

DOMINANCE IN HUMANS

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ABSTRACT

Dominance is the aspect of social hierarchy that arises from agonistic interactions involving actual aggression or threats and intimidation. Accumulating evidence points to its importance in humans and its separation from prestige--an alternate mechanism in which status arises from competence or benefit-generation ability. In this review, we first provide an overview of the theoretical underpinnings of dominance as a concept, as well as some complications regarding the application of this concept to humans, which often shade into arguments that minimise its importance as a determinant of social influence in our species. We then review empirical evidence for its continued importance in human groups, including the effects of dominance rank on measurable outcomes such as social influence and reproductive fitness (independently of prestige), evidence for a specialized dominance psychology, and evidence for gender-specific effects. Finally, because human-specific factors such as norms and coalitions may place bounds on purely coercive status-attainment strategies, we end by considering key situations and contexts that increase the likelihood for dominance status to coexist alongside prestige status within the same individual, including how: 1) institutional power and authority tend to elicit dominance; 2) dominance-enhancing traits can at times generate benefits for others (prestige), and 3) certain dominance cues and ethology may lead to mis-attributions of prestige.

Introduction

The concept of dominance plays an important role in animal behavior, social psychology, developmental psychology and anthropology. Dominant individuals accrue social influence and achieve superior resource access and greater fitness through their greater coercive control over costs and benefits; they maintain their attained rank in a stable hierarchy through intimidation and threats. Individuals who *fear the cost-infliction or benefit-withholding capacity* of the dominant in an escalated conflict yield to the dominant in contests, and grant dominants--with resistance when possible--the resources and accoutrements of status. Recently, however, some researchers have raised questions regarding the importance of dominance in structuring social rank in humans (Anderson & Kilduff, 2009; Chapais, 2015; Durkee et al., 2020; Lukaszewski et al., 2016); they argue that social status in our species has substantially diverged from the patterns observed in other great apes such that coercive routes to status attainment play little to no role in our species.

To address this debate, we review and integrate existing approaches to dominance with an eye on the evolved peculiarities of humans. First, drawing on the conceptual framework of evolutionary game theory, we review when and why social animals might evolve to either fight for dominance or consent to a subordinate status. Second, in light of this framework, we discuss several features of humans that have emerged through culture-gene coevolutionary processes that make it challenging for researchers to isolate and study dominance status. These features include: (1) prestige-based status, a second avenue to status arising from access to information in the form of knowledge and skills, (2) social norms that enforce egalitarian relationships, suppress the use of aggression and create opportunities for individuals to leave unequal groups, and (3) cumulative cultural products like languages and projectile weapons that create challenges for prospective dominants and opportunities for anti-dominance behaviors from subordinates. Third, we review the psychological and behavioral evidence for dominance in humans, drawing evidence from research with infants, children and adults across populations. Finally, we close with a discussion of some of the methodological challenges to studying human status and important areas of focus for future research, such as the differences in how dominance emerges in men and women, and how it interacts with institutions, culture, and forms of prestige status.

Theorizing dominance

Aggression in group-living animals is often stably patterned, with one member of any given pair tending to be the aggressor toward the other individual, who does not reciprocate, and who often yields valuable resources during contests. This patterning was first highlighted by Schjelderup-Ebbe (1922) among chickens, from which the notion of a *pecking order* derives. Empirically, pairwise dominance relations often form a linear order or *dominance hierarchy* in an enormous range of species, including chimpanzees and bonobos (Wittig & Boesch, 2009; Murray et. al. 2006, 2007; Thompson et. al. 2007; Noe et. al. 1980; Vervaecke et. al. 2000; Hobson et. al. 2020) and humans (Chase & Linqvist, 2009; Levi Martin 2009; Savin-Williams,

1979; McGrew 1969; Edelman & Omark 1973; Sluckin 1977; Strayer & Strayer 1976; Strayer & Trudel 1986).

Why are dominance hierarchies so common? To address this question, standard evolutionary game theorists developed variants of the Hawk-Dove Game (Maynard-Smith and Price 1973; Maynard-Smith, 1982a; McElreath and Boyd 2007). In this game, two players confront each other over a resource, and can choose either a peaceful division (act as Doves), where each benefits from half the resource at no cost, or fight for its entirety (act as Hawks). However, if one player decides to fight and the other does not, the aggressor takes the resource at no cost. If players could only act in one way permanently, natural selection will favor a mixture of Hawks and Doves depending on the value of the resource, each individual's chances of winning, and fighting costs. However, if agents can switch, natural selection can favor the use of even arbitrary differences among pairs to coordinate Hawk or Dove status, thereby preventing fights (Maynard-Smith & Parker; 1974). For example, in the stable state achieved if all players use the *bourgeois strategy*, the individual who arrives first at the resource receives it (plays Hawk) while the later arrivals are Doves. This suppresses costly conflicts and permits the bourgeois to drive out pure Hawks and Doves.

Such models frame dominance hierarchies as the product of evolved strategies for resolving disputes over limited resources and for minimizing repeated, escalated conflicts in group-living animals. In these models, the evolutionarily stable strategy (ESS)¹ under many different conditions predicts that some players will yield resources to specific others, giving rise to a system of dominance rank. The rank order in turn can be determined by mechanisms such as mutual assessment of formidability (or *resource-holding-potential*, Smith & Parker 1976; Parker 1974; Chase & Seitz 2011), a physical sign or "badge" of physical condition (Rohwer 1983; Johnstone & Norris 1993), the outcome of one or several fights (Parker 1974; Hall et. al. 2020), or even by some conventional sign such as age, tenure in the group, or inherited status (Maynard-Smith & Parker 1976; Matsumura & Kobayashi 1988; Strauss 2019; Foerster et. al., 2016). Because top-rankers in a stable hierarchy have access to more resources, these models predict that selective pressure exists for traits that enable competition for high rank. They also predict the evolution of a 'dominance psychology'--those adaptations that enable the behavioral flexibility needed to successfully navigate dominance relations (Van Vugt et. al., 2015; Henrich and Gil-White 2001).

