



Functional coordination of personality strategies with physical strength and attractiveness: A multi-sample investigation at the HEXACO facet-level

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ABSTRACT

Previous research has supported adaptationist hypotheses pertaining to the functional coordination of personality strategies with phenotypic determinants of bargaining power, such as physical strength and attractiveness. However, prior studies have focused primarily on explaining variation in Extraversion and Emotionality/Neuroticism as broadband traits. The current study synthesizes data from three subject samples ($N = 766$) to test correlations of physical strength and attractiveness with the HEXACO factors and facets among young adults. Our analyses reveal specific, functionally meaningful, patterns of phenotypic coordination, and thereby help illuminate which facets drive previously documented associations at the factor-level. Among both sexes, strength was an especially important predictor of facets whose secondary loadings place them in the quadrant of factor space defined by high Extraversion (Expressiveness, Liveliness, Social Boldness) and low Emotionality (Fearfulness, Anxiety). Findings bolster the hypothesis that specific personality strategies are coordinated with phenotypic components of bargaining power, and suggest that granular measures of personality (such as facets) may provide more mechanistic and functional insight than broadband trait factors.

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1. Introduction

Why do people exhibit stable between-person variation in their personality features? Over the past decade, researchers have developed evolutionarily-informed frameworks for addressing the ultimate and proximate origins of variation in behavioral strategies, as well as covariation among behavioral and morphological phenotypes (Buss, & Hawley, 2010; Lukaszewski, 2019; Nettle, 2005; 2006; Tooby & Cosmides, 1990). From these theoretical standpoints, natural selection can maintain adaptively patterned (co-)variation as a function of cost-benefit tradeoffs along behavioral continua. For example, there are potential benefits of aggression (e.g., status or resource acquisition), but also potential costs (e.g., injury). Thus, to the extent that the optimal levels of aggressiveness vary across ecologies or individuals, natural selection can favor (genetic or developmental) mechanisms that coordinate levels of manifest aggressiveness with circumstances that alter the costs or benefits of aggression—including variation in other phenotypic features, such as physical formidability (Tooby & Cosmides, 1990). In support of this, physical size and strength

are functionally coordinated with levels of behavioral aggressiveness in many species across the animal kingdom (Archer, 1988), including humans (Archer & Thanzami, 2007; Sell, Tooby, & Cosmides, 2009).

Recent models of human variation predict that individual differences in behavioral strategies described by broadband personality factors from the Big Five (John, Naumann, & Soto, 2008; McCrae & Costa, 2008) and HEXACO (Ashton, Lee, & Goldberg, 2007) taxonomies will be functionally coordinated with phenotypic determinants of social value and bargaining power, such as physical strength and attractiveness (Lukaszewski, 2013; Lukaszewski & Roney, 2011; Lukaszewski, Simmons, Anderson, & Roney, 2016). Specifically, as reviewed below, multiple studies have supported the predictions that physical strength and attractiveness are positively associated with HEXACO (and Big Five) Extraversion, whereas they are negatively associated with HEXACO Emotionality (and Big Five Neuroticism).

1.1. Coordination of physical strength and attractiveness with Extraversion

The Extraversion continuum, which is represented in multiple structural personality taxonomies, is a broadband factor capturing

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correlations among behavioral strategies described as sociable, bold, assertive, and lively (e.g., Ashton, Lee, & Paunonen, 2002; Ashton et al., 2007; Goldberg, 1990; John et al., 2008; McCrae & Costa, 2008). Implementing such strategies involves competing with others for social attention and status (Ashton et al., 2002; Neel, Kenrick, White, & Neuberg, 2016), and variation in extraversion therefore entails tradeoffs between potential benefits (e.g., relationship initiation, status acquisition) and costs (e.g., conflict, pathogen exposure, opportunity costs) (Nettle, 2005, 2006). Individuals vary in their overall *bargaining power*: the ability to generate benefits and inflict costs on others. Variation in bargaining power will theoretically influence the likelihood of securing the benefits associated with highly extraverted strategies, for example, success in status pursuit. Additionally, such variation will influence the likelihood of incurring the potential costs of extraverted strategies, for example, by deterring competition for social attention from rivals. Therefore, it is hypothesized that levels of extraversion are functionally coordinated with variation in determinants of bargaining power, such as physical strength and attractiveness (Lukaszewski & Roney, 2011; Lukaszewski, 2013).

