Facial Cues in Humans Predict Winners and Losers in Mixed Martial Arts Fights

Running head:

Facial cues to fighting success

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Abstract

In antagonistic encounters the primary decision to be made is to fight or not and so it is predicted that animals may possess adaptations to assess fighting ability in their opponents. Previous studies suggest humans can assess strength and fighting ability based on facial appearance. Here we extend these findings to specific contests by examining the perception of male faces from paired winners and losers of individual fights in mixed martial arts sporting competitions. Observers were presented with image pairs and asked to choose which of the two men was most likely to win if they fought while other observers chose between the faces based on other questions. We found that individuals performed at rates above chance in correctly selecting the winner as more likely to win the fight than the loser. We also found that winners were seen to be more masculine, stronger, and aggressive than losers. Finally, women saw the winners as more attractive than the losers. Together these findings demonstrate that 1. humans can correctly predict the outcome of specific fighting contests, 2. that perceived masculinity/strength/aggression are putative cues to fighting success available from faces, and 3. that facial cues associated with successful male-male competition are attractive to women.

Key words: Face appearance; competition; intra-sexual; violence; fighting

Introduction

Adaptive behaviour relies on an animal's ability to make adaptive decisions given certain situations. Adaptive, or fitness enhancing decisions, are those that maximize the net benefits while minimising the net costs of particular actions (1). Across many animal species, fighting as a form of intra-sexual selection, relating to competition between members of the same sex, is common and has led to the evolution of animal weapons, such as horns and antlers, particularly in males (2). In antagonistic encounters with other individuals of the same species, the primary decision to be made is to fight or not. The benefits to be gained, such as territory, must be weighed against the costs, the potential for injury or even death.

While the benefits of fighting will vary across species and environment, the same costs are applicable to many species and, critically, the costs vary greatly depending on whether an animal is likely to be the winner or loser of the fight. We can then expect that animal's that engage in intra-species fighting will possess perceptual/cognitive adaptations to assess the risks involved in this behaviour by assessing fighting ability in their opponents (3, 4) using cues that are potentially related to fighting ability such as body size, strength, and weaponry (1). Indeed, there is evidence that animals make decisions about fighting based on the assessment of the relative fighting abilities of their opponents (5, 6) and that specific traits of some species can be related to fighting success. For example, in terms of visual perception, variable black facial patterns in paper wasps are related to both body size and social dominance (7) and red chest colouration in gelada baboons is related to troop status, with leader males having the reddest chests (8). Given appearance imparts information about fighting ability, other individuals can base their decisions on such

information allowing them to compete when likely to win and to avoid costly agonistic interactions when likely to lose.

In humans, there is cross-cultural evidence that male-male competition is important, at least in some cultures. For example, as noted by Sell et al. (2009), fighting ability is associated with access to resources in the Yanomamo of Venezuela (9), the Achuar of Ecuador (10), and the Tsimane of Bolivia (11). In other cultures, sports involving ritualized combat between men are common and take many forms, such as Sumo in Japan and stick-fighting in the Suri of Ethiopia. These ritualized forms of combat have a long recorded history, including fencing in the 16th century Germany and gladiatorial combat in Ancient Rome. In line with this history of violence, also noted by Sell et al., there are a range of anatomical and physiological sex differences that appear to reflect adaptation to male-male competition in humans, including sex differences in height and physical strength(12, 13).

Given evidence for intra-sexual conflict in humans and following theoretical predictions for adaptations to assess fighting ability (3, 4), previous researchers have suggested that humans possess adaptations to infer fighting ability, specifically that fighting ability might be inferred from facial, body, and vocal cues (14, 15). For example, people make relatively accurate inferences about men's physical strength from static facial images (14) and voice recordings (15), and measurements of physical strength are associated with ratings of fighting ability (14). Focusing on human facial cues, masculinity in male faces has been associated with perceived dominance (16) and physical strength is positively related to ratings of facial masculinity (17). Recent studies have also highlighted that face measurements are associated with aggression in men. For example, facial width scaled for face height is correlated with perceived aggression (18), related to self-reported dominance and,

relating to real behaviour, aggressive behaviour in sport (19). Further, one study examining forensic data from skeletons has shown that men with narrow faces are more likely to have died from contact violence that their wider faced peers (20).

