



Strong personalities: Investigating the relationships between grip strength, self-perceived formidability, and Big Five personality traits

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ARTICLE INFO

Keywords:
Formidability
Embodied capital
Personality
Neuroticism
Extraversion
Sex differences

ABSTRACT

Individuals vary in physical size, strength, and overall physical formidability, and this variation has potential consequences for the relative costs and benefits of certain types of social interactions. For example, dispositional vigilance towards potential ecological or social threats may be more beneficial for less formidable (relative to more formidable) individuals. However, previous research has only begun to elucidate the relationship between formidability and broad personality traits. In the current research we explored the relationships between hand-grip strength and Big Five personality traits, and found relationships that were partly – but not entirely – consistent with previous research. Across two samples of American undergraduates ($N > 500$), we found negative correlations between grip strength and neuroticism in both men and women, but no correlation between grip strength and other Big Five traits. In Study 2, we also extended previous research by examining self-reported perceived formidability. Perceived formidability correlated negatively with neuroticism and positively with extraversion in both sexes. Importantly, perceived formidability also mediated the relationship between grip strength and neuroticism. Finally, exploratory analyses revealed that differences in grip strength also fully accounted for sex differences in neuroticism.

1. Introduction

Intragroup variation in physical size and strength is an inherent characteristic of all human groups around the world, and this variation has implications for the dynamics of both everyday social interactions and infrequent social disruptions (e.g., conflict). All else equal, physical altercations are costlier for less formidable individuals than for more formidable individuals. In many mammal and primate species this physical variation has implications for dispositional tendencies pertaining to status, courtship, and dominance (e.g. Anestis, 2005; Leigh, Setchell, Charpentier, Knapp, & Wickings, 2008; Pereira, 1995; Setchell, Wickings, & Knapp, 2006). But how is physical size and strength associated with human personality traits, if at all? Here, we investigate the relationships between formidability and Big Five personality traits.

Formidability—the ability to physically impose one's will—has conferred a suite of adaptive benefits throughout human evolutionary history (Buss & Schmitt, 1993). For example, men with greater upper-body strength have been shown to attract more sexual partners in both modern and hunter-gatherer societies (Apicella, 2014; Fink, Neave, & Seydel, 2007; Lukaszewski, Simmons, Anderson, & Roney, 2016). Importantly, formidability is also crucial in both intra-group and inter-

group conflict (McDonald, Navarrete, & Van Vugt, 2012), and is associated with specific psychological and behavioral characteristics including leadership qualities and stress management (Apicella, 2014; Lukaszewski et al., 2016; von Rueden, Lukaszewski, & Gurven, 2015). Recent studies have also suggested links between personality and proxies of formidability and masculinity (Fink, Weege, Pham, & Shackelford, 2016; Lippa, 2006).

Not only can formidability influence the behavior of the individual themselves by altering the cost-benefit ratio in situations involving confrontations or violence, it can also affect the way that people are treated by others. For example, more athletic children are more likely to be accepted by their peers (Vannatta, Gartstein, Zeller, & Noll, 2009), while stronger men are typically rated as more attractive by women—some results suggest that strength accounts for more than half of the variability in male bodily attractiveness (Apicella, 2014; Fink et al., 2007; Lukaszewski et al., 2016). There is also evidence that a person's own formidability influences how they perceive others: Both dominant men and tall men are less sensitive to signs of dominance in other men (Watkins et al., 2010; Watkins, Jones, & DeBruine, 2010). Experimental evidence suggests a causal link between perceived formidability and dominance: Watkins and Jones (2012) found that priming the idea of losing a competition made men more sensitive to cues of dominance in

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others. Similarly, manipulating people's ability to defend themselves by physically restraining them led people to overestimate the size of potential foes (Fessler & Holbrook, 2013).

Formidability has been characterized by some researchers as representing *embodied capital*—physical characteristics which facilitate resource acquisition and can thus change the cost-benefit calculus for certain behavioral strategies (Petersen, Sznycer, Sell, Cosmides, & Tooby, 2013; von Rueden et al., 2015). Variation in aggression provides a useful example of this concept. If people tailor their behavior according to embodied capital, we should expect more formidable individuals to be more aggressive, since aggression has a more favorable risk-to-benefit ratio for more formidable people. There is a substantial amount of evidence that this is the case. Men with stronger grips tend to display more aggression (Gallup, White, & Gallup, 2007). Deaner, Goetz, Shattuck, and Schnotala (2012) found an association between body weight and levels of aggression in men's ice-hockey. There is also evidence that physical size correlates with levels of aggression in the wider population. In a large-scale longitudinal study ($N = 34,653$), Salas-Wright and Vaughn (2014) found significant relationships between physical size and likelihood of committing a range of aggressive acts—namely, intimidation, intentionally causing physical injury to others, and hitting somebody hard enough to require medical attention—in both men and women. A study of Spanish adolescents (aged 14–18) revealed a positive correlation between fighting ability (measured as hand grip strength and checked in relation to self-reported fighting ability) and levels of physical aggression, although this relationship was smaller in older children (Muñoz-Reyes, Gil-Burmán, Fink, & Turiecano, 2012). A likely affective mediator for the relationship between formidability and aggressive behavior is the experience of anger. Consistent with this, there is evidence of a positive association between formidability and anger sensitivity (Sell, Tooby, & Cosmides, 2009).