More recent evolutionary models of resource partitioning in group-living organisms demonstrate how 1) the degree to which dominants benefit from the presence of subordinates and 2) the relative attractiveness of subordinates' outside options can limit the degree of inequality that dominant individuals can impose on the rest of the group (Vehrencamp 1983; Boone 1992; Mattison et. al. 2016 & references therein). Consistent with such models,

¹ The evolutionary stable strategy in any system is the *strategy* (pattern of choices in a *game*, where agents pick from a list of options; the payoffs are dependent on both self's and other's choices in the matrix of options) that has the following two properties: 1. It is a *Nash Equilibrium*: when all players play according to the equilibrium strategy, no player can improve their outcomes by switching to an alternate strategy. 2. It is *evolutionarily stable*; when all players play according to the equilibrium strategy, no other strategies can be evolutionarily favoured, because natural selection keeps the equilibrium strategy in place.

observational studies suggest that dominance can be complicated by the fact that subordinates benefit dominants by provisioning services (such as grooming, food-sharing, etc.) or by mutualism (through predator detection or cooperation in hunting or warfare). This means that subordinates can punish dominants by withholding or threatening to withhold these benefits. Such *leverage* (Hand 1986; Matsumura & Okamoto 2000; de Waal 1996; Lewis 2002) occurs wherever subordinates provide benefits in such a way that the provisioning cannot be compelled. It influences dominance in great apes (de Waal 1996; Watts 2006; Surbeck 2011; Surbeck 2013; Lewis 2018), and is likely important among humans (Mattison et. al. 2016; von Rueden 2020) as we cooperate in domains as diverse as foraging, food-sharing, breeding and warfare, and as we often choose to leave groups--which is another way subordinates can harm dominants, which, in the extreme, culminates in ostracism (Soderberg & Fry 2016). Pervasive leverage weakens the unidirectionality of aggression or intimidation, increases affiliative and reconciliatory behaviors, and reduces rank-based inequality, making dominance hierarchies less *despotic* and more *egalitarian* (De Waal 1986; Thierry 1990; Watts 2006; Preuschoft & Van Schaik 2000), or less *steep* (De Vries et. al. 2005).

Coalitions between individuals who coordinate their aggression can also influence dominance in many primates (Van Schaik et. al. 2004; Bissonnette et. al. 2015) including humans (Boehm 1993, 1999). For example, one type of coalition--the large leveling coalition (defined theoretically as one that reduces rank-associated inequality without changing the rank order; Van Schaik et. al. 2006; Preuschoft & Van Schaik 2000), may have been especially important in human evolution (Boehm 1993, 1999). Factors that promote the evolution of leveling coalitions--which are all likely to have existed in our evolutionary history, as reviewed later--include lower returns to dominance (low despotism) and lower coalition costs (Van Schaik et. al. 2004; Pandit & Van Schaik 2003; Van Schaik et. al. 2006), *synergy* (if coalition strength exceeds the combined strength of its constituents; Gavrillets 2012; Chen et. al. 2017), and increasing returns to resource ownership, which makes it in all individuals' interest to reduce within-group inequalities (Gavrillets; 2012).

In short, evolutionary game theory provides a firm foundation for understanding how, when and why dominance hierarchies emerge from social interaction in group-living species. The evolutionarily stable behavioral strategies find their counterparts in a suite of psychological adaptations--a "dominance psychology"--that should be observable in both dominants and subordinates. Dominance arises relationally and is not an individual-level trait, but is often correlated to individual traits such as resource-holding potential and physical size. Furthermore, leverage arising from cooperation, mutualism and outside options, as well as coalitional dynamics--which are all important in humans--are expected to influence the inequalities associated with dominance and to modify its expression.

Challenges to dominance in humans

Although we have every reason to suspect that the evolutionary processes and incentives identified by the logic of the models described above will apply to humans, identifying and studying dominance in our species poses particular challenges due to the influence of both

cultural evolution and culture-gene coevolution. Below, we consider three key factors that have likely shaped our species' genetic evolution and that continue to influence the expression of dominance in the modern world:

- 1) the emergence of a second avenue to high status--prestige, from the uneven distribution of our species' most important non-rival good, *cultural information*, such as knowledge, skills, tactics and techniques;
- 2) the spread of social norms that favor egalitarian behavior, suppress aggression and facilitate mobility among groups; and
- 3) the development of cultural products such as projectile weapons, poisons, languages and cooperative hunting and raiding techniques that influence the balance of power between dominants and subordinates.

We discuss these in the context of contemporary mobile hunter-gatherers, because features of social life among these populations were likely recurrent over at least the later Paleolithic and may have shaped the evolution of our species' dominance psychology.

Humans have evolved a second avenue for achieving status--prestige (Henrich & Gil-White, 2001; Maner, 2017), which emerged alongside our species' increasingly sophisticated capacities for cultural learning (Henrich 2016), including our ability to target our cultural learning specifically at those models most likely to possess adaptive information. Evolutionarily, deference in a prestige hierarchy is exchanged for informational access, and thus comes with learning opportunities--those paying deference get to 'hang out' with the more prestigious (Henrich & Gil-White, 2001). Consequently, high prestige produces feelings of respect and admiration and induces approach toward the prestigious, instead of the fear and avoidance associated with dominance (Cheng et al. 2010). The prestigious and dominant both enjoy increases in social influence and preferential attention (Foulsham et. al. 2010; Cheng et. al. 2010), but prestige increases social influence through voluntary deference, imitation and true persuasion whereas dominance relies on force and avoidance of the costs that dominant individuals can inflict (Cheng et al., 2010, 2013).