While the accurate assessment of strength and its association with fighting ability (14) and links between facial measurements and aggression (19) are in line with the notion that humans can assess fighting ability from facial cues, they do not provide direct evidence for this notion. One study has, however, examined fighting success based on instances of real fights in mixed martial arts sporting contests. Calculating fighting success as the ratio of wins to losses across a fighter's UFC fighting career, it was found that the perceived aggressiveness of fighters' faces was linked to their success in actual physical confrontations, although perceived fighting ability and differences in facial shape were only associated with fighting success in heavyweight fighters (21). This suggests that perceived aggression may be an underlying cue to fighting success rather than the cognitively complex inferred fighting success. However, calculating fighting success across fights may underestimate human ability to accurately assess fighting outcomes from faces in particular contests. In other words, only one face is relevant when assessing general fighting ability, whereas, in specific contests, individuals can compare the traits of two protagonists. This comparison may enable greater accuracy in judgement and is more akin to decisions made in potential specific conflicts when information from both parties would be available. For example, an individual can compare their own perceived ability to a competitor's ability based on appearance. Additionally, the ability to choose between alternatives in terms of who to ally with or who to manipulate based on fighting ability may prove adaptive.

In the current study, we examined individual's abilities to directly assess the outcome of particular fights. While previous results suggest that individuals can assess the fighting ability of particular fighters from their faces based on their overall success across a number of fights (21), here we focused on a more fine-grained analysis in which face images of fighters were presented as pairs such that observers were tasked to judge the difference in perceived traits of the winners and losers of specific fights. We asked observers to judge between the winners and losers of fights for a variety of traits to test ideas relating to intra-sexual and inter-sexual selection. Firstly, we addressed accuracy in judgement by asking observers to choose who they think would win in a fight. Accuracy at this level would indicate that observers are able to assess the relative fighting ability of two fighters to correctly determine the outcome. Secondly, we examined specific cues from faces that may underlie accuracy: perceived masculinity, strength, and aggressiveness. Thirdly, we addressed attractiveness to the opposite-sex because, while perception of fighting ability is often considered the domain of intra-sexual selection, it may also be related to inter-sexual selection. In terms of attractiveness to the opposite-sex, there are benefits that could be associated with preferring better fighters: 1. indirect benefits, genetic benefits that are passed to offspring such as genes associated with health, strength, or strong immune systems, and 2. direct benefits, benefits that are directly passed to mates or offspring such as resources or protection from other males. We then also asked a sample of women who they thought was more attractive out of the pair.

Methods

Participants acting as observers

There were four different studies in which participants chose between pairs of faces for different traits. There were 44 participants who selected the most likely to win in a

fight out of the pair (33 women, 11 men, mean age = 26.8, SD = 9.3), 35 participants who selected the most masculine out of the pair (23 women, 12 men, mean age = 25.0, SD = 8.0), 25 participants who selected the strongest out of the pair (19 women, 6 men, mean age = 26.6, SD = 8.4), 20 participants who selected the most aggressive out of the pair (11 women, 9 men, mean age = 27.5, SD = 8.9), and 27 women who selected the most attractive out of the pair (mean age = 27.4, SD = 8.9). Participants were selected for being older than 16 and less than 46 years of age. For attractiveness judgements, only women reporting to be heterosexual were selected for analysis. Participants were recruited for the study online via a research-based website and the study was conducted online.

Stimuli

The study population consisted of 285 MMA fighters for which facial photographs and details of their previous fight (opponent and win/loss), as well facial photographs of their opponent, were available from the official Web site of MMA division Ultimate Fighting Championship (UFC; www.ufc.com; database accessed in June 2012). Because this represented the total pool of fighters, excepting unselected fighters for which data or photographs were unavailable, it was possible to match the 285 fighters with their opponent in their most recent fight. Out of the 285 fighters, 12 of the winners and 15 of the losers were represented twice because they fought two of the other 284 fighters in their most recent fight. No fighter was repeated more than twice. These data were included because each fight is a unique pair. The final set of images used were 156 unique pairs representing 156 fights between two different fighters. Using the available database, for each pair, one fighter was classified as the winner and one as the loser.