Functional coordination of extraversion with bargaining power may be orchestrated via facultative calibration of extraversion in response to one's relative physical strength or attractiveness over development (Lukaszewski & Roney, 2011). Or, such coordination could develop if individuals pursuing extraverted behavioral strategies purposefully invest in cultivating greater bargaining power in targeted ways, such as engaging in strength-building activities, grooming, or ornamentation (Haysom et al., 2015; von Rueden, Lukaszewski, & Gurven, 2015; von Borell, Kordsmeyer, Gerlach, & Penke, 2019). Either of these non-mutually exclusive causal pathways, which may operate reciprocally (von Rueden et al., 2015), can create adaptively patterned coordination of extraversion with strength and attractiveness.

Multiple studies have found support for the predicted positive associations of attractiveness and strength with measures of extraversion. Extraversion has been found to positively correlate with objective measures of attractiveness in men and women, such as third-party rated photographs (Lukaszewski & Roney, 2011; Lukaszewski, 2013; Haysom et al., 2015). Additionally, positive associations between self-perceived attractiveness and Extraversion have been found in both sexes (Lukaszewski & Roney, 2011; Lukaszewski, 2013; von Borell et al., 2019). Moreover, Extraversion has been found to associate positively with objective measures of men's physical strength (Lukaszewski & Roney, 2011; Lukaszewski, 2013; Fink, Weege, Pham, & Shackelford, 2016; Kerry & Murray, 2018; von Borell et al., 2019). Associations of women's objective strength and perceived strength with extraversion have also been observed in some studies (Lukaszewski & Roney, 2011; von Rueden et al., 2015).

1.2. Coordination of physical strength and attractiveness with Emotionality/Neuroticism

Emotionality and Neuroticism are overlapping broadband personality factors that are represented in the major five- and six-factor structural personality models (e.g., Ashton et al., 2007; Goldberg, 1990; John et al., 2008; McCrae & Costa, 2008). Although HEXACO Emotionality and Big Five Neuroticism have some nuanced differences conceptually, both factors capture overlapping phenotypic indicators, such as variation in anxiety, fear, and emotional dependence. Because much of the content captured by Emotionality/Neuroticism is related to threat sensitivity and felt vulnerability, variation along these dimensions is theorized to exhibit functional coordination with environmental and phenotypic variables that buffer one's vulnerability to potential threats (e.g., Ashton et al., 2007; Nettle, 2006). For example, individuals

with greater social value and bargaining power are less likely to be exposed to various social threats (e.g., conflict, exclusion, abandonment), and more likely to have social networks and relationships that would support them in times of illness, injury, conflict, or misfortune. Therefore, it is hypothesized that determinants of bargaining power are negatively associated with variation in Emotionality (Lukaszewski, 2013) and Neuroticism (Fink et al., 2016; Kerry & Murray, 2018).

Lukaszewski (2013) reported negative relationships of Emotionality with physical strength, self-perceived formidability, self-perceived attractiveness, and self-perceived bargaining power in men. Among women, such relationships were only observed for self-perceived strength and self-perceived bargaining power. One study documented a negative relationship between handgrip strength and Neuroticism in men (Fink et al., 2016). This negative relationship between men's handgrip strength and Neuroticism remained after controlling for potential confounders (e.g. BMI). Kerry and Murray (2018) also documented a negative relationship between handgrip strength and Neuroticism in men and in the total sample, although the association was null among women when they were analyzed separately. In a second study including a measure of self-perceived formidability, they found a negative correlation between handgrip strength and Neuroticism in women. In addition, self-perceived formidability was negatively correlated with Neuroticism in both sexes. Although patterns were not entirely consistent across their studies, von Borell et al. (2019) found negative associations between Neuroticism and measures of self-perceived attractiveness, as well as height, a component of physical formidability.

1.3. The present study: A multi-sample investigation of the associations of physical strength and attractiveness with the HEXACO factors and facets

The literature has primarily focused on the coordination of strength and attractiveness with broadband personality factors, in particular Extraversion, Neuroticism, and Emotionality. However, much less research has investigated these relationships with more granular personality constructs. It has been argued that, in order to fully understand individual differences in traits and their development over the lifespan, personality researchers should deconstruct personality hierarchies and focus on narrower trait constructs, such as items or facets (Möttus, 2016; Möttus & Rozgonjuk, 2019; Möttus et al., 2018). To our knowledge, no extant studies have examined associations of strength and attractiveness with personality at the HEXACO facet-level. Although, as discussed further below, von Borell et al. (2019) recent study did incorporate facet-level analyses for the Big Five personality dimensions. This is an important objective, given that selective associations of strength or attractiveness with particular personality facets could provide clues about the specific psychological mechanisms and behavioral tactics that are functionally coordinated with relative bargaining power.