Prestige can facilitate coalition formation and collective action (Henrich et. al. 2015; Price & Van Vugt 2014), and such cooperative coalitions often endow prestigious individuals--who naturally emerge as leaders--with the ability to inflict costs. That is, the coalition enables prestigious individuals to behave dominantly towards disloyal followers or even those outside his or her coalition. This means that prestige and dominance status may overlap in some individuals. Similarly, in more complex societies with meritocratic institutions and legally-enforced private property, prestige can lead to fame, wealth and institutional power, giving prestigious individuals coercive control over costs and benefits. This again merges prestige and dominance in complex ways (Henrich & Gil-White 2001; Glowacki et. al. 2015; Garfield et. al. 2019; Garfield & Hagen. 2020). The diffusion of meritocratic and pluralistic institutions over the last few centuries has likely increased the relative importance of prestige (Henrich 2020). Therefore, researchers interested in the psychology of status must carefully disentangle prestige and dominance by recognizing how coalitions and institutions can reinforce the relevance of either dominance or prestige, or even induce overlap between the two.

Alongside prestige, cultural evolution and culture-gene coevolution also gave rise to social norms, which came to increasingly shape social life, eventually leading to a *norm psychology* (Chudek and Henrich 2011; House et. al. 2020). In contrast to our ape relatives, there is reason to suspect that many hunter-gatherer populations deep into our evolutionary history possessed social norms that promoted egalitarianism and suppressed aggression or coercion (Knauff et. al. 1991; von Rueden 2020; Boehm 1993, 1999; Gintis et. al. 2015; Mattison et. al. 2016; Boehm et al 1999; Lee 1979). Aggressive individuals among contemporary hunter-gatherers, who resort to force and intimidation or violate the autonomy of others are subjected to social sanctions imposed by the community, effectively deploying escalating sanctions beginning with criticism, ridicule, ostracism, or execution (Boehm et. al.1993; Boehm 2012, 1997; Wrangham 2019; Wrangham 2021). Even behaviors that suggest potential aggression or domineering tendencies (e.g. issuing commands, or selfishness during resource sharing) are closely monitored and sanctioned (Boehm 1999). Our dominance psychology has had to adapt to a norm-governed world where manipulative use of coercive incentives had to be accomplished more subtly, within the context of social rules and third-party monitoring.

Over the course of human evolution, norms and institutions pertaining to marriage, exchange, and communal rites also promoted 'outside options' for individuals by providing opportunities to move among local groups or bands within an ethno-linguistic community (Chapais et. al. 2009; Smith et al., 2018; Henrich 2016). Marriage norms required or encouraged individuals to find partners outside of their local groups and exchange norms encouraged individuals to maintain ongoing gift-giving relationships with a portfolio of partners, effectively promoting wide networks of relationships (Weissner 1982). Communal rituals brought diverse residential groups into periodic contact, which helped keep doors open among residential communities and produced a degree of freedom to move among groups not observed in other socially cooperative species. By providing outside options, these social norms provided further 'leverage' for subordinates and weakened the control of dominants.

Finally, cultural evolution created a variety of cultural products, including communicative repertoires--vocal and sign languages--as well as weapons and tactics that would have made the project of domination in a mobile hunter-gatherer society very difficult. Language would allow effective subordinate coordination to assassinate aggressive or dominant individuals, and projectile weapons--from atlatls to poisoned arrows--would have reduced the costs of taking down a dominant, especially when combined with ambush tactics developed for hunting or raiding (Gintis et. al. 2015; Boehm et. al. 2012; Wrangham et. al. 2019).

Dominance in humans: assessing the evidence

As we'll show, however, the impact of the factors reviewed in the previous section provide an incomplete explanation of status asymmetries as dominance plays a pervasive role in human social life. Despite the constraints imposed on dominance by norms, social fluidity, or specific cultural products, and its frequent subordination to prestige, we will draw on experimental, observational, and anthropological evidence from both children and adults from

diverse societies to show how dominance reliably impacts social influence, collective decision-making, and reproductive fitness in humans. This body of evidence suggests that dominance continues to contribute pervasively to status asymmetries in humans.

From an evolutionary point of view, our baseline expectation should be that humans likely inherited some form of dominance psychology from our shared ancestry with chimpanzees and bonobos, whose social life is strongly shaped by dominance hierarchies (Franz et. al. 2015; Majolo et. al. 2012; Preuschoft & Van Schaik, 2000; Noe et. al. 1980; Boesch & Boesch-Ackermann 2000; De Waal & De Waal 2007). Among these apes, dominance rank is associated with both shorter-term social influence, including access to food and mating opportunities (Wittig & Boesch 2003; Murray et. al. 2006, 2007; Thompson et. al. 2007), and longer-term outcomes such as fitness (Muller & Wrangham 2004; Wroblewski et. al. 2009; Surbeck et. al. 2017). Alongside directed movements like chasing and biting as well as cues like peering (Noe et. al. 1980; Vervaecke et. al. 2000), both of our closest relatives acknowledge their place in a stable hierarchy by signalling dominance or submission using arbitrary displays such as pant-grunts (Preuschoft & Van Schaik, 2000; Noe et. al. 1980; Boesch & Boesch-Ackermann 2000; Schamberg et. al. in press; De Waal & De Waal 2007). Strikingly, aspects of human dominance appear evolutionarily continuous with those in apes, such as attentional mechanisms (Lewis 2021) and some cross-culturally conserved and likely reliably developing ethological displays, which include the pride display (homologous with the bluff display in chimpanzees; Beall & Tracy 2020) relevant for dominance when accompanying *hubristic pride* (Cheng & Tracy 2010), and the shame display (homologous with elements in a variety of primate submission displays, such as crouching or a lowered body posture) which can signal pure subordination, especially in non-WEIRD societies (Fessler 2004; Fessler 2007; Beall & Tracy 2020).