For each pair of fighters, we obtained data on their weight class, which was the same for each fighter. To reduce the number of classifications and increase the sample size of final groupings, we averaged the seven available weight classes into three groupings: lightweight (bantamweight, featherweight, lightweight, N = 68 pairs), middleweight (welterweight, middleweight, N = 52 pairs), and heavyweight (lightheavyweight, heavyweight, N = 32 pairs).

The stimulus set comprised the official front-on photographs available from www.ufc.com (photographs and fight information were downloaded in June 2012). These photographs appear to have approximately similar lighting and background with individuals posing with an approximately neutral expression. To equate size of the face in the image, all images were aligned to standardize the position of the pupils in the image.

Figure 1 around here

Procedure

Participants were administered a short questionnaire assessing age, sex, and sexual orientation (only used for women rating attractiveness), followed by a forced-choice face test. There were five different forced-choice face tests for which the stimuli and procedure was identical except that participants in each test were given different instructions on what type of discrimination they were asked to do. Different participants took part in each of the tests.

In the forced-choice tests, the 156 pairs of winners and losers of MMA fights as described above were shown with both order and side of presentation randomized. Participants were asked to choose the face from the pair that they found most of a particular trait. Clicking a button below the face selected moved participants on to the

next face trial. There was no time limit for responses and both faces remained on screen until participants selected a face.

Specific questions for the five tests were:

"Which person is more likely to WIN in a physical fight?"

"Which person is more MASCULINE?

"Which person is PHYSICALLY STRONGER?"

"Which person is more AGGRESSIVE?"

"Which person is more ATTRACTIVE?"

Results

By-observer analysis

For each observer, we calculated the proportion of winner's faces chosen out of the 156 pairs of faces to provide an overall score reflecting how likely the winner's faces were chosen for a particular question compared to the loser's faces. We additionally calculated the proportion of winner's faces chosen over loser's faces separately for the three weight categories.

Mixed model ANOVAs were carried out with *relative proportion of winner's faces chosen* as the dependent variable, *weight class* (light vs. middle vs. heavy) as a within-participant factor, and *sex of observer* (male vs. female) as a between-participant factor. These were followed-up with one-sample t-tests against chance (50%). Mean proportion of winner's vs. loser's faces chosen for each questions plit by weight category can be seen in Figure 2.

Figure 1 around here

Perceived likelihood to win

A one-sample t-test, ignoring weight class and sex of observer, revealed that, overall, winner's faces were more likely to be chosen as winners than loser's faces (M = .535, SD = .034, t(43) = 6.77, $p < .001$).

A mixed model ANOVA revealed no significant interaction between *sex of observer* and *weight class* ($F_{2,84} = 2.02$, $p = .139$, $\eta_p^2 = .046$), no significant main effect of *sex of observer* ($F_{1,42} = 0.49$, $p = .488$, $\eta_p^2 = .012$), and a close to significant main effect of *weight class* ($F_{2,84} = 2.54$, $p = .085$, $\eta_p^2 = .057$).

To examine the impact of weight class, one-sample t-tests, ignoring sex of observer, revealed that winner's faces were more likely to be chosen as winners than loser's faces for heavy (M = .536, SD = .092, t(43) = 2.59, $p = .013$), medium (M = .569, SD = .078, t(43) = 5.84, $p < .001$), and light (M = .517, SD = .049, t(43) = 2.33, $p = .025$) weight categories. The non-significant effect of *weight class* then appears to reflect that observers were most accurate at choosing winners correctly in the middle weight class versus other classes.

Perceived masculinity

A one-sample t-test, ignoring weight class and sex of observer, revealed that, overall, winner's faces were more likely to be chosen as more masculine than loser's faces (M = .532, SD = .039, t(34) = 4.84, $p < .001$).

A mixed model ANOVA revealed no significant interaction between *sex of observer* and *weight class* ($F_{2,66} = 0.31$, $p = .738$, $\eta_p^2 = .009$), no significant main effect of *sex of observer* ($F_{1,33} = 0.23$, $p = .632$, $\eta_p^2 = .007$), and no significant main effect of *weight class* ($F_{2,66} = 1.32$, $p = .273$, $\eta_p^2 = .039$).

