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Size and Dominance

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Synonyms

Size: breadth, circumference, girth, height, length, mass, stature, volume, weight
Dominance: influence, power, prestige, rank, status

Definitions

Size refers to relative organismal magnitude among conspecifics and is typically measured by somatic height, weight, mass, and volume, as well as length, width, and circumference of morphological traits. Among animals, larger body size often facilitates dominance, one's social rank attained via the use of force or threat of force.

Introduction

Size is among the most salient properties of biological organisms. An association of largeness with dominance and smallness with submission exists across species – exemplified by the common behavioral trait of manipulating one's apparent size through expansive or contractive gestures and, in humans, by the pervasive use of size terminology to denote status (e.g., "the high and the mighty" vs. "little people") (Ellis 1994). In many species, dominance is associated with superior fitness outcomes, particularly among males (Ellis 1995), reflecting a legacy of selection favoring greater size, manipulations of size, and acuity to both. In humans, high social rank and rank-related reproductive benefits are attainable not merely through size and physical coercion, but also via prestige, status earned through perceived merit (Henrich and Gil-White 2001).

Selection for Size

Biological taxa often exhibit phyletic increase in size. This tendency is believed to result from the reproductive importance of organismal size despite costs attendant both to being and becoming large: greater food requirements, thermal stress, and conspicuity to predators, as well as the protracted vulnerability associated with slower growth, or the risky foraging and early reproduction associated with faster growth (Blanckenhorn 2000). In fact, not only do larger-bodied individuals realize greater fitness than do smaller-bodied conspecifics across phylogenetically distant species, selection is stronger on size than it is on other morphological traits. Possible ecological selection pressures favoring large size include greater capacity to survive

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environmental variation, increased longevity, more efficient use of heat per unit volume, better ability to engage in or avoid predation, and reduction in mortality from superior resource competition and use (Kingsolver and Pfennig 2004).

Ecological selection pressures may also explain much intraspecific variation in size. As initially suggested by Darwin (1871) and supported more recently in a diverse array of anisogamous reproducers, selection often favors greater female size because of associated increases in fertility: larger females are often better able to procure resources, physiologically invest in offspring (e.g., in mammals via gestation and lactation), and produce ova of greater quality or in greater quantities (Andersson 1994). In some sequential hermaphroditic species, for example, individuals begin life as males but possess the ability to reproduce as females upon reaching a body size at which the costlier investment of female reproduction is advantageous. However, in many species, particularly among birds and mammals, males are larger than females. This is often the result of sexual selection, the evolutionary process that favors traits beneficial in securing mating opportunities (Darwin 1871). Competition for mates is generally more intense among males, for whom greater size may permit physical exclusion of same-sex rivals from mating opportunities and/or increase attractiveness to females (Andersson 1994).

Size and Dominance in Males

In humans, greater body size is associated with better fitness outcomes among men. For example, Mueller and Mazur (2001) found a positive relationship between height and reproductive success in a cohort of male military officers, attributable to taller men's greater number of wives. Similarly, in a British cohort, Nettle (2002a) found that although taller men did not out-reproduce shorter men, they had more long-term relationships and were less often childless (though very tall men were more likely to be childless and have serious illnesses). Because men's height was better predicted by their fathers' social class than by their own social class, Nettle (2002a) attributed the finding to taller men's greater ability to secure long-term mates. Furthermore, Pawlowski et al. (2000) reported that taller men in their thirties, forties, and fifties were significantly more likely to be married and have children than were shorter men in each age group.

Men's height exceeds women's across populations (Gaulin and Boster 1985) and appears to be the product of sexual selection, a hallmark of which is appreciable sexual dimorphism that emerges at puberty. Males' 1% greater length and similar body fat percentage to females at birth (Wells 2007) becomes 7% greater height (Gustafsson and Lindenfors 2004) and 14% greater body mass in adulthood (Smith and Jungers 1997), largely as a result of males' pubertal increase in testosterone production.

One mechanism through which sexual selection may have favored male height is female mate choice. Females are predicted to be relatively discriminating in their mating decisions, and so the preferences of ancestral females may have shaped male stature. Consistent with this, studies of personal advertisements have shown females, but not males, to prefer tall partners, and taller males, but not taller females, to receive more responses. Similar results have been obtained in studies featuring greater ecological validity. Hill et al. (2013), for instance, found men's height to predict their attractiveness to familiar women when other sexually dimorphic traits were controlled, and in a natural fertility population from The Gambia, Sear (2006) found that while taller men did not realize greater reproductive success than did shorter men, they did have more marriages. This may reflect female mate choice for greater male height, or kin-mediated marriage decisions in which taller men have greater access to resources, possibly by virtue of higher status. In addition to height, masculine male body morphologies are consistently associated with greater male attractiveness and mating success.