Evidence from infants and children

Studies of infant cognition indicate that the cognitive machinery for mentally representing dominance is used to formulate expectations about the social world already in preverbal infants as young as 6-10 months of age. Such infants can use information about relative coercive capacity--inferred from attributes such as physical size, strength, and formidability---as heuristics to predict patterns of deference and resource acquisition (Charafeddine et. al. 2015; Gazes et al. 2017; Mascaro et. al. 2012; Pun et al, 2016; Pun et al., 2017; Thomsen et. al., 2011; for a review, see Thomsen, 2019). Even before the end of their first year, infants appear to understand key properties of dominant relations such as transitivity (if A dominates B, and B dominates C, then A also dominates C) and temporal or cross-context stability (if A dominates B today in one domain, A will also dominate B tomorrow in another domain; Bas et al., 2021, Gazes et. al. 2015, Mascaro & Csibra 2012, 2014). Given how early and reliably these abilities emerge, the cognitive mechanisms for inferring and responding to dominance likely have a shared genetic basis with primates and other species, who demonstrate many of the same cognitive abilities (Bergman et al., 2003; Cheney & Seyfarth, 1999; Hobson & DeDeo, 2015).

Children aged 2 to 6 begin to deploy these cognitive capacities to navigate a social world organized by status hierarchies by using dominant tactics (Henrich & Gil-White 2001). Dozens

of studies show that linear dominance hierarchies reliably develop in peer groups in children as young as two (McGrew 1969; Edelman & Omark 1973; Sluckin 1977; Strayer & Strayer 1976; Strayer & Trudel 1986). High rates of agonism in this age group and the frequency of unsupervised play situations with peers or siblings are likely jointly responsible for the strong dominance phenomena observed. Indeed, rates of angry outbursts and physical aggression--kicking, throwing, biting, and breaking objects--peak at ages 2 to 3 across genders and cultures (with a small male bias; Cole et al., 2011; Liu et al., 2013; Tremblay, 2000). These dominance hierarchies are maintained by a relatively small number of highly aggressive children who consistently coerce others via force or threats; preschoolers who routinely initiate aggression are reliably recognized by classmates as high status (Sluckin & Smith, 1977).

Nevertheless, the prominence of dominance-related social rank begins to decline from middle childhood onward, while prestige becomes increasingly important. Cultural norms likely play a key role in this developmental transition. Children in middle childhood readily acquire the social norms of their communities and move toward the behaviors and normative standards of local adults (Bauer et al., 2014; Blake, Piovesan, et al., 2015; Eisenberg & Fabes, 1998; Eisenberg & Mussen, 1989; House et al., 2013, 2019; McAuliffe, Raihani, et al., 2017). Children and adults alike are motivated to avoid punishment for norm violations (Mathew & Boyd, 2011; McAuliffe et al., 2015). This means that, to the extent that they are part of the local culture, middle childhood marks a critical period of strengthened behavioral adherence to norms that promote egalitarianism and prosociality and suppress the use of coercion. In addition, norm adherence is facilitated by a maturing brain that improves executive functioning, impulse control (Berns et al. 2007; Harden & Tucker-Drob, 2011), and emotional regulation (particularly of anger; Blanchard-Fields & Coats, 2008) and increases risk-aversion (Paulsen et al., 2012). Consistent with this, studies reveal a cross-culturally typical trajectory of progressive decline in physical aggression beginning at age 4 to 5 (S. Côté et al., 2006; Liu et al., 2013; Nagin & Tremblay, 1999; Tremblay, 2000), alongside a concomitant rise in concerns with egalitarianism, fairness, and prosociality (Blake, McAuliffe, et al., 2015; Fehr et al., 2008; McAuliffe, Blake, et al., 2017; Melis et al., 2015).

Despite this, dominance does not cease to exist in older children and adults and continues to shape status asymmetries along with prestige. In a classic study on German 8 to 11-year olds, Hawley and colleagues (2002) observed children in dyadic play situations. Some children attained influence--where influential children are those who were observed to spend more time actively playing with an attractive and novel toy that was highly coveted while the other child watched--by deploying prestige through helping, demonstrating useful goal-directed behavior, or offering advice (a tactic she termed 'prosocial'). Other equally influential children deployed dominance by using physical aggression (e.g., pushing or slapping the partner), by grabbing the toy, or by hurling insults (a tactic she termed 'coercive'). Similar evidence comes from studies that apply ethological methods developed for primates to adolescents (Savin-Williams, 1979; Levi Martin, 2009). Savin-Williams (1979), for example, found that dominant boys who frequently issued commands, used ridicule, or threatened others with physical aggression tended to prevail in disputes and be regarded as leaders by peers and observers alike.

Yet, the forms in which dominance is expressed may vary across sex and age. Sex differences in the expression of dominance emerge early in life and persist across age and societies. Whereas males display greater physical and verbal aggression, indirect aggression is more frequently used by females than males (Archer, 2009; Hess & Hagen, 2006, 2019). Gender norms may combine with any evolved sex differences in traits such as relative tolerance of physical risk (Archer, 2009; Campbell, 2013) to increase the use of physical aggression in men and indirect aggression in women. With respect to age, whereas younger children coerce through physical aggression, older children increasingly deploy non-physical, more normatively acceptable forms of dominance, through verbal or indirect aggression (e.g., use of ridicule, rumor or gossip, or social exclusion; Côté et al., 2007; Savin-Williams, 1979; Vaillancourt, 2005). Furthermore, older children may learn to deploy a mix of dominance and prestige tactics to maximally influence others' attitudes and behaviors, leveraging simultaneously their threat potential and coercive capacity in conjunction with any valued abilities, knowledge, or recognition that they possess. In her work on status hierarchies in late childhood and adolescence, Hawley (2003; 2007a; 2007b; 2014) describes individuals who skillfully influence the behavior of others via *both* persuasion and force, which she terms 'bistrategic'. She notes: "bistrategic controllers across all age groups have shown themselves to be the most successful at resource control. Part of their success is due to the fact that they are high in aggression yet mitigate the costs of aggression by employing prosociality" (p. 435).