While not significant, for consistency, one-sample t-tests, ignoring sex of observer, revealed that winner's faces were more likely to be chosen as more masculine than loser's faces for heavy (M = .530, SD = .076, t(34) = 2.32, $p = .026$),

medium (M = .556, SD = .063, t(34) = 5.24, $p < .001$), and light (M = .526, SD = .063, t(34) = 2.40, $p = .022$) weight classes.

Perceived physical strength

A mixed model ANOVA revealed no significant interaction between *sex of observer* and *weight class* ($F_{2,46} = 0.09$, $p = .911$, $\eta_p^2 = .004$), no significant main effect of *sex of observer* ($F_{1,23} = 0.21$, $p = .651$, $\eta_p^2 = .009$), and a significant main effect of *weight class* ($F_{2,46} = 8.39$, $p = .001$, $\eta_p^2 = .267$).

To examine the impact of weight class, one-sample t-tests, ignoring sex of observer, revealed that winner's faces were more likely to be chosen as stronger than loser's faces for heavy (M = .547, SD = .083, t(24) = 2.82, $p = .009$), medium (M = .585, SD = .047, t(24) = 9.08, $p < .001$), but not light (M = .498, SD = .056, t(24) = 0.18, $p = .858$) weight classes. The significant effect of *weight class* then appears to reflect that observers were most likely to choose winners as stronger in the middle weight class and at chance for the light weight class. A one-sample t-test, ignoring weight class and sex of observer, revealed that, overall, winner's faces were more likely to be chosen as stronger than loser's faces (M = .534, SD = .034, t(24) = 4.98, $p < .001$).

Perceived aggression

A one-sample t-test, ignoring weight class and sex of observer, revealed that, overall, winner's faces were more likely to be chosen as more aggressive than loser's faces (M = .530, SD = .040, t(19) = 3.35, $p = .003$).

A mixed model ANOVA revealed no significant interaction between *sex of observer* and *weight class* ($F_{2,36} = 1.26$, $p = .295$, $\eta_p^2 = .066$), no significant main effect of *sex of observer* ($F_{1,18} = 0.47$, $p = .502$, $\eta_p^2 = .025$), and a significant main effect of *weight class* ($F_{2,36} = 4.25$, $p = .025$, $\eta_p^2 = .191$).

To examine the impact of weight class, one-sample t-tests, ignoring sex of observer, revealed that winner's faces were more likely to be chosen as more aggressive than loser's faces for medium (M = .572, SD = .069, t(19) = 4.62, p< .001), but not heavy (M = .531, SD = .111, t(19) = 1.24, p = .230) or light (M = .501, SD = .046, t(19) = 0.07, p = .946) weight classes. The significant effect of *weight class* then appears to reflect that observers were most likely to choose winners as aggressive in the middle weight class and at chance for the heavy and light weight class.

Perceived attractiveness

A one-sample t-test, ignoring weight class, revealed that, overall, winner's faces were more likely to be chosen as more attractive than loser's faces (M = .534, SD = .031, t(26) = 5.59, p< .001).

A repeated measures ANOVA revealed a significant main effect of *weight class* ($F_{2,52}$ = 5.60, p = .006, η_p^2 = .177).

To examine the impact of weight class, one-sample t-tests revealed that winner's faces were more likely to be chosen as more attractive than loser's faces for heavy (M = .572, SD = .088, t(26) = 4.35, p< .001), medium (M = .528, SD = .050, t(26) = 2.96, p = .007), and light (M = .518, SD = .045, t(26) = 2.12, p = .044) weight classes. The significant effect of *weight class* then appears to reflect that observers were most likely to choose winners as more attractive in the heavy weight class and lower for the middle and light weight classes.

By-Face analysis

As an alternative analysis, we also addressed judgements using the pairs of fighter's faces as the unit of analysis. To do this, mean proportion of time the winner's face was chosen over the loser's faces was calculated for each pair of images. This

score additionally allowed us to calculate inter-correlations between perceptions and run a regression examining predictors related to the perception of winning vs. losing fights. These effects were confirmatory of the significant effects seen in the by-observer analysis and are presented as 1-tailed.

