated with sporting performance and aggression in men. However, it has been argued that the effect of fWHR might be a by-product of associations between body size and behavioral measures. Here we tested whether fWHR is associated with perceived aggressiveness, fighting ability and success in physical confrontation, while controlling for body size, also in a sample of MMA fighters. We found that perceived fighting ability was predicted by weight but not by fWHR. In contrast, both fWHR and body weight independently predicted perceived aggressiveness. Furthermore, we found positive associations between fWHR and fighting performance which appear to be independent of body size. Our findings provide further support for the proposal that fWHR is associated with fighting ability and perceived aggression, and that these effects are independent of body size. Therefore, fWHR might be considered as a viable and reliable marker for inference of success in male intra-sexual competition. *Aggr. Behav.* 41:331–334, 2015. © 2014 Wiley Periodicals, Inc.

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A growing body of evidence indicates an association between facial morphology and some aspects of human psychology. Such morphological and personality/temperamental characteristics can be affected by a shared underlying biological mechanism. For instance, testosterone levels during puberty affect both muscle growth and aggression-related behaviors (Tremblay et al., 1998).

An extensively studied morphological trait that is also associated with behavior is facial width-to-height ratio (fWHR). fWHR has been shown to be positively associated with anti-social behavior (Haselhuhn & Wong, 2012; Stirrat & Perrett, 2010), self-perceived and other-perceived dominance (Mileva, Cowan, Cobey, Knowles, & Little, 2014), perceived aggressiveness (Lefevre & Lewis, In press; Short et al., 2012), actual aggressive behavior (Carré & McCormick, 2008; Carré, McCormick, & Mondloch, 2009), sport performance (Tsujimura & Banissy, 2013; Třebický, Havlíček, Roberts, Little, & Kleisner, 2013), strength (Windhager, Schaefer, & Fink, 2011), the probability of being killed in violent physical encounters (Stirrat, Stulp, & Pollet, 2012) and lifetime reproductive success (Loehr & O'Hara, 2013).

Testosterone levels appear to influence growth trajectories of craniofacial shape during puberty (Verdonck, Gaethofs, Carels, & de Zegher, 1999) and recently it was found that fWHR variation in adult men is related to reactive testosterone levels (Lefevre, Lewis, Perrett, & Penke, 2013). As testosterone levels also correlate with various aspects of aggressive behavior (for review see Archer, Graham-Kevan, & Davies, 2005), testosterone may represent a shared underlying mechanism that

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explains covariance between these morphological and behavioral characteristics.

Recently, Zilioli et al. (In press) reported an association between fWHR, fighting performance and judgments of formidability, employing faces of professional mixed-martial arts (MMA) fighters as stimuli. They showed that fighters with greater fWHR had longer fighting careers, and both higher numbers and proportions of career wins, independent of their BMI. Further, Zilioli et al. collected assessments of formidability using two pairs of composite facial images, in which the first pair varied in experience and the second pair in bizygomatic breadth. Composites of the more experienced and wider-faced fighters were assessed as more formidable and judged as tougher opponents.

Coincidentally, we recently tested a similar hypothesis (Třebický, Fialová, Kleisner, & Havlíček, 2013) as a follow-up to our previous research examining other aspects of facial appearance and success in MMA fighters (Třebický, Havlíček, et al., 2013). Specifically, we tested whether variation in fWHR is associated with actual fighting performance, perception of aggressiveness and fighting ability, while controlling for potentially confounding effects of body height and weight, in a sample of professional MMA fighters from the same organization, UFC®.

While drawn from an overlapping database, in comparison to Zilioli et al.'s study, our stimuli set consisted of a smaller sample of portrait photographs ($N = 146$) as we only used images of fighters that fulfilled the following criteria: (i) being of apparent non-African or non-Asian origin, (ii) facing directly into the camera, (iii) with an absence of beard, moustache or hair obscuring the face, in order to minimize the effects of these potentially confounding variables. We also obtained data about fighter's age ($M = 29.77$ years, $SD = 4.6$), height ($M = 179.5$, $SD = 8$), weight ($M = 79.08$, $SD = 14.55$), number of fights ($M = 8.78$, $SD = 7.02$) and wins ($M = 5.86$, $SD = 5.19$) in the UFC. Subsequently, we calculated their fighting performance (proportion of wins to fights) and measured their fWHR as per Carré & McCormick (2008). The images were rated online for aggressiveness by 618 individuals (216 men) and for fighting ability by 278 individuals (98 men) from the Czech Republic. For details of ratings see Třebický, Havlíček, et al. (2013). As fighters' weight, height, and fighting performance were not normally distributed, we used Kendall's correlations.

