Contest competition and men’s facial hair: Beards may not provide advantages in combat.

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# Abstract

In contemporary human societies, where direct male-male competition is reduced compared to ancestral societies, sporting competitions remain outlets for status acquisition via intra-sexual competition. Beards are the most visually salient and sexually dimorphic of men’s secondary sexual traits and play a strong role in communicating masculinity, dominance and aggressiveness intra-sexually. Hypotheses have been advanced that beards provide advantages in intra-sexual combat, as protective organs and honest signals of fighting ability. Here we provide the first test of these hypotheses using data from professional mixed martial arts fighters competing in the Ultimate Fighting Championships. We explored whether secondary sexual traits (height, weight, beardedness), fighting stance (southpaw, orthodox), arm reach and past contest experiences impact on contest outcomes. If beards function as protective organs, bearded fighters should succumb to fewer knock-outs than clean-shaven fighters. Alternatively, if beards signal fighting ability then bearded fighters should win more fights. We found no evidence that beardedness was associated with fewer knock-outs or greater fighter ability. While fighters with longer reaches won more fights, neither stance nor past experience influenced fight outcomes. We suggest that beards represent dishonest signals of formidability that serve to curtail the escalation of intra-sexual conflict rather than providing advantages in combat.

**Key words:** Sexual selection; intra-sexual competition; facial hair; human evolution.

# Introduction

Intra-sexual selection has shaped the evolution of male weaponry and aggressive behavioural displays across many taxa (Anderson, 1994; Emlen, 2008; Zahavi, 1975). Claws, horns and canines operate in concert with fighting styles to determine the outcome of fights (McCullough, Miller, & Emlen, 2016). Despite the importance of phenotypic traits, , not good genes Like all other animals, human males also compete intra-sexually via behavioural displays that incorporate facial and bodily secondary sexual traits (Archer, 2009; Puts, 2016). Masculine facial structure, which includes the jawline, brow ridge and mid-face, are exaggerated in men compared to women and associated with upper body strength (Fink et al., 2007; Sell et al., 2009), behavioural aggressiveness (Archer, 2009), and judgements of men’s masculinity, dominance, and aggressiveness (Geniole et al., 2015). More dominant looking adolescent males are more behaviourally aggressive (Archer, 2009), attain sexual maturity more rapidly (Doll et al., 2016), and attain earlier ages at first copulation (Mazur et al., 1994). In adulthood, men’s acquisition of status and mating success within male-male hierarchies is associated with facial masculinity, dominance, and height (Hill et al., 2013; Mueller & Mazur, 1996). This pattern is also found in small-scale subsistence societies where upper body strength is associated with male hunting reputation and reproductive success (Apicella, 2014) and social status is linked to reproductive success (von Rueden & Jaeggi, 2016). It is for these above reasons that secondary sexual facial traits are argued to be shaped by contest competition in ancestral human environments (Puts, Bailey, & Reno, 2015).

Beards are arguably the most visually conspicuous and sexually dimorphic of all human secondary sexual traits. Beards develops under the actions of androgens during early adolescence and are fully developed by adulthood (Randall, 2008). Beards develop faster among adolescent boys who are more behaviourally aggressive (Isen, McGue, & Iacono, 2015) and intra-sexually competitive (Singal, Bhatnagar, & Kaur, 2006). In adults, bearded men report feeling more masculine (Addison, 1989) and have higher levels of serum testosterone (Knussman & Christiansen, 1988) than clean-shaven men. Full beards consistently enhance ratings of men’s age, masculinity, social dominance, and aggressiveness compared to clean-shaven faces (Dixson & Brooks, 2013; Dixson & Vasey, 2012; Geniole & McCormick, 2015; Neave & Shields, 2008; Saxton et al., 2016) by augmenting jaw size (Dixson et al., 2017a), overall facial masculinity (Sherlock et al., 2017), and aggressive facial expressions (Dixson & Vasey, 2012). Facial hair is also more sexually attractive and is positively associated with mating success under conditions of high male-male competition (Barber, 2001; Dixson et al., 2007b).