Firstly, to confirm effects seen in the by-observer analysis, we ran one-sample t-tests against chance for each question. These revealed, ignoring weight-class, that winners were seen as more likely to win the fight (M = .535, SD = .193, t(155) = 2.26, p = .013), as more masculine (M = .532, SD = .189, t(155) = 2.11, p = .019), as physically stronger (M = .534, SD = .242, t(155) = 1.76, p = .040), as more aggressive (M = .530, SD = .203, t(155) = 1.83, p = .035), and as more attractive by women (M = .536, SD = .245, t(155) = 1.71, p = .045).

Secondly, we ran Pearson product-moment correlations to examine relationships between the different perceptions. Correlations can be seen in Table 1.

Table 1 about here

Finally, we conducted two regression analyses. To examine predictors of perceived winners, we entered perceived masculinity, physical strength, and aggression as predictors of the perception of winning fights in a linear regression. This revealed a significant overall model ($F_{3,152}$ = 152.30, p< .001, R^2 = .750) in which masculinity (beta = .194, p = .006), physical strength (beta = .513, p< .001), and aggressiveness (beta = .266, p< .001) were all significantly positively associated with the perception of winning fights.

To examine predictors of women's preferences, we entered perceived masculinity, strength, and aggression as predictors of women's attraction in a linear regression. This revealed a significant overall model ($F_{3,152}$ = 6.97, p< .001, R^2 = .121) in which masculinity was significantly positively (beta = .438, p = .001),

aggressiveness was significantly negatively (beta = -.403, $p < .001$), and physical strength was not significantly (beta = .080, $p = .477$) associated with women's attraction.

Discussion

Our data demonstrated that both men and women perceive winners of fights differently from losers. Specifically, using observer as the unit of analysis, winner's faces were more likely to be seen as able to win the fight, be physically stronger, be more aggressive, be more masculine, and be more attractive to women than loser's faces. There was also a tendency for these effects to be different according to weight category. Generally, effects were strongest for the middle weight category and weakest for the light weight category. For attractiveness, however, the effect was strongest for the heavy weight category. In all instances, effects were significant across all weight categories except that winners in the light weight category were not seen as physically stronger than losers and winners in the heavy and light weight categories were not seen as more aggressive than losers.

In a by-face analysis, the same directional effects were observed, although the effects were somewhat weaker. Weaker effects here are likely the result of greater variance between faces than between observers in terms of choices. Such a pattern highlights that accuracy in assessing the winners of fights is by no means perfect and that individual cues, such as physical strength or aggression are unlikely to be perfect predictors of fighting success. There are also two aspects of our study that may limit accuracy. Firstly, our stimuli were drawn from sporting competitions in which fighters are selected to fight within weight categories specifically designed to create more even odds. In real fighting situations, where weight, as a proxy for muscle mass or strength, is uneven, we might predict greater success in predicting the outcomes of

fights between humans. Secondly, our interest was in static facial cues, which under-represents the actual information available when two individuals fight or are deciding to fight. In real life fights, body size and dynamic cues are available which may increase accuracy. Given the basic nature of static faces, it is all the more interesting that humans can assess the outcome of fighting contests based on faces alone at all.

Given the potential importance of male intra-sexual selection in human evolution(9-12), our data are in line with the notion that humans possess perceptual/cognitive adaptations to assess the risks involved fighting by assessing fighting ability in other humans, as expected in a species that engages in such behaviour(3, 4). While previous researchers have suggested that humans possess adaptations to detect fighting ability(14, 15) based on perceptions of strength, here we show direct evidence that humans can predict the actual outcome of specific fights based on facial information, in line with a previous demonstration that the perceived aggressiveness of fighters' faces was linked to their career fighting success (21). While humans do not necessarily have specific evolved weaponry or ornaments that advertise their fighting abilities, as in other animals (1), humans may display cues to their fighting abilities and possess adaptations to help guide their choice to fight specific individuals (3, 4).