Nevertheless, children continue to refine their ability to assess and distinguish prestige and dominance with learning and developmental age, facilitated by an improved cognitive understanding of the benefits and costs associated with deference. One study of British and Chinese children (Kajanus et al., 2020) showed that 5-year-olds demonstrate some ability to distinguish between dominance and prestige--mentally associating prestige with being liked and dominance with being feared--but also that they occasionally conflate the two strategies. In contrast, these mistakes are virtually absent among 10-year-olds, who consistently distinguish the two kinds of status.

Evidence from adults

In adults, dominance reliably affects collective decision-making and increases perceived and empirically measured influence in naturalistic groups in both large- and small-scale societies (Cheng et. al. 2013; in both sexes; Brand & Mesoudi 2019; McClanahan et al., in press; Redhead et. al. 2019; Redhead 2016). Dominant-aggressive behaviors increase individuals' other-rated power and their attainment of organizational positions in corporate settings in a large longitudinal dataset over 14 years (Anderson et. al. 2020). A vast literature in social psychology, which uses a similar measurement of *personality dominance* (assertiveness, forcefulness), documents the positive impact it has on social influence and group decision-making in WEIRD societies (Anderson & Kilduff 2009 and references therein). In small-scale societies, dominance predicts getting one's way in a dispute for males--a context directly relevant to contest-based theories of dominance (Von Rueden et. al. 2011), and increases likelihood of leadership among the Chabu (an Ethiopian population of former hunter-gatherers),

especially among men (Garfield & Hagen 2020). In a cross-cultural study using an ethnographic dataset, dominance as evaluated by terms indicating *coercive authority* contributes to leadership in 59% of the traditional societies surveyed (Garfield et. al. 2020).

As reviewed above, high-status individuals have greater reproductive success than lower status males in diverse species of primates (Ellis, 1995; Surbeck et al., 2017). Paralleling this, dominance contributes to male fitness in small-scale human societies. To illustrate this, we estimate the effect of dominance and prestige status on men's reproductive success through re-analysis of von Rueden & Jaeggi's (2016) meta-analytic study of fertility in 46 studies across 33 non-industrial societies. As shown in Figure S1, dominance--as indexed by physical formidability in existing studies--contributes significantly to increased fitness as measured by the number of surviving children, alongside prestige (indicated by hunting success; $Zr = .18$ and $.30$, respectively). Similar evidence comes from other work that captures non-physical elements of dominance. Consider how, for example, a quantitative study of ethnographic records from 59 non-industrial population reveals that members of the community who are aggressive or exercise coercive authority (dominant) tend to have multiple mating partners (polygynous) and higher quality spouses (Garfield, Syme, & Hagen, 2020). Similarly, among the Chabu, men who are feared (dominant) have more current spouses and more marriages over the lifetime, although in these data a higher number of mating partners do not necessarily translate into more surviving children (Garfield & Hagen, 2020). In contemporary WEIRD societies marked by low fertility norms, status--often indexed by income and wealth in studies, thus conflating dominance and prestige (Cheng & Tracy, 2013)--has a zero or weak positive association with male reproductive success, but a more variable and often negative effect on female fitness (Barthold et al., 2012; Hopcroft, 2006; Pérusse, 1993).

As expected by the different psychologies evoked by the two forms of status, however, the manner through which dominance and prestige increase fitness may differ. Evidence from the Tsimane show that, for example, although men with either form of status have a higher number of surviving offspring for their age, dominant men--as indexed by their greater physical formidability--marry younger wives and (like prestigious men) have more extra-marital affairs, whereas prestigious men marry at an earlier age and their offspring experience lower childhood mortality (von Rueden, Gurven, & Kaplan, 2011). Other evidence, mostly from WEIRD societies, indicate that while women prefer prestigious men over dominant men when evaluating romantic partners, particularly in long-term relationships, greater dominance is selectively preferred in the context of short-term relationships (Valentine et. al. 2014; Puts et. al. 2006; Wolff & Puts 2010; Snyder et. al. 2008). Traits supporting high dominance attainment may also support intrasexual competition, and many traits that serve as dominance signals, such as vocal pitch and physical formidability, are sexually selected in men in both small-scale (Rosenfeld et. al. 2020; Apicella et. al. 2007) and large-scale societies (Valentine et. al. 2014; Puts et. al. 2006; Wolff & Puts 2010; Aung & Puts 2020; Snyder et. al. 2008; Kordsmeyer et. al. 2016). The effects of status on female fitness, despite being consistently positive in most female mammals, is more variable in human societies and less well studied (Borgerhoff Mulder, 1987).

An accumulating body of evidence strongly indicates that multiple verbal, nonverbal and physical cues reliably signal dominance or domineering intentions in human adults and are interpreted as such; by contrast, prestige is associated with a distinct set of cues. For example, in both small and large scale societies, experiments and field observation indicate that the appearance of 'physical formidability' is associated with greater dominance status (Von Rueden et. al. 2008; Von Rueden 2011; Blaker & Van Vugt 2014; Lukazewski et. al. 2016). Similarly, among the nonverbal behaviors, dominance is associated with physical expansiveness and a downward head tilt (Witkower et. al. 2020) while prestige is associated with signals of confidence (e.g. upward head tilt, erect torso and smile). Overall, the combination of physical traits and nonverbal cues shapes initial expectations of dominance in a rapid, highly automatic process that involves little conscious processing ("at first glance", Kalma, 1991), and interactants can extract so much nonverbal information before any verbal exchange that subsequent verbal interactions do not modify initial dominance ratings (Kalma, 1991).