Although contemporary ecological and social conditions in human societies are vastly different from those that occurred ancestrally, sporting contests remain active Darwinian arenas in which direct same-sex competition for status readily occur (Lombardo, 2012). There is also evidence that individual performance within sporting contests relies on many of the same physical and mental faculties as those employed during earlier phases of human ancestry (Lombardo, 2012). Sporting competitions are ritualised interactions typically restricted to competitions within the same-sex which are often performed in front of audiences (Deaner et al., 2015). As would be predicted if sporting competitions were analogous to male-male competitions, analyses of 50 small-scale societies revealed that sports were more likely to occur between men than women or be of mixed sex (Deaner et al., 2013). Success in sporting contests can also result in higher social status, greater mating opportunities, and higher fitness for males involved in sports (Lombardo, 2012; Potsma, 2013). For example, among Sereer communities in rural Senegal, men competing in a traditional form of Greco-Roman wrestling known locally as ‘Njom’ had significantly more surviving offspring and higher social status than non-wrestlers (Llaurens, Raymond, & Faurie, 2009). This seems to be true in modern societies as well as male athletes in Universities report higher mating success than non-athletes (Faurie, Pontier, & Raymond, 2004).

Research among mixed martial arts (MMA) fighters competing in the The Ultimate Fighting Championship® (UFC) provides evidence that sexually dimorphic traits function directly in intra-sexual competition. The UFC is a US based promotional company for MMA fights and is the largest and includes the highest ranked fighters in the world. Fights takes place between two individuals in an enclosed octagon-shaped cage. Fighters use a variety of techniques, sometimes in combination, from wrestling, martial-arts, grappling and boxing in no-holds barred contests in which victory is assigned via knockouts, submission, or judge decisions. The lack of stringent regulations coupled with the highly aggressive nature of the fights make the UFC an ideal arena for testing evolutionary hypotheses regarding male-male competition. The UFC also maintains an unofficial rule that after three losses in a row a fighter must retire (Zilioli et al., 2015), making this an intriguing arena within which to test the role of non-phenotypic traits like past contest outcomes on fighting performance. The risks involved in competing in such a violent sport are strongly financially incentivised, with winners in the UFC routinely receiving high rewards that in one fight were reported to be $400,000 (Pollet et al., 2013). UFC fighters with more pronounced androgen-dependent facial traits, particularly a more robust midface, have the most victories (Třebický et al., 2015; Zilioli et al., 2015) and are judged as looking more aggressive by naïve raters (Třebický, et al., 2013). Participants who were unfamiliar with the UFC were also able to accurately assign winners from bouts and assigned winners higher ratings of masculinity, strength, aggressiveness and attractiveness (Little et al., 2016). The UFC also has a female league and analyses revealed that the facial characteristics associated with male fighting success did not predict female fighting success (Palmer-Hague et al., 2016).

While beards cannot directly enhance fighting ability directly, there are two main hypotheses that suggest evolutionary advantages for facial hair during intra-sexual contests. First, phylogenetic analyses of the facial structures of ancestral members of the genus *Homo* suggest that facial structure and musculature evolved, in part, to protect against blows to the head (Carrier & Morgan, 2015). As facial hair develops around the around the jaw, lips and midface, framing and enhancing perceptions of the sexually dimorphic facial regions (Goodhart, 1960; Guthrie 1970), Blanchard (2010) hypothesised that beards are analogous to the male lion’s mane in covering the vital parts of the face and neck from costly blows. Since a meta-analysis of MMA bouts revealed that 66-78% of serious injuries are to the head and face (Jensen et al., 2017; Lystad et al., 2014), if the human beard has evolved as a protective organ to blows to the lower face (Blanchard, 2010), then fighters with beards should suffer fewer knockouts than clean-shaven fighters.