In terms of specific cues to fighting success, winner's faces were generally seen as more masculine, stronger, and more aggressive than loser's faces. One potential cue to fighting ability is facial masculinity as facial masculinity is positively related to perceived dominance (16) and real physical strength(17). Facial masculinity is also related to testosterone levels, although the relationship may be somewhat more complex than a simple linear relationship (22). Judgements of perceived physical strength from faces have been previously highlighted as a proxy for judgements of

fighting ability (14)with perceived strength relating to actual measured strength (14). There are also links between facial measurements and aggression (19) and one previous study has shown that fighter with more aggressive appearing faces are more likely to have higher success in their fights over the careers (21). Given these traits are potentially interlinked, they could all relate to fighting success via the same mechanism. For example, underlying levels of testosterone could underpin facial cues to masculinity, strength and aggression. However, at the perceptual level at least, each factor was an independent and significant predictor of perceived fighting success, suggesting that these traits may be associated with fighting success for different reasons. For example, strength may be seen as a good predictor of who wins fights because it is linked directly to the outcome of competition, but in more evenly matched fights, cues to behavioural aggression may also be used to predict winners independent of strength (see also 21).

From the by-face analysis, we were also able to examine associations between traits that led specific faces to be seen as likely to win fights or be more attractive to women. As noted above, in predicting faces chosen as winners in fights, masculinity, strength, and aggressiveness were all positively and independently related to faces being selected as likely to win. While each may have a significant contribution to perceived fighting success, it is also worth noting this does not preclude a shared underlying component as outlined above. In fact there may be shared and unshared factors relating to fighting success for each of these three factors.

In predicting women's preferences, masculinity was positively related, aggressiveness negatively related, while strength was unrelated to faces being selected as attractive to women. This is suggestive that while women found the winners faces as more attractive than losers, this was directly accountable to perceived strength and

388 may reflect attraction to masculinity instead. This further highlights that these traits,
389 while having similar effects on perceived intra-sexual competition abilities (winning
390 fights), have quite different effects in term of inter-sexual selection (their
391 attractiveness to women). Indeed, the benefits of avoiding aggressive male partners
392 are clear despite the fact that such males may be successful in intra-sexual
393 competition. Previous studies have shown that women moderate their preferences for
394 masculine facial cues according to their recent experience of visual environmental
395 cues of direct male-male competition and violence. In these studies, women preferred
396 more masculine male faces after exposure to cues of direct male-male competition
397 and violence (23) which is consistent with idea that women here preferred the faces of
398 men who were most likely to be successful in male-male competition. Perhaps such
399 preferences reflect that ideal men should be able to compete successfully but not
400 actively seek out conflict (potentially indicated by high perceived aggression). In this
401 way women may select men who can defend themselves, their partner, and their
402 offspring from other men but who do not continually seek conflict. In such
403 preferences it is difficult to tease apart the role of indirect from direct benefits. This is
404 because preferences for successful competition can relate to both. For example,
405 preferring men who are likely to win in fights can lead to the direct benefits in terms
406 of resources as such men may most successfully defend or acquire resources.
407 However, the preference can lead to potential indirect benefits by passing genes for
408 such successful on to male offspring, if these factors are heritable. This reasoning also
409 suggests that if women prefer traits in men that are associated with the ability to
410 provide direct benefits then the ability to provide direct benefits and associated
411 attractive traits may be passed to her offspring providing indirect benefits (24). It is

then likely that both direct and indirect benefits from men play a role in generating in preferences for the faces of men likely to win fights.

In summary, we found that individuals performed at rates above chance in correctly selecting the winner as more likely to win the fight than the loser. We also found that winners were seen to be more masculine and stronger than losers. Finally, women saw the winners as more attractive than the losers. The effect sizes for each of these relationships were generally small but could have potentially important evolutionary consequences. Together these findings demonstrate that 1. humans can correctly predict the outcome of specific fighting contests, 2. that perceived masculinity/strength/aggressiveness are all putative cues to fighting ability available from faces, and 3. that facial cues associated with successful male-male competition are attractive to women.