More subtly, dominance and prestige also produce different verbal behaviors in humans. Dominance is associated with aggressive attempts to take up conversational space, overt signalling of one's own importance, exaggeration of one's own contributions, attempts to manipulate and exploit (Cheng et. al. 2010; 2013), as well as lowered vocal pitch (Cheng et. al. 2016; Aung & Puts 2020). Lower unmodulated vocal pitch predicts higher assessed dominance through its influence on perceived threat potential in small and large-scale societies (Puts et. al. 2006; Puts et. al. 2012). Dynamic lowering of pitch also predicts higher assessed dominance and is interpreted by others as signalling intent to pursue a dominance-based strategy to attain social rank (Zhang et. al. 2021; Cheng et. al. 2016). Interestingly, men modulate their vocal pitch in response to their self-perceived physical dominance relative to a male competitor (Puts et. al. 2006; Leongomez et. al. 2017)--an example of social dynamics and assessment influencing levels of expressed dominance. In contrast, prestige is associated with self-deprecation, praise for others, and an open conversational style that invites criticism, signals respect for others' opinions, and respect for group consensus (Cheng et. al. 2010; 2013). Prestige also heightens voice pitch (Cheng et. al. 2016).

As human relationships come with extensive benefits, strategic behaviors or *social tactics* in such relationships can also correlate with dominance and prestige. Dominance is associated with both *coercive* and *complaisant* (gaining influence by pleasing others) social tactics, in line with its dependence on perceived cost-infliction abilities, but prestige is associated with the use of only *complaisant* tactics in a WEIRD sample (Ketterman & Maner 2021). The combination of complaisance and coercion suggests that benefit provisioning may be a part of dominance-pursuit if it increases the future effectiveness of benefit-withholding as a threat--this is why the difference between prestige and dominance shouldn't be rooted in costs v.s. benefits per se but instead must reflect the non-rivalrous and non-zero sum nature of the exchange.

Dominance and prestige are also associated with distinct emotional and motivational states, at least in WEIRD societies. Dominance is associated with a facet of pride--*hubristic pride*--capturing narcissism, arrogance and egotism--states that may support the antisocial

behaviors, manipulation, and strategic lying associated with pursuing dominance rank (Cheng et. al. 2010). In contrast, prestige is associated with *authentic pride*, stemming from genuine accomplishment, which may adaptively facilitate or signal motivation, humility and prosociality (Tracy et. al. 2020). *Anger* may also help dominants credibly signal their commitment to inflict costs or withhold benefits, attracting subordinate attention and improving their bargaining position (Sell et. al. 2009). Anger independently promotes dominance-seeking behavior (Cabral et. al. 2019), and often co-occurs with shame; the two emotions are strongly correlated (Beall & Tracy 2020), and they may jointly motivate people to counter threats to dominance status. Low dominance rank heightens sensitivity to social threats and increases social inhibition, but high dominance blunts such sensitivity, promotes approach behaviors, and reduces inhibition--attentional and behavioral biases that may be adaptive to different levels of social privilege (Keltner et. al. 2003; Anderson et. al. 2002).

Discussion

The evidence reviewed above indicates that dominance continues to be a viable route to rank acquisition, impacting both social influence and fitness in humans across a wide range of contexts, and plays a role in human status asymmetries from the youngest of ages. However, the human-specific complications presented in this review cannot be overlooked. First, we comment on some important methodological and theoretical issues with research programs that attempt to measure dominance in our species. Second, we look into gender-specific effects of dominant strategies for rank acquisition. And finally, because norms may place bounds on the effectiveness of coercion-based strategies to rank attainment or even modify their function, we lay out the evidence for three social dynamics that influence dominance attainment and their interaction with prestige, and use concepts previously developed to consider how socioecological and institutional factors affect when and how dominant individuals can attain influence.

Theoretical & Methodological Challenges

Because dominance produces status or influence over others' actions that is achieved *against anothers' preferences*, survey measures that tap the colloquial understanding of "social influence" or "status" or that rely on the definition of *status* in social psychology (which involves gaining deference through *changing* another's preferences; Cheng et. al. 2013), may fail to capture the full impact of dominance. Indeed, a recent high-profile analysis of questionnaire responses (Durkee et. al. 2020) found, across a range of large-scale societies, that people rated dominant traits (defined by "cost-infliction inclinations and abilities") to have weak or no impact on social influence after controlling for prestigious traits ("benefit-provisioning inclinations and abilities"). However, in several follow-up studies, Cheng et. al. (2021) demonstrated that the descriptors of the dependent variable ("social influence") in the study strongly activated prestige-related concepts, which would make 'prestige' appear more important in the results. Translations often magnified this problem by using synonyms for "reputation" and sometimes "prestige" itself in the target language for the dependent variable. Additionally, the analyses

suffered from high collinearity between dominance and prestige, which rendered any firm conclusions inappropriate. However, reanalyses designed to address this issue revealed an important role for dominance, albeit less than for prestige--which is not unexpected given the translation process and the semantics of words used for the dependent variable. Of course, for the reasons we've described, prestige may often be more important than dominance in many contexts, but that doesn't mean that dominance plays no role.