Alternatively, as beards are incorporated into threatening jaw-thrusting behaviors (Eibl-Eibesfeldt 1989; Guthrie 1970), facial hair might reflect a handicap in fights that allowing opponents to grasp and pull a fighter towards an opponent towards them, providing leverage when delivering blows to the face (Zahavi and Zahavi, 1997). Thus, only high quality fighters can adorn full beards and may do so in order to signal confidence in their ability to overcome the handicapping effects to opponents (Zahavi and Zahavi, 1997). If beards are a form of handicap signal and bearded fighters have higher fighting ability compared to clean-shaven fighters, we hypothesised that bearded fighters should win more fights than clean-shaven fighters. We tested these two hypotheses using data on individual fighting characteristics (i.e. stance), morphological traits (arm reach, height and beardedness) and outcomes of contests (i.e. knockout, submission) among 393 fighters in 598 fights from UFC events 2007-2015.

**Methods**

**MMA fight outcomes:** Fight outcome data is available for all UFC events that have taken place, however; photographs of fighters during each event are somewhat limited. As a result, fight outcome data was used from UFC71 (26/05/07) up to the most recent event at the time of data collection (UFC194, 12/12/2015). Fight outcomes were drawn from either the Wikipedia page for each event or the UFC official website. Method of victory was coded as follows: 1 = knock out, 2 = technical knockout (fight stopped based on fighter not intelligently defending themselves), 3 = doctor or corner stoppage (doctor or corner disallows fight to continue for fear of injury or exacerbated injury i.e. severe cut or broken bone), 4 = submission (fighter ‘taps out’ due to chokehold or joint lock), 5 = unanimous decision (all three judges score fight in favour of the victor), 6 = split decision (two of three judges scored fight in favour of the victor), and 7 = no contest/draw/disqualification or stoppage due to injury (stoppage due to injury is the result of an accident i.e. accidental eye poke).

**MMA fighter level of facial hair:** Research assistants who were blind to the predictions of the current study scored each fighter’s profile as the most appropriate of ten possible facial hair styles: 0 = clean-shaven, 1 = stubble, 2 = moustache, 3 = goatee (without moustache), 4 = Goatee (with moustache), 5 = Sideburns, 6 = Sideburns and moustache, 7 = moustache and soul patch, 8 = Full beard (trimmed), 9 = Full beard (bushy; Fig. S1 in ESM1; Dixson et al., 2017b). To ensure that the level of beardedness that was scored accurately reflected the amount of facial hair each fighter had during the fight, images and video footage from the actual fights were scored rather than profile images wherein beardedness may not reflect that which was present during the actual bouts. We created three categories; 1) the ‘clean-shaven’ category included the percentage of men with no facial hair of any kind (category 0). 2) the ‘beard’ category included the percentage of men with trimmed and bushy full beards (8&9), and 3) the ‘non-beard facial hair’ category included the percentage of men in all classes of facial hair except clean-shaven and full beards (1-7).

**MMA fighter characteristics**: Along with fight outcomes and the type of facial hair, we also collected data on player height, weight, reach, and fighting stance from the website (www.fightmetric.com). However, because weight is tightly controlled in contests as fighters must be within the same weight class, we did not use weight for further analyses. As some data were missing from particular fighters, we searched their specific wiki pages to collect any missing data.

**Statistical analyses:** We used a Bradley-Terry Model to analyse the contest data set. The Bradley-Terry model is perfectly suited for examinations of repeated contests between individuals as it incorporates the non-independence of using both competitors from an individual contest. It also allows the modelling of individual performance over time by using repeated contests, considering the order and outcome of the contests to calculate an ability score for each individual   
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
(Cattelan et al. 2013). The Bradley-Terry model then uses this ability score to determine whether any predictors help explain the variance in a particular fight. Because the Bradley-Terry model takes into consideration the order of contests, individual, ability, and various fighter-specific traits, it allows for the examination of the importance of various traits on an outcome of a contest while also incorporating previous contest experience   
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
  
(e.g., Kasumovic et al. 2010).