In the current study, therefore, we analyzed associations of strength and attractiveness with the HEXACO factors and facets across three independent samples of young adults. Because strength and attractiveness were operationalized using self-assessments and more objective measures (measured strength; other-rated attractiveness) in all of these archival samples, we were able to test the focal associations using (1) self-assessed strength and attractiveness; (2) objective measures of strength and attractiveness, and (3) aggregated measures of strength and attractiveness created by averaging together self-assessments and objective measures. The rationale for examining three different types of operationalizations for strength and attractiveness is that each type of measure has complementary advantages and lim-

itations. Self-assessments, on their own, can produce artifactual correlations among socially valued traits via halo effects or other scale use biases. However, an advantage of self-ratings is that they likely reflect participants' internal estimates of their own strength and attractiveness that are based on comparisons with people they actually interact with in daily life—and toward whom many of their behaviors are therefore directed (Lukaszewski & Roney, 2015). The advantages and limitations of objective measures are complementary: they are not subject to psychometric biases, but they may produce estimates of participants' strength or attractiveness that do not accurately map onto their standing relative to the people in their real social worlds. For instance, a participant might be in the 55th attractiveness percentile within their actual peer group, but in the 80th percentile within the participant sample; if so, objective measures will tend to underestimate correlations of attractiveness with personality variables (Lukaszewski & Roney, 2015). Aggregated measures of strength and attractiveness that take the average of self-ratings and objective measures may balance the advantages and limitations of each type of measure when used in isolation, in effect allowing each to help correct for the potential bias of the other (Sell, Tooby, & et al., 2009). Thus, the current study reports findings from all three operational definitions of strength and attractiveness when testing their associations with personality scales.

Consistent with prior research, we predicted that strength and attractiveness would associate positively with Extraversion (and its facets) and negatively with Emotionality (and its facets). We left which specific facets would drive any factor-level associations as an empirical question. Finally, we included exploratory analyses for the remaining four HEXACO factors (and their facets): Honesty-Humility, Agreeableness, Conscientiousness, and Openness.

2. Method

2.1. Participants

A total of seven hundred sixty-six undergraduate students (367 men) from three large universities in the US were participants in one of three separate studies. Sample 1 is composed of 85 men ($M = 19.70$, $SD = 1.29$) and 89 women ($M = 18.70$, $SD = 1.21$) from a university in California. Sample 2 is composed of 110 men ($M = 19.35$, $SD = 1.38$) and 99 women ($M = 18.91$, $SD = 1.0$) from a university in California. Sample 3 is composed of 172 men ($M = 19.79$, $SD = 2.12$) and 211 women ($M = 19.23$, $SD = 1.62$) from a large university in the Midwestern USA.

2.2. Measures and procedures

2.2.1. Personality: HEXACO factors and facets

The first and second samples completed the IPIP-HEXACO Inventory. IPIP-HEXACO is a 240-item measure developed by the International Personality Item Pool (IPIP) project (<http://ipip.ori.org/>) to measure six factors of personality and their corresponding facets (i.e. thirty total). Honesty-Humility factor is composed of the following facets: Sincerity (e.g. "Don't pretend to be more than I am"), Fairness (e.g. "Would never take things that aren't mine"), Greed Avoidance (e.g. "Don't strive for elegance in my appearance"), and Modesty (e.g. "Don't think that I'm better than other people"). Emotionality factor is composed of the following facets: Fearfulness (e.g. "Tremble in dangerous situations"), Anxiety (e.g. "Worry about things"), Dependence (e.g. "Let myself be influenced by others"), and Sentimentality (e.g. "Feel other's emotions"). Extraversion factor is composed of the following facets: Expressiveness (e.g. "Talk a lot"), Social Boldness (e.g. "Don't mind being