Although Weston, Friday, and Lio (2007) originally found fWHR to be independent of body size, several subsequent studies have suggested that the link between fWHR and aggression or sport performance might be an epiphenomenon of body size (Deaner, Goetz, Shattuck, & Schnotala, 2012; Mayew, 2013). It has also been shown that variation in body dimensions are related to the size of

the face, including fWHR (Coetzee, Chen, Perrett, & Stephen, 2010). For this reason, we tested the relationship between body size and fWHR and did find significant positive correlations between fWHR and fighter's height ($\tau = .171$, $P = .003$) and weight ($\tau = .210$, $P < .001$) in our sample ($N = 146$). Similar to Zilioli et al.'s results for the association between proportion of wins and fWHR ($r = .139$), we found a positive correlation between fWHR and fighting performance of comparable effect size ($\tau = .114$, $P = .046$), but not with body height ($\tau = .021$, $P = .73$) or weight ($\tau = .03$, $P = .625$). Interestingly, in Zilioli et al.'s sample, the positive relationship was restricted to the Caucasian looking fighters. As the authors noted, the null results in non-Caucasian fighters might be due to the small number of non-Caucasians in the UFC and thus there was low power for detecting a possible effect. Alternatively, the fWHR-related effects might be restricted to individuals of European origin. Also, other performance/aggression related studies have been performed predominantly on Caucasian samples (Carré & McCormick, 2008; but see Tsujimura & Banissy, 2013 who used an Asian sample of baseball players) suggesting bias towards Caucasian competitors in fWHR studies. Further studies should therefore examine the relationship between fWHR and formidability related characteristics in non-Caucasian samples.

In our study, both perceived aggressiveness and fighting ability were positively correlated with fighter's fWHR ($\tau = .161$, $P = .004$; $\tau = .157$, $P = .005$, respectively), body weight ($\tau = .189$, $P = .002$ and $\tau = .153$, $P = .01$, respectively), but not with fighter's height ($\tau = .08$, $P = .171$ and $\tau = .072$, $P = .215$, respectively). In comparison, Zilioli et al. in their study 2b reported a substantially stronger positive correlation ($r = .46$) between toughness ratings of the individuals faces and fWHR. This stronger effect might reflect their selection method as they employed only the faces extreme in respect to facial width and fighting experience (see below for more detailed discussion). The effect of fWHR on perception of aggressiveness and fighting ability was further examined by GLM with height and weight as covariates (covariates were added only if these characteristics were found to be significantly associated with the relevant measures). The GLM analysis revealed that perceived aggressiveness was significantly and independently correlated with both fWHR ($F_{(1, 143)} = 7.108$, $P = .009$, $\eta^2 = .047$) and weight ($F_{(1, 143)} = 6.335$, $P = .013$, $\eta^2 = .042$) while fighting ability was correlated with weight ($F_{(1, 143)} = 4.018$, $P = .047$, $\eta^2 = .027$) but not with fWHR ($F_{(1, 143)} = 2.649$, $P = .106$, $\eta^2 = .018$).

Zilioli et al. employed two pairs of composite images varying in the level of fWHR and fighting experience for perceptual tests. They used a forced-choice paradigm which is highly sensitive to detect subtle effects.

However, a disadvantage of this approach is that it uses only extreme forms from the overall variation and may therefore overestimate the actual effect. In contrast, we used a variety of non-manipulated faces which captures natural variability more thoroughly. However, such a test might be somewhat less sensitive to detect possible effects. Thus, the effect size for the correlation between the toughness ratings and fWHR, based on the forced-choice paradigm reported by Zilioli et al. in their study 2b, was substantially stronger ($r^2 = .34$) than the effect size for the correlation between perceived aggressiveness and fWHR ($\eta^2 = .047$) in our sample. We note that the values of r^2 and η^2 are equivalent and for comparison we computed r^2 from the Cohen's d reported by Zilioli et al. by employing an effect size conversion formula (Borenstein, Hedges, Higgins, & Rothstein, 2009).

The two approaches are complementary, and because the results converge it gives us more confidence that relative facial width acts as a cue to formidability. However, our results also indicated some influence of body weight in the perception of aggressiveness, independently of fWHR. In contrast, assessments of fighting ability were driven solely by body weight. This suggests that studies testing the potential association between morphological and formidability-associated characteristics should control for the effect of confounding morphological variables such as body height or weight (Sell, Cosmides, Tooby, Sznycer, von Rueden, & Gurven, 2009).

As noted above, both our study and that of Zilioli et al. find that fWHR, but not body height and weight, was positively correlated with performance, at least when competitors were relatively matched for weight. This is not to say that body weight is irrelevant (Sell et al., 2009), because MMA fights take place between fighters in specified weight categories. Further research is needed to test possible interactions between fWHR, body size and performance in other samples. Interestingly, we also found no significant association between performance and fighters' height, which is correlated with upper arm length and could thus provide advantage through longer reach and greater striking force (Carrier, 2011).

Our results showing that fWHR is associated with the perception of facial aggressiveness, and that perception of fighting ability is only correlated with body weight, might have interesting theoretical consequences. One may speculate that the assessment of potential opponents acts on multiple dimensions. The first step, a "fight or flight" decision, might depend predominantly on the overall size of the fighters, as suggested in our ratings of fighting ability. However, when the rivals are of comparable size, a further level of assessment takes place which is related to the perception of aggressiveness, affected by fWHR as well as other bodily and behavioral traits (Třebický, Havlíček, et al., 2013). Future studies

might also test whether context affects the relative significance of attributed characteristics. For instance, fWHR may play a different role when assessing formidability of potential opponents and when judging suitability of potential allies.

In conclusion, our independent study, based on a similar sample of professional MMA fighters but with different methodology, shows parallel results to Zilioli et al.'s recent study. This mutually converging evidence supports the notion that relative facial width can act as a cue to formidability and may play an important role in intra-sexual selection, as well as suggesting that human perception may have been selected to be attentive to such cues.

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