# Results

Of all the fighters in our data set, there were two individuals that only appeared once, and as a result, they could not be fit properly in the model. We therefore removed these two individuals by removing two contests from the model. Our results are thus based on a total of 393 fighters in 598 fights.

For our first model, we explored whether previous contest outcome, the type of facial hair, height, stance, and reach affected the outcome of a contest. The only factor that significantly predicted contest outcome was the reach a fighter had, with individuals with a longer reach winning more fights (z=2.666, p=0.008). The type of stance a fighter used also significantly affected fight outcome, but this was driven by the fact that fighters using stance classified as other (N=25) performed significantly worse than individuals using an orthodox stance (N=292; z=-2.517, p=0.01). Individuals using a southpaw stance (N=76) performed equally to individuals using an orthodox stance (z=1.598, p=0.11). There was no effect of previous contest outcome, height, or whether an individual had a beard (Table 1). As a result, the type of facial hair an individual possessed did not affect their fighting ability score (Figure 1).

We next separated the contests by the type of outcome. The first group consisted of fights that occurred in either a knock-out (KO, N=83) or technical knock-out (TKO, N=117); both contest outcomes are judged by the referee and occur when the defender cannot defend themselves. The second group consisted of stoppage due to injury (N=7), submissions (N=97), judge decisions (N=277), and some type of disqualification or no contest judgment (N=17). We separated these data in this manner because the hypothesis that beardedness functions as a protective organ against blows to the face states that beards should reduce the likelihood of knockouts, but should not affect contest outcomes determined in other manners (e.g, submission). Because previous contest outcome and height did not have an effect in our first model, and because it was only individuals that used a stance classified as other (N=25) that did significantly worse, we removed previous contest outcome, height, and stance from this second model. Neither facial hair nor reach affected contest outcomes in contests with knock-outs (N=200) or fights ending in decisions (N=398, Table 2, Figure 2), suggesting that beards do not provide any protective advantage during fights.

# Discussion

Hypotheses suggest that along with playing a strong role in communicating masculinity, dominance and aggressiveness intra-sexually, beards evolved to provide advantages in intra-sexual combat through their ability to protect the face as well as honest signals of fighting ability. Using data from 598 professional mixed martial arts (MMA) fights from 393 fighters competing in the Ultimate Fighting Championships (UFC), we show that beards neither act as a protective feature nor as an honest signal of fighting ability. The only predictor of contest outcomes was the reach a fighter had. Our results thus

Phylogenetic analyses suggest that sex differences in human facial musculature evolved, in part, to provide protection to blows to the face during intra-sexual combat (Carrier & Morgan, 2015). In MMA, the majority of serious injuries occur on the face, particularly the jaw and cheek bones (Lystad et al., 2014), which are the regions where beard growth is most profuse (Dixson & Rantala, 2016). Blanchard (2010) suggested that the human beard functions like the mane of the male lion in providing protection to the face and neck during fights. We found no evidence that bearded fighters succumb to fewer knockouts than clean-shaven fighters and therefore conclude that facial hair does not provide any protective advantage during male-male contest competition. Our results thus agree with studies exploring the strike patterns during fights between male lions which suggest that the mane is unlikely to play a protective role (West et al., 2006).