the center of attention"), Sociability (e.g. "Love to chat"), and Liveliness (e.g. "Am usually active and full of energy"). Agreeableness factor is composed of the following facets: Forgiveness (e.g. "Am inclined to forgive others"), Gentleness (e.g. "Take things as they come"), Flexibility (e.g. "Adjust easily"), and Patience (e.g. "Rarely get irritated"). Conscientiousness factor is composed of the following facets: Organization (e.g. "Like to tidy up"), Diligence (e.g. "Work hard"), Perfectionism (e.g. "Pay attention to details"), and Prudence (e.g. "Do things according to plan"). Lastly, Openness to Experience factor is composed of the following facets: Aesthetic Appreciation (e.g. "Believe in the importance of art"), Inquisitiveness (e.g. "Would love to explore strange places"), Creativity (i.e. "Have a vivid imagination"), and Unconventionality (e.g. "Rebel against authority"). Items from this scale were rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The third sample completed the HEXACO PI-R scale. HEXACO PI-R is a 100 item measure developed by Lee and Ashton (2018) to measure six factors of personality, their corresponding facets (i.e. thirty total), and an Interstitial factor of Altruism. Honesty-Humility factor is composed of the following facets: Sincerity (e.g. "I wouldn't use flattery to get a raise or promotion at work, even if I thought it would succeed"), Fairness (e.g. "I would never accept a bribe, even if it were very large"), Greed Avoidance (e.g. "Having a lot of money is not especially important to me"), and Modesty (reverse scored as "I want people to know that I am an important person of high status"). Emotionality factor is composed of the following facets: Fearfulness (e.g. "I would feel afraid if I had to travel in bad weather conditions"), Anxiety (e.g. "I sometimes can't help worrying about little things"), Dependence (e.g. "When I suffer from a painful experience, I need someone to make me feel comfortable"), and Sentimentality (e.g. "I feel like crying when I see other people crying"). Extraversion factor is composed of the following facets: Social Self Esteem (reverse scored as "I feel that I am an unpopular person"), Social Boldness (e.g. "In social situations, I'm usually the one who makes the first move"), Sociability (e.g. "I prefer jobs that involve active social interaction to those that involve working alone"), and Liveliness (e.g. "On most days, I feel cheerful and optimistic"). Agreeableness factor is composed of the following facets: Forgiveness (e.g. "I rarely hold a grudge, even against people who have badly wronged me"), Gentleness (e.g. "I tend to be lenient in judging other people"), Flexibility (e.g. "I am usually quite flexible in my opinions when people disagree with me"), and Patience (e.g. "Most people tend to get angry more quickly than I do"). Conscientiousness factor is composed of the following facets: Organization (e.g. "I plan ahead and organize things, to avoid scrambling at the last minute"), Diligence (e.g. "I often push myself very hard when trying to achieve a goal"), Perfectionism (e.g. "I always try to be accurate in my work, even at the expense of time"), and Prudence (reverse scored as "I make a lot of mistakes because I don't think before I act"). Lastly, Openness to Experience factor is composed of the following facets: Aesthetic Appreciation (reverse scored as "I would be quite bored by a visit to an art gallery"), Inquisitiveness (e.g. "I'm interested in learning about the history and politics of other countries"), Creativity (i.e. "I would enjoy creating a work of art, such as a novel, a song, or a painting"), and Unconventionality (e.g. "I like people who have unconventional views"). Items from this scale were rated on a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The IPIP-HEXACO and HEXACO PI-R scales contain all the same facets and factors except, for one Extraversion facet. The IPIP-HEXACO contains the facet Expressiveness while the HEXACO PI-R instead contains the Social Self-Esteem facet. As such, Social Self-Esteem was excluded from the multi-sample analyses, and the Expressiveness facet was analyzed across the two samples that employed the IPIP-HEXACO. Effects including Social Self-Esteem

facet can be found in the correlation tables but will not be included in the multi-sample analysis.

2.2.2. Physical strength and physical attractiveness

Objective physical strength was assessed using dynamometer measurements of chest/arm strength and handgrip strength, using procedures validated by Sell, Cosmides, & et al. (2009). For measurements of chest/arm strength, participants positioned the dynamometer in front of their chest and pressed the dynamometer inward with both hands until they could not apply additional pressure. For handgrip strength, participants held the dynamometer at their side. With their dominant hand, participants applied as much pressure as they could. These measurements of chest-arm and grip strength were z-scored and combined to form a unit-weight composite of objective strength. Objective strength measurements were taken using this procedure in all three samples.

Objective physical attractiveness was measured with ratings by third party raters of standardized photographs. Participants in the first and second samples were photographed from a standardized distance in their own clothing, resulting in photos that depicted most of their bodies (the bottoms of their legs were cut off at about the mid-shin). They stood against a solid white wall and were instructed to make a neutral facial expression with hands at their sides. Photographs of participants in the second sample were rated for "attractiveness as a mate" by 12 undergraduates (six men) from a university in California in a random order; raters only rated participants of the opposite sex. Raters' responses were then averaged into a six-item unit-weighted attractiveness composite for each sex ($\alpha = 0.88$ for women; 0.86 for men). According to the same procedures, photographs of participants in the second sample were also rated for "attractiveness as a mate" by 12 undergraduates (six men) from a university in California in a random order. Raters' responses were then averaged into a six-item unit-weighted attractiveness composite for each sex ($\alpha = 0.90$ for women; 0.77 for men). Participants in the third sample were photographed under standardized conditions against a solid white wall. Women were given dark grey shorts, black sports bras, and grey tank tops; men were given black shorts and white tank tops. Each participant was photographed from standardized distances, with a neutral facial expression, in four poses (standing front, side, back, and sitting). There were two marked areas (one for sitting and one for standing) to ensure that each participant fit within the frame. Each participant's four photos were then compiled into a collage. Raters ($N = 95$; $M = 33.99$ years old), recruited from Amazon's Mechanical Turk and compensated \$1.00, viewed these collages in a random order and rated each participant's attractiveness using a 5-point scale (1 = very unattractive to 5 = very attractive). Raters' responses were then averaged into a unit-weighted attractiveness composite ($\alpha = 0.98$).