Selection pressures other than female mate choice may also have favored greater male size. For example, in an exploration of mating success among groups of social peers, Hill et al. (2013)

found that body size (measured by a composite of weight as well as biceps, chest, and shoulder circumference) predicted number of sex partners in the previous year, a relationship not mediated by attractiveness to females but by physical dominance to males. Thus, men's mating success in this sample was predicted by success in male contest competition, a mechanism of intrasexual rivalry favoring greater size, strength, anatomical weaponry, and bellicosity that facilitates physical exclusion of same-sex rivals from mating opportunities. This research suggests that physical contests among men may have exerted stronger sexual selection pressure on human male traits than has female mate choice (see also Hill et al. 2017; Puts 2016). Indeed, U.S. presidents, many of whom have achieved their rank at least partly via dominance, have tended to be taller during times of societal threat and enjoy a wider margin of victory even with this variable controlled, suggesting that male height may be more valued when the perceived benefits of a dominant leader are believed most in need (McCann 2001).

Intrasexual contests also appear to have influenced male phenotypes among the other great apes (e.g., Wilson et al. 2014), whose male-biased sexual size dimorphism suggests that this trait may be phylogenetically conserved (Plavcan 2012). However, humans are more skeletally sexually dimorphic than their closest extant relatives, the chimpanzees (Gordon et al. 2008). In addition, sexual dimorphism in overall human body mass fails to capture men's appreciably greater muscle mass (Lassek and Gaulin 2009), which would likely have been attenuated in the absence of continued selection favoring it in antecedent hominins. Moreover, male-biased sexual size dimorphism among polygynous primates is positively related to the intensity of mating competition, even with phylogeny and allometry controlled (Mitani et al. 1996).

Across a wide array of species, body size is associated with male dominance (Ellis 1994), and dominant males realize greater reproductive success (Ellis 1995). Being large or conveying cues to large size is thus an important determinant of fitness outcomes in animals. Indeed, exaggerations of apparent size such as low-frequency vocalizations are prominent among primates, including humans, perhaps because they create the impression of size with less somatic investment (Puts et al. 2014, 2016). In many primate species, dominant males monopolize sexual access to multiple females or disproportionately mate with those near ovulation. Across 13 species from 6 anthropoid genera, for instance, Cowlishaw and Dunbar (1991) found a positive relationship between male dominance rank and mating success with estrous females. Although inferences of fitness outcomes from mating behavior in nonhuman primates can be complicated by paternity uncertainty, genetic research has demonstrated positive relationships between male rank and reproductive success.

Male dominance and fitness also exhibit a consistent relationship in the human ethnographic record. Among the Yanomamo of Venezuela and Brazil, Chagnon (1988) found that *unokais* (warriors, or "men who have killed") realize greater reproductive success than do non-*unokais* as a result of both marriage and bride-theft. Becoming an *unokai*, an encouraged but voluntary duty, confers higher status on men, who list access to females as their primary impetus for killing. By contrast, men who consistently abandon inter-village raiding parties lose status, as evinced by the increased sexual attention from other males that the wives of such men receive. As with all traits, however, there are costs to physical aggression, the optimal level of which is therefore likely to vary across environments. For example, among the Ecuadorian Waorani, "a people even more warlike than the Yanomamo," the most zealous warriors experience poorer measures of fitness than do less zealous warriors (Beckerman et al. 2009).

Status in human males may be achieved not only as dominance via coercion, but also as prestige via elicitation of voluntary deference. Whereas dominant individuals are often feared and avoided, prestigious individuals are sought-after, emulated, and venerated because of their locally valuable knowledge and skills (e.g., in hunting), as well as their willingness to share these (Henrich and Gil-White 2001). For instance, among the Tsimane of Bolivia, von Rueden et al. (2008) found that men's knowledge-based skills and social support

impacted the influence and respect they received among community members more than did their body size, though body size was the best predictor of peer assessments of men's ability to win in dyadic physical fights. Moreover, prestige-oriented status is associated with male fitness across small-scale human societies (e.g., Irons 1979). Prestige, however, does not appear to have superseded dominance in importance – both are viable means of acquiring and maintaining status in humans (Cheng et al. 2013). Indeed, among the Tsimane, both dominance and prestige have predicted men's surviving offspring, number of live births, extramarital affairs, number of serial marriages, wives' attractiveness, and number of allies and labor partners (von Rueden et al. 2011).