Several studies have shown an association between greater physical size in childhood and aggressive behavior later in life. For example, being taller at age 8–10 is associated with a greater likelihood of violent behavior at 16–18 (Farrington, 1989). Similarly, researchers found an association between greater height and body bulk (operationalized as a computation based on height and weight) at age 3 and increased aggressive behavior at age 11 (Raine, Reynolds, Venables, Mednick, & Farrington, 1998). There is also evidence that height and bulk are associated with anti-social personality disorder (ASPD) in men, and that this association could not be explained by adversity, which was another predictor for ASPD (Ishikawa, Raine, Lencz, Bihrlé, & LaCasse, 2001). Evidence from other studies supports this explanation: height and bulk are associated with fighting ability in adolescents (Beaver, Connolly, & Schwartz, 2015), and muscular, but not obese, build was associated with increased delinquency in adolescents (Sampson & Laub, 1997). There is also evidence of a relationship between formidability and aggression in young adults. In a large sample of US and Canadian college students ($N > 11,000$), a range of androgen-related physical characteristics were weakly associated with increased reports of various types of criminal behavior in both men and women (Ellis, Das, & Buker, 2008). In men, the strongest of these associations were between self-reported measures of physical strength and violent behavior.

Beyond its relationship to aggression, there is evidence that formidability can influence a range of social attitudes, including the political and moral domains. For example, being formidable is associated with lower egalitarianism in wealthier men, since formidable men are hypothesized to be more likely to impose their own interests (Petersen et al., 2013; Price, Sheehy-Skeffington, Sidnaius, & Pound, 2017). However, the evidence for the relationship between formidability and egalitarianism is somewhat mixed, with one study showing a *positive* association between self-reported strength and egalitarian attitudes (Ellis & Hoskin, 2015). The differences in results between these studies may relate to methodological differences, and especially differences in the operationalization of both formidability and egalitarianism.

There is also some evidence of formidability influencing moral cognition. Men, but not women, differentially judge moral violations, based on how formidable the violator is (Jensen & Petersen, 2011). This depends on the gravity of the offence: for more serious transgressions, more formidable men were judged more harshly, while for more trivial violations, the opposite was true.

1.1. Formidability and global personality traits

Although several investigations have now explored relationships between formidability and specific traits (such as aggression), much less work has explored the implications of formidability for broader personality traits. Some work suggests that physical strength correlates with personality traits in Western samples. Fink et al. (2016) investigated the relationship between one specific proxy of formidability – grip strength – and personality measures, based on the Big Five Inventory, and found that British males with higher grip strength scored higher in self-reported extraversion and lower in neuroticism, whereas women with higher grip strength scored lower in agreeableness (although this last result did not remain significant after correction for familywise error). These relationships make sense within the lens of an embodied capital framework. Historically, formidable men should have had more to gain and less to lose from exploratory, socially interactive behavior (extraversion) and less to gain from being fearful or overly vigilant of potential threats (neuroticism). Associations between formidability and personality are not limited to Western undergraduate students. In a study on the Tsimane – a small-scale forager-agriculturist society in Bolivia – individuals with higher embodied capital were more likely to develop personality traits that are associated with leadership, scoring higher on Prosocial Leadership Orientation (von Rueden et al., 2015). Such traits include prosocial gregariousness, being highly trusting, and being calm in stressful situations (an indicator of low neuroticism).

An interpretation of the evidence linking personality to formidability based on embodied capital implies that people facultatively adjust personality characteristics based on their formidability. Cognitively speaking, formidability should also be associated with self-perceived strength. Thus, to the extent that people have accurate self-perceptions of formidability, if the embodied capital interpretation offers the best explanation for associations between actual formidability and personality traits, these associations should be mediated by self-perceived formidability.

The current study extends previous research by a) including self-report measures of formidability and testing whether these predict personality traits, b) examining whether increases in perceived formidability mediate relationships between grip strength and personality traits, c) assessing whether formidability is a better mediator than other forms of embodied capital (health and attractiveness), and d) testing the generalizability of previous findings by using a larger sample from a different country to previous studies (USA). We addressed these questions by measuring grip strength in two samples of American undergraduates, and by asking participants in the second study to self-report their fighting ability, physical strength, attractiveness, and health.

2. Study 1

2.1. Method

Two hundred and forty undergraduate students (119 male, 117 female, 4 unidentified, Age 18–39, $M = 19.04$ years, $SD = 1.70$) were recruited from the participant pool of a private university in the southern United States. Six of these participants had measurement or recording errors for the grip strength variable, leaving a sample 234 for the analyses reported below.

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