Self-perceived physical strength was measured with three items for the first sample. The first item asked participants to rank their physical strength out of a random sample of 100 students. The other two items asked participants "How physically strong are you relative to individuals of your own age and sex?" and "At a normal social gathering, what percentage of women (men) are physically stronger than you?" using Likert scale of 1 to 7. These items were z-scored and combined to form composite variables of self-rated physical strength. For the second and third sample, self-perceived strength was measured using a 10-item scale (e.g. "In a physical fight, I could hold my own against anyone of my same age and sex") using a Likert scale of 1 (Strongly Disagree) to 7 (Strongly Agree). After reverse-coding negatively worded items, responses were z-scored, and computed into composite variables for self-perceived physical strength.

Self-perceived physical attractiveness was assessed with three items for the first sample. The first item asked participants to rank

their physical attractiveness out of a random sample of 100 students. The other two items asked participants "How physically attractive are you relative to individuals of your own age and sex?" and "At a normal social gathering, what percentage of women (men) are more physically attractive than you?" using Likert scale of 1 to 7. These items were z-scored and combined to form an average self-rated physical attractiveness variable. For the second and third samples, self-perceived attractiveness was measured using an 11-item scale (e.g. "Members of the opposite sex are very attracted to me as a potential sexual partner") using a Likert scale of 1 (Strongly Disagree) to 7 (Strongly Agree). Again, appropriate items were reverse scored, z-scored, and averaged to form a self-rated physical attractiveness composite variable.

Aggregated physical strength and attractiveness variables. Inter-correlations among objective and self-perceived measures of strength and attractiveness within each of the three samples can be found in Table 1. When analyzed across the sexes, these correlations confirm that self-perceived strength exhibited moderate positive correlations with objective strength ($r_s = 0.38$ – 0.49), and that self-perceived attractiveness exhibited moderate positive correlations with objective attractiveness ($r_s = 0.23$ – 0.42). The sex-specific correlations within each of the three samples showed similar patterns for strength (men's $r_s = 0.50$ – 0.59 ; women's $r_s = 0.29$ – 0.49) and attractiveness (men's $r_s = 0.36$ – 0.42 ; women's $r_s = 0.16$ – 0.44). We therefore computed aggregated measures of physical strength and attractiveness, respectively, by taking the average of z-scores for self-perceived and objective measures. Aggregated strength was an average of the z-score for self-perceived strength and the z-score for objective strength. Aggregated attractiveness was an average of the z-score for self-perceived attractiveness and the z-score for objective attractiveness (see Tables 2–4).

3. Results

To examine associations of the strength and attractiveness measures with personality variables, we conducted a multi-sample analysis across all three samples, comprising a total of 766 participants, in the statistical software program R using the metacor.DSL function from the metacor package (Laliberté, 2011). Data and code can be accessed here: osf.io/zx2ka/?view_only=8f9ae94fc5324ba7addf2cef87b4b919. Although statistical analyses were conducted using all HEXACO factors and facets as criterion variables (totaling in 360 effects), we will limit our discussion of these effects to the Extraversion and Emotionality factors and their facets (see Tables 5 and 6). Exploratory analyses pertaining to other HEXACO factors and facets are in Supplementary Materials.

3.1. Extraversion factor and facets

The results of the multi-sample analysis provide support for the predicted relationship of physical strength and attractiveness with the Extraversion factor and facets across the three samples for men and women. In men, the Extraversion factor was positively correlated with aggregated strength, objective strength, and self-perceived strength (Table 5). The primary Extraversion facets that appeared to be driving the significant positive relationships with physical strength measures were Expressiveness, Liveliness, and Social Boldness. The Sociability facet did not show any significant relationships with the three measures of physical strength. A similar pattern in women emerged. Expressiveness, Liveliness, and Social Boldness had significant positive associations with aggregated, objective, and self-perceived measures of strength, respectively (Table 6). Lastly, the sociability facet had significant

Table 1

Inter-correlations among strength and attractiveness variables in each study sample.