In addition to being distinct from dominance, prestige exhibits no clear relationship with body size. For instance, while male-biased sexual size dimorphism has been explained as the product of ecological selection via hunting (Plavcan 2012), a predominantly male activity associated with men's fitness in natural fertility populations (Gurven and von Rueden 2006), hunting is the most learning-intensive of all foraging behaviors (Kaplan et al. 2000), and return rates from hunting in small-scale societies often peak long after males peak in physical formidability (Walker et al. 2002). Thus, while hunting may have helped shape certain traits related to men's physical performance (e.g., Apicella 2014), relationships between hunting success and male fitness are most parsimoniously attributed to possession of knowledge-based skills. Moreover, the male-biased sexual size dimorphism inferred among some Pliocene hominin species (Plavcan 2012) reflects a greater antiquity in the human lineage than the emergence of hunting during the Pleistocene, and ecological selection leaves unexplained a suite of men's traits (e.g., facial hair, facial robusticity, and deep voices) that confer little benefit apart from aiding in male contests (Hill et al. 2017).

Size and Dominance in Females

As in males, body size is reproductively consequential in females of many species. In contrast to large males, however, large females often accrue fitness benefits through ecological selection for greater fecundity (Andersson 1994). In mammals, for example, selection favors females capable of gestating, lactating, and provisioning and protecting altricial offspring at least until weaning (Eibl-Eibesfeldt 1989). Human females appear similarly designed to invest physiologically in offspring. Women's body fat is essential for successful ovulatory function (Frisch and McArthur 1974), taller and heavier women have been shown to produce heavier offspring (e.g., Kirchengast et al. 1998), and maternal height is negatively related to offspring mortality, particularly in non-Western populations (e.g., Stulp et al. 2012). In women as well as men, moreover, height and mortality are negatively related (Jousilahti et al. 2000), though extreme height has been associated with reduced fitness and poor health in both sexes (Nettle 2002a, b).

Physiological investment in offspring is contingent on acquisition of resources such as food, to which dominance over same-sex conspecifics often affords females priority. Indeed, dominance and reproductive success are associated in females of many species (Ellis 1995). Across primates, benefits accrued by dominant females include higher-quality diets, earlier reproduction, faster reproductive rate, longer lifespan, and offspring that mature earlier and survive longer (e.g., Fedigan 1983; Harcourt 1987; Pusey et al. 1997).

While dominance and height are associated in females of many species, including humans, the association is often not as strong as it is in males (Ellis 1994). In nonhuman species, this may reflect constitutional differences among females that permit some to achieve dominance more easily than others, or superior developmental diet and health, particularly in the case of inherited rank. In humans, females may compete more for access to long-term mates likely to furnish limited resources than for direct access to resources. As a result, sexual selection via contest competition has shaped the human female phenotype less than has male mate choice, which often appears designed to capture female physiological investment (Puts 2016).

Conclusion

In humans and across an array of animal species, organismal size facilitates and is positively related to dominance, or coerced social rank. While this relationship exists in both sexes, it is stronger among males, particularly in humans. Large individuals often receive priority of access to the resources most strongly constraining their reproduction: males to mates, food, and resources, females to food and resources. While alternative explanations have been posited, the aggregate of evidence suggests that, in humans, male size and body composition are the products largely of male contest-mediated sexual selection, whereas female size and body composition are the products largely of ecological selection for fecundity as well as male mate-choice mediated sexual selection. These conclusions have received support from diverse methodologies, species, and human populations.

Cross-References

- ▶ Access to Resources
- ▶ Anatomical Adaptations for Fighting
- ▶ Assessment of Fighting Ability
- ▶ Body Attractiveness
- ▶ Body Fat Percent and Distribution
- ▶ Body Posture
- ▶ Change in Male Hunting Returns
- ▶ Comparative Evidence
- ▶ Cross-Cultural Studies
- ▶ Dominance and Health
- ▶ Dominance and Territory
- ▶ Dominance and Testosterone
- ▶ Dominance in Humans
- ▶ Evolutionary Standards of Female Attractiveness
- ▶ Facial Width to Height Ratio and Dominance
- ▶ Female Mate Choice
- ▶ Height and Dominance
- ▶ Indicators and Correlates of Status and Dominance
- ▶ Intrasexual Rivalry Among Men
- ▶ Intrasexual Rivalry Among Women
- ▶ Male Adaptations that Facilitate Success in War
- ▶ Male Adaptations to Assess Fighting Ability
- ▶ Male-Male Strategies
- ▶ Nonverbal Indicators of Dominance
- ▶ Resources
- ▶ Secondary Sexual Characteristics
- ▶ Serotonin and Dominance
- ▶ Sex Differences
- ▶ Sex Differences in Ability to Assess Fighting Ability
- ▶ Sexual Access as Benefit of Victory in War
- ▶ Sexual Selection via Direct Male-Male Interactions
- ▶ Shifting Dominance
- ▶ Social Status and Economic Resources
- ▶ Status and Dominance Hierarchies
- ▶ Upper Body Strength
- ▶ Upper Body Strength and Fighting Ability
- ▶ Upper Body Strength from Photo
- ▶ Vocal Indicators of Dominance
- ▶ Waist-to-Hip Ratio
- ▶ Women's Mate Preferences

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