Studies of non-human primates use multiple measures of dominance, such as resource control after competitive bouts, or directionality of aggression and formal dominance signals. These measures usually correlate, but not always, leading to doubts about construct validity in some species (Drews 1994). Nevertheless, recent research in humans that treats dominance as a trait reflecting individual differences in tendency to use force-based strategies for rank pursuit (Cheng et al. 2010) generally finds very high inter-rater correlations of subject's dominance ($\sim .78-.88$; Cheng et al. 2010 ; $>.8$;Cheng et al. 2013), and Cronbach's alpha (.83 in Cheng et al. 2010; .83-.93 in Cheng et al. 2012; .86, Brand & Mesoudi 2019), indicating that naturalistic groups reach near-consensus on a dominance construct that demonstrates excellent validity according to standard psychological criteria. Empirically, measured dominance and prestige tend to be uncorrelated ($r = .03-.12$, Cheng et al. 2010; $r = 0.01$, Cheng et al. 2013; $r = -.12 - .17$, Redhead et al. 2019) or negatively correlated (Brand & Mesoudi 2019), which means that the high level of collinearity that people believe exists between prestige and dominance in Durkee et al. (2020) is not empirically reflected in naturalistic groups in the lab or the field. An older tradition in the measurement of dominance inspired by primate ethology uses purely relational measures (such as the direction of unreciprocated agonistic behaviors), which is perhaps closer to the theory (McGrew 1969; Sluckin 1977; Strayer & Strayer 1976; Strayer & Trudel 1986; Savin-Williams, 1979). When used together with survey-assessed trait dominance, rank and trait dominance strongly correlate, regardless of whether the survey is filled by observers or group participants (Savin-Williams, 1979).

Overall, the evidence points to the importance of avoiding self-report measures in favor of integrating both other-report measures and ethological observation.

Gender-specific effects

Current research supports the view that dominance plays a role in status attainment for both men and women in same and mixed-gender contexts (Anderson et al., 2020; Brand & Mesoudi, 2019; Cheng et al., 2013; McClanahan et al., in press; Redhead et al., 2019). However, evidence exists for gender-specificity in the way dominance impacts social status. For example, in a study of status among same-sex face-to-face groups in Canada (Cheng et al., 2013), women perceived as dominant were deemed less likeable by other women ($r = -0.24$, $p = 0.025$), whereas dominant men incurred little to no social penalty ($r = 0.08$, $p = 0.43$). Among the egalitarian Chabu in Ethiopia, dominance contributed less to leadership attainment among women than among men (Garfield & Hagen, 2020).

One potential explanation for this comes from social role theory (Eagly, 1987, 1995; Eagly & Wood, 2016): women's lower status across societies results from social norms emphasizing that women ought to be communal--warm, nurturing, kind--while men should strive

to be agentic--assertive, authoritative, and independent (Eagly et al., 2020; Hentschel et al., 2019; Prentice & Carranza, 2002; Williams & Best, 1990). A proclivity to sanction gender norm violations (Moss-Racusin et al., 2010; Ridgeway, 2019; Sullivan et al., 2018) may result in backlash against women who exercise dominance, who are often described by scholars as overly agentic relative to norm expectations (Brescoll & Uhlmann, 2008; Buss, 1981; Eagly & Karau, 2002; Rudman et al., 2012; Rudman & Glick, 2001; M. J. Williams & Tiedens, 2016). Backlash occurs even when dominant women seek to lead groups with communal and other-serving (stereotypically feminine) goals (Ferguson, 2018), and among same-sex sanctioners (Gabriel et al., 2018).

The social dynamics of prestige and dominance

While prestige and dominance co-exist as pathways to status in humans, they need not operate independently. Many high status individuals may derive influence from *both* prestige and dominance processes. This is especially important given the factors reviewed that limit the effectiveness of coercive tactics alone. Alongside the more straightforward process where subordinates are compelled into compliance exclusively via coercive threats, three mechanisms may produce an overlap between dominance and prestige status components.

First, culturally-evolved institutional hierarchies may grant formal leaders, managers, and other authorities legitimate control over rewards and punishments, which creates the conditions for dominance via coercive threats (.). Because such positions may in some societies be attained (or be assumed to be attained) through skill, competence or knowledge, high status authorities may demonstrate prestige ethology even as they keep aggressive or coercive tactics in their toolboxes for use in limited occasions. Such roles may exist even in egalitarian societies, for example among shamans, who tend to be simultaneously respected and feared (Rogers, 1982; Singh et al. 2018; Garfield et al. 2020).

Second, traits, attributes, and motivations that generate coercive threat may themselves constitute valued abilities worthy of emulation or deference in some situations. Physically formidable men may be seen as more capable of generating benefits for in-group members through their perceived capacity to punish free-riders, to facilitate inter-group competition (Holbrook et al., 2016; Lukaszewski et al., 2016; von Rueden et al., 2014; Redhead et al., 2021; Chen, Zhang, Laustsen, & Cheng, in press), or to compel broader coalitional support from others (Chapais, 2015; Henrich et al., 2015).

Third, displays of confidence, which are frequent among dominant individuals (Anderson & Kilduff, 2009a), can lead to an undeserved prestigious reputation relative to their true skill. This will depend on the quality of information on other's skill levels, meaning that this mechanism is more likely to operate in complex large-scale societies with high levels of specialization and where ephemeral interactions with strangers are important.

CONCLUSION

Convergent evidence from multiple disciplines and from studies across ages, sexes, and cultures, show that agonistic and aggressive forms of rank-pursuit involving the deployment of cost-infliction or benefit-withholding strategies continues to be a viable route to social status in humans. Norm-governed coalitionary behaviors and human-specific ecological factors strongly temper and modify the expression of dominance in our species, but the fundamental strategic calculus rooted in game theory, where individuals who are more willing and able to inflict costs in protracted conflicts have resources ceded to them and gain influence, continues to hold, and is required to explain empirically measured social asymmetries and fitness differentials across societies and contexts. Furthermore, developmental and comparative studies demonstrate that the cognitive, emotional and motivational mechanisms that constitute a “dominance psychology”, as well as multiple aspects of human dominance ethology, appear to be cross-culturally stable, to demonstrate phylogenetic continuity with similar phenomena in great apes, and to emerge early in development. This strongly indicates that dominance has played and continues to play a role in structuring our social environments and shaping our psychology.