Variable	1.	2.	3.	4.
Sample 1 (N = 175)				
1. Objective strength	–	0.57**/0.29**	0.48**/–0.19	0.35**/–0.06
2. Self-perceived strength	0.41**	–	0.26**/–0.24*	0.43**/0.35**
3. Objective attractiveness	0.08	–0.09	–	0.37**/0.16
4. Self-perceived attractiveness	0.14	0.38**	0.23**	–
Sample 2 (N = 209)				
1. Objective strength	–	0.59**/0.31**	0.45**/–0.04	0.47**/–0.03
2. Self-perceived strength	0.38**	–	0.29**/0.00	0.59**/0.24*
3. Objective attractiveness	0.16*	0.15*	–	0.42**/0.44**
4. Self-perceived attractiveness	0.27**	0.44**	0.42**	–
Sample 3 (N = 365)				
1. Objective strength	–	0.50**/0.49**	0.03/–0.07	0.24**/0.21**
2. Self-perceived strength	0.49**	–	0.08/0.01	0.42**/0.29**
3. Objective attractiveness	–0.02	–0.03	–	0.36**/0.31**
4. Self-perceived attractiveness	0.22**	0.36**	0.28**	–

Note. Above the diagonal, correlations for men are on the left of the slash; those for women are on the right. Beneath the diagonal are correlation values across each entire sample. Sample 1: $N_{\text{men}} = 78$, $N_{\text{women}} = 77$, Sample 2: $N_{\text{men}} = 110$, $N_{\text{women}} = 99$, Sample 3: $N_{\text{men}} = 165$, $N_{\text{women}} = 201$. Any missingness was handled via pairwise deletion. ** = $p < .01$, * = $p < .05$

Table 2

Bivariate Correlations among Extraversion & Emotionality factors and facets and measures of physical strength and attractiveness (Sample 1).

Variable	Aggregated strength ($N_{\text{men}} = 85$, $N_{\text{women}} = 89$)	Objective strength ($N_{\text{men}} = 85$, $N_{\text{women}} = 89$)	Self-perceived strength ($N_{\text{men}} = 85$, $N_{\text{women}} = 89$)	Aggregated attractiveness ($N_{\text{men}} = 86$, $N_{\text{women}} = 89$)	Objective attractiveness ($N_{\text{men}} = 78$, $N_{\text{women}} = 77$)	Self-perceived attractiveness ($N_{\text{men}} = 86$, $N_{\text{women}} = 89$)
Expressive	0.25**/0.32**	0.19/0.15	0.25*/0.37**	0.33**/0.19	0.23*/–0.05	0.36**/0.33**
Liveliness	0.44**/0.31**	0.42**/0.11	0.35**/0.38**	0.57**/0.10	0.48**/–0.15	0.44**/0.33**
Social Boldness	0.37**/0.36**	0.30**/0.19	0.35**/0.39**	0.39**/0.06	0.38**/–0.19	0.32**/0.29**
Sociability	0.29**/0.23*	0.24*/0.12	0.26*/0.25*	0.36**/0.13	0.36**/0.00	0.26*/0.23*
Extraversion	0.39**/0.35**	0.34**/0.17	0.36**/0.40**	0.48**/0.14	0.43**/–0.11	0.40**/0.34**
Anxiety	–0.29**/–0.14	–0.32**/–0.01	–0.20/–0.21*	–0.25*/0.10	–0.22/0.31**	–0.21/–0.15
Dependence	–0.27**/–0.11	–0.33**/0.02	–0.16/–0.21*	–0.09/0.06	–0.11/0.15	–0.07/–0.05
Fearfulness	–0.59**/–0.23*	–0.51**/–0.08	–0.53**/–0.28**	–0.45**/0.09	–0.39**/0.28*	–0.41**/–0.17
Sentimentality	–0.04/0.01	–0.04/0.05	–0.04/–0.03	0.00/0.08	–0.01/0.05	0.01/0.10
Emotionality	–0.46**/–0.15	–0.46**/0.00	–0.36**/–0.24*	–0.31**/0.11	–0.28*/0.27*	–0.27*/–0.09

Note. Within each cell, correlations for men are on the left of the slash; those for women are on the right. Any missingness was handled via pairwise deletion. Factor variables are italicized. * $p < .05$, ** $p < .01$.

Table 3

Bivariate Correlations among Extraversion & Emotionality factors and facets and measures of physical strength and attractiveness (Sample 2).