Alternatively, male secondary sexual traits may reflect fighting ability more directly (Puts et al., 2015). For instance, UFC fighters with wider and more robust midfaces win more fights than men with narrower facial widths (Třebický et al., 2015; Zilioli et al., 2015) and are judged as looking more aggressive (Little et al., 2016; Třebický et al., 2015; Zilioli et al., 2015). Given that the midface, cheekbones and jaw are the facial regions that are most targeted in MMA bouts (Jensen et al., 2017; Lystad et al., 2014), it is possible they also reflect reliable markers of fighting ability (Little et al., 2016). Men’s beardedness enhances judgements of masculinity, dominance and aggressiveness due to exaggerating the apparent size of masculine craniofacial traits (Dixson et al. 2016; 2017a; Sherlock et al., 2017). Zahavi and Zahavi (1996) drew an analogy between the human beard and the beard of the male ibex, which they regarded as a handicap that could be grasped by predators and that the expression of facial hair by male ibex signals confidence that potentially curtailed predation attempts. Zahavi & Zahavi (1996) argued that the human beard may also be easily clutched by opponents during fights and therefore a bearded fighter could be signalling fighting quality and confidence. As bearded fighters did not have a greater fighting ability than clean-shaven fighters as calculated by the Bradley-Terry model, we also found no support for the hypothesis that beards do not behave as a handicap signal.

Aside from phenotypic traits, non-phenotypic traits are also linked to fighting performance. For example, past performance can impact future contest success (Hsu et al., 2006; Kasumovic et al., 2010), however, despite this being shown in other animals, we found no evidence that the outcomes from past fights were associated with the outcome of UFC fights. This result, however, is expected given the length of time between fights in the UFC. We would expect past performance to be less important in the UFC in comparison to sports wherein individuals compete in sequential contests in the same day (e.g., kickboxing, judo, fencing). Additionally, left handedness often has an advantage in sporting contests due to negative frequency dependence of the trait (Raymond, Pontier, Dufour, & Moller, 1996). Despite this, walso found that individuals using a southpaw stance did not perform any better than individuals using an orthodox stance, which is in agreement with past research using data from MMA (Baker & Schorer, 2013). While and there may be a southpaw advantage in reaching the UFC, this does not translate into more victories when actually competing in the UFC (Dochtermann, Gienger, & Zappettini, 2014; Pollet, & Riegman, 2014; Pollet, Stulp, & Groothuis, 2013).

Evidence that animal ornamentation or weaponry represent costly handicaps is mixed or even contradictory (Husak & Swallow, 2011), potentially reflecting trade-offs among traits with varying degrees of functional relevance to performance (Lailvaux & Husak, 2014). In men, androgens exert their effects on a suite of sexually dimorphic traits (Dixson, 2016), some of which function directly during fights (Puts, 2010; 2016) while others may not (Dixson et al., 2005; Grueter et al., 2015). It is possible that some weapons evolved as dishonest signals, enhancing perceived formidability while not being associated with fighting ability. For example, in slender crayfish (*Cherax dispar*), males with larger claws are dominant over males with smaller claws, yet claw size is not positively correlated with muscle strength (Wilson et al., 2007; 2009). While men’s secondary sexual characters are androgen-dependent muscularity, the androgenic processes that gives rise to their expression differ in several ways (Dixson, 2016). Masculine facial morphology, which includes a robust midface, pronounced brow ridge and enlarged jaw, muscularity, height and aggressive behaviours emerge under the effects of testosterone (Dixson, 2016). However, beards develop due to the conversion of testosterone to dihydrotestosterone via 5 alpha reductase enzyme activity in the root of hairs (Randall, 2008). Additionally, the extent to which androgenic processes produce beards is largely genetic (Hamilton, 1964), which means that highly muscular and masculine looking males may grow little facial hair while less formidable males may grow profuse beards. Research quantifying facial morphometrics shows that beards enhance facial masculinity and dominance among men by exaggerating the apparent size of the jaw structure (Dixson et al., 2017a), the midface (Sherlock et al., 2016) and augmenting the saliency of agonistic expressions (Dixson & Vasey, 2012). Odemonstrate does We do, however, suggest that beards are dishonest signals of formidability that curtail the costs of engaging in fights given the exaggerating effect beards have on judgements of masculinity, dominance and aggressiveness (Dixson et al. 2016; 2017a; Sherlock et al., 2017). This hypothesis would be worthwhile pursuing in future research.

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