Some important open questions are how much dominance affects the fitness of women, and whether the dominance cues in women are identical to those that strongly affect assessed dominance in men. How institutional, socioecological and cultural factors affect the success of either dominance or prestige-based strategies for rank-pursuit, and how they may affect the specific mechanisms that confer dominance or prestige (or both) on certain individuals, remain a fruitful avenue for future research.

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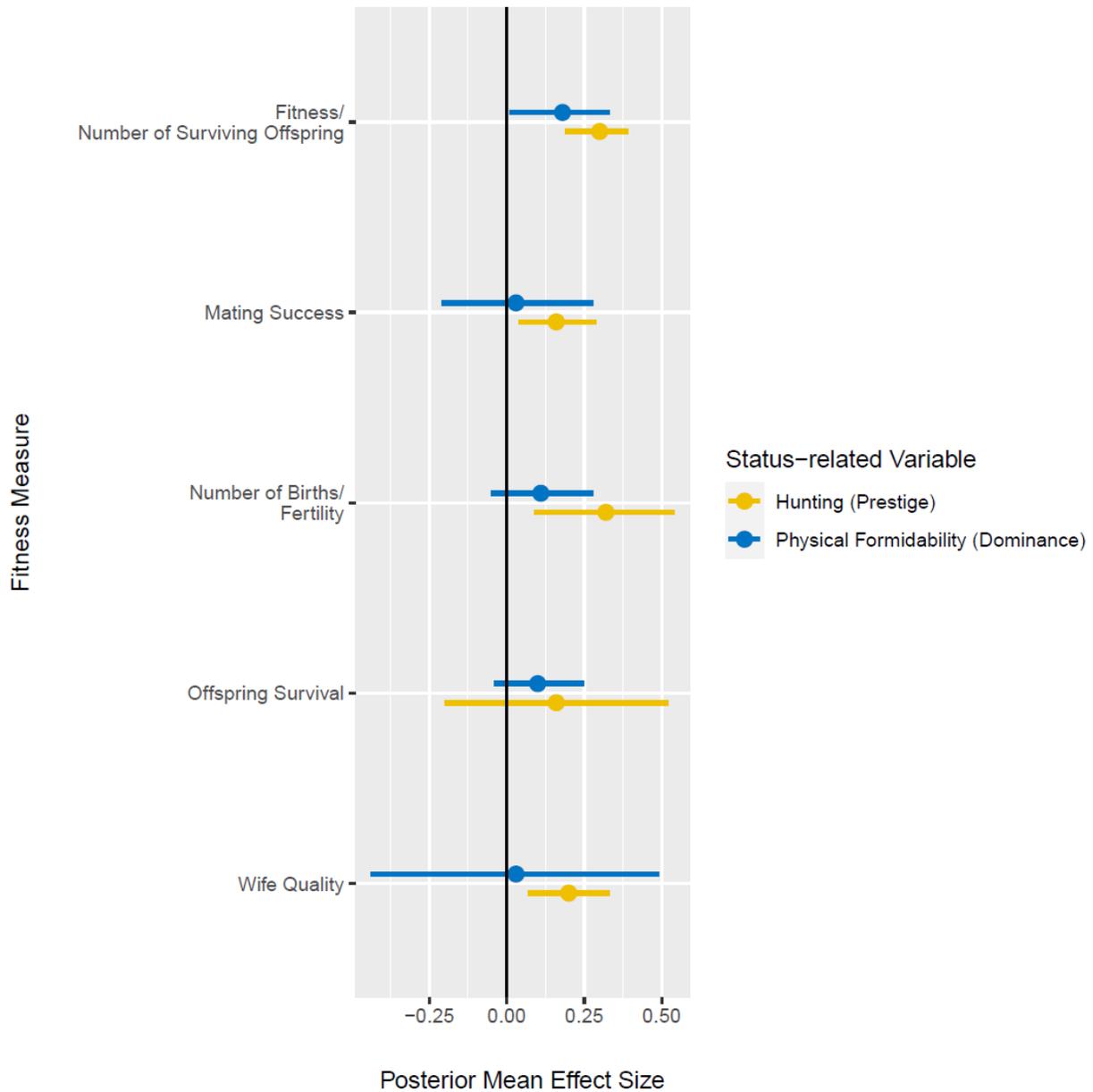


Figure S1 | Results of a meta-analysis of effect sizes of physical formidability (dominance) and hunting ability (prestige) on reproductive fitness, based on data reported in Von Rueden and Jaeggi (2016). Other status items (wealth and political influence) were excluded from the analysis due to their possible implication of both dominance and prestige mechanisms. Each coefficient estimate represents an estimated effect size aggregated from studies that test the effects of either prestige (yellow) or dominance (blue) on a given measure of reproductive success indicated on the Y-axis. Lines represent 95% confidence intervals for the point estimate. Studies that measured the effect size of physical formidability on the number of surviving children were coded as using “Fitness” as their dependent variable/measure of reproductive success. Studies that measured age at first marriage or age of first birth, the total number of wives or extrapair copulations, as well as marriage status, were coded as using “Mating Success” as their dependent variable. Studies measuring number of live births and offspring mortality were coded as using “Fertility” and “Survival” respectively, while studies measuring the youth, BMI, or food production of the wife were coded as using “Wife Quality” as the dependent variable. While the overall sample size of studies is low, resulting in large confidence intervals, dominance has a robust and positive effect on overall fitness (first point in the plot), as does prestige. Data for this analysis is drawn from von Rueden & Jaeggi (2016), and can be found at [this link](#). The code for the analysis can be found at <https://osf.io/87zxf/>.