Variable	Aggregated strength ($N_{\text{men}} = 110$, $N_{\text{women}} = 99$)	Objective strength ($N_{\text{men}} = 110$, $N_{\text{women}} = 99$)	Self-perceived strength ($N_{\text{men}} = 110$, $N_{\text{women}} = 99$)	Aggregated attractiveness ($N_{\text{men}} = 110$, $N_{\text{women}} = 99$)	Objective attractiveness ($N_{\text{men}} = 110$, $N_{\text{women}} = 99$)	Self-perceived attractiveness ($N_{\text{men}} = 110$, $N_{\text{women}} = 99$)
Expressive	0.20*/0.37**	0.13/0.26**	0.22*/0.34**	0.16/0.29**	–0.01/0.13	0.28**/0.38**
Liveliness	0.42**/0.45**	0.27**/0.13	0.46**/0.48**	0.48**/0.28**	0.30**/0.17	0.50**/0.30**
Social Boldness	0.36**/0.39**	0.28**/0.24*	0.36**/0.37**	0.41**/0.27**	0.17/0.09	0.51**/0.37**
Sociability	0.14/0.33**	0.05/0.12	0.19*/0.34**	0.23*/0.24*	0.06/0.10	0.33**/0.30**
Extraversion	0.34**/0.46**	0.22*/0.24*	0.37**/0.45**	0.38**/0.32**	0.14/0.14	0.50**/0.41**
Anxiety	–0.25**/–0.19	–0.16/–0.13	–0.27**/–0.17	–0.27**/–0.16	–0.16/–0.12	–0.30**/–0.15
Dependence	–0.22**/–0.24*	–0.20*/–0.20*	–0.20*/–0.20*	–0.19*/0.00	–0.08/0.04	–0.23*/–0.05
Fearfulness	–0.55**/–0.40*	–0.45**/–0.24*	–0.53**/–0.38**	–0.39**/–0.04	–0.20*/–0.03	–0.46**/–0.04
Sentimentality	–0.06/0.05	–0.07/0.06	–0.04/0.03	–0.08/0.10	–0.12/0.15	–0.01/0.02
Emotionality	–0.35**/–0.29**	–0.28**/–0.19	–0.34**/–0.27**	–0.30**/–0.04	–0.18*/0.00	–0.32**/–0.08

Note. Within each cell, correlations for men are on the left of the slash; those for women are on the right. Any missingness was handled via pairwise deletion. Factor variables are italicized. * $p < .05$, ** $p < .01$.

positive associations with aggregated and self-perceived strength, but not objective strength.

The relationship between the Extraversion factor and its facets with physical attractiveness was descriptively largest for self-perceived attractiveness and the aggregated measure of attractiveness for both sexes. More specifically in men (Table 5), all four

Extraversion facets showed significant positive relationships with aggregated and self-perceived attractiveness, respectively. Only the Liveliness facet exhibited a significant positive association with objective attractiveness. The Extraversion factor was significantly positively correlated with all three operationalizations of men's attractiveness. Among women (Table 6), aggregated and self-

Table 4

Bivariate Correlations among Extraversion & Emotionality factors and facets and measures of physical strength and attractiveness (Sample 3).

Variable	Aggregated strength (N _{men} = 164, N _{women} = 201)	Objective strength (N _{men} = 164, N _{women} = 204)	Self-perceived strength (N _{men} = 172, N _{women} = 208)	Aggregated attractiveness (N _{men} = 165, N _{women} = 200)	Objective attractiveness (N _{men} = 165, N _{women} = 203)	Self-perceived attractiveness (N _{men} = 172, N _{women} = 208)
Social Self-Esteem	0.12/0.23**	0.03/0.17*	0.20**/0.20**	0.41*/0.32**	0.08/0.06	0.56**/0.47**
Liveliness	0.04/0.22**	0.06/0.20**	0.04/0.18**	0.34**/0.28**	0.19*/0.07	0.36**/0.41**
Social Boldness	0.08/0.32**	0.02/0.23**	0.12/0.31**	0.26**/0.30**	0.00/0.06	0.37**/0.42**
Sociability	-0.02/0.10	-0.01/0.03	-0.03/0.14*	0.17*/0.28**	0.09/0.09	0.17*/0.37**
Extraversion	0.06/0.27**	0.03/0.20**	0.10/0.26**	0.37**/0.36**	0.11/0.09	0.45**/0.51**
Anxiety	-0.16*/-0.18**	-0.07/-0.17*	-0.23**/-0.14*	-0.27**/-0.14*	-0.13/-0.02	-0.30**/-0.21**
Dependence	-0.10/-0.23**	-0.06/-0.14*	-0.13/-0.24**	-0.04/0.03	-0.02/0.04	-0.02/0.00
Fearfulness	-0.45**/-0.38**	-0.38**/-0.27**	-0.37**/-0.37**	-0.14/-0.04	0.01/0.04	-0.20**/-0.11
Sentimentality	-0.15*/-0.13	-0.07/-0.09	-0.22**/-0.14*	-0.08/0.08	-0.02/0.10	-0.10/0.02
Emotionality	-0.31**/-0.35**	-0.20**/-0.26**	-0.34**/-0.34**	-0.19*/-0.02	-0.06/0.06	-0.23**/-0.11

Note. Within each cell, correlations for men are on the left of the slash; those for women are on the right. Any missingness was handled via pairwise deletion. Factor variables are italicized. *p < .05, **p < .01.