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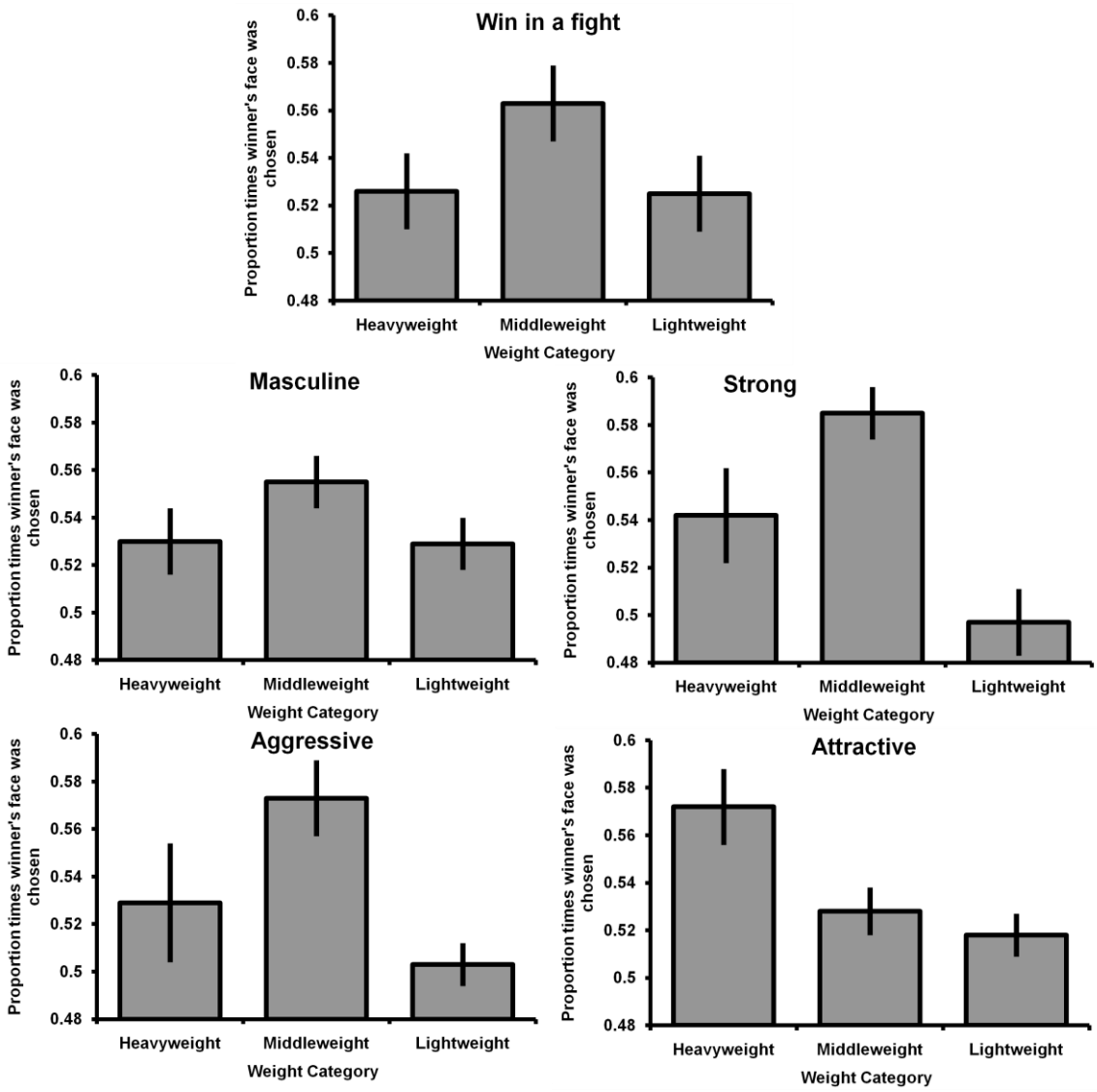
Figure 1: Proportion of winner's faces chosen over loser's faces (+/- 1SE of mean) split by weight category for each question: More likely to win in a fight, more masculine, stronger, more aggressive, and more attractive.



493 **Table 1: Inter-correlations among perceived traits based on the choice of a face**

494 **out of a pair for each question.**

	Masculine	Strong	Aggressive	Attractive
Win fight	.760**	.810**	.705**	.166*
Masculine		.732**	.717**	.208**
Strong			.584**	.166*
Aggressive				-.042

495 **significant at $p< 0.01$, *significant at $p< 0.05$.

496