Table 5

Multi-sample effects across three samples for associations of Extraversion & Emotionality factors and facets with measures of strength and attractiveness in Men.

Variable	Aggregated strength	Objective strength	Self-perceived strength	Aggregated attractiveness	Objective attractiveness	Self-perceived attractiveness
Expressive	0.22 [0.08, 0.35]	0.15 [0.01, 0.29]	0.24 [0.10, 0.37]	0.23 [0.06, 0.39]	0.10 [-0.14, 0.33]	0.31 [0.18, 0.44]
Liveliness	0.31 [0.02, 0.54]	0.25 [0.02, 0.45]	0.29 [0, 0.53]	0.45 [0.31, 0.58]	0.32 [0.14, 0.47]	0.42 [0.33, 0.51]
Social Boldness	0.27 [0.06, 0.45]	0.19 [0, 0.37]	0.27 [0.09, 0.43]	0.34 [0.24, 0.43]	0.18 [-0.04, 0.39]	0.40 [0.29, 0.51]
Sociability	0.12 [-0.06, 0.30]	0.08 [-0.06, 0.22]	0.13 [-0.05, 0.31]	0.23 [0.13, 0.33]	0.16 [-0.01, 0.33]	0.24 [0.14, 0.34]
Extraversion	0.26 [0.04, 0.46]	0.19 [0, 0.36]	0.27 [0.07, 0.44]	0.40 [0.30, 0.48]	0.22 [0.02, 0.39]	0.45 [0.37, 0.53]
Anxiety	-0.22 [-0.32, -0.12]	-0.17 [-0.31, -0.02]	-0.23 [-0.33, -0.13]	-0.26 [-0.36, -0.16]	-0.16 [-0.26, -0.06]	-0.28 [-0.37, -0.18]
Dependence	-0.18 [-0.28, -0.08]	-0.18 [-0.33, -0.02]	-0.16 [-0.26, -0.05]	-0.10 [-0.20, 0]	-0.06 [-0.16, 0.04]	-0.10 [-0.23, 0.02]
Fearfulness	-0.52 [-0.60, -0.43]	-0.43 [-0.51, -0.34]	-0.47 [-0.57, -0.35]	-0.32 [-0.50, -0.12]	-0.19 [-0.41, 0.05]	-0.35 [-0.51, -0.18]
Sentimentality	-0.10 [-0.20, 0]	-0.06 [-0.16, 0.03]	-0.12 [-0.24, 0]	-0.06 [-0.16, 0.04]	-0.05 [-0.15, 0.05]	-0.04 [-0.15, 0.05]
Emotionality	-0.36 [-0.44, -0.26]	-0.30 [-0.44, -0.15]	-0.34 [-0.43, -0.25]	-0.25 [-0.35, -0.15]	-0.16 [-0.28, -0.02]	-0.27 [-0.36, -0.17]

Note. N_{men} = 367. Multi-sample effects for Expressiveness facet do not include Social Self-Esteem correlation values in its computation. Factor variables are italicized. Bolded values represent 95% confidence interval that do not span zero.

Table 6

Multi-sample effects across three samples for associations of Extraversion & Emotionality factors and facets with measures of strength and attractiveness in Women.

Variable	Aggregated strength	Objective strength	Self-perceived strength	Aggregated attractiveness	Objective attractiveness	Self-perceived attractiveness
Expressive	0.35 [0.21, 0.47]	0.21 [0.07, 0.34]	0.35 [0.22, 0.47]	0.25 [0.11, 0.39]	0.04 [-0.13, 0.22]	0.35 [0.22, 0.47]
Liveliness	0.32 [0.17, 0.45]	0.16 [0.06, 0.26]	0.34 [0.14, 0.51]	0.24 [0.14, 0.34]	0.04 [-0.12, 0.20]	0.36 [0.27, 0.45]
Social Boldness	0.35 [0.26, 0.43]	0.23 [0.13, 0.32]	0.34 [0.25, 0.43]	0.23 [0.09, 0.35]	0.00 [-0.15, 0.16]	0.38 [0.29, 0.46]
Sociability	0.21 [0.06, 0.34]	0.07 [-0.02, 0.17]	0.23 [0.10, 0.34]	0.24 [0.14, 0.33]	0.07 [-0.02, 0.17]	0.32 [0.23, 0.41]
Extraversion	0.35 [0.23, 0.46]	0.20 [0.10, 0.29]	0.36 [0.23, 0.47]	0.30 [0.17, 0.41]	0.05 [-0.07, 0.19]	0.44 [0.33, 0.54]
Anxiety	-0.18 [-0.27, -0.08]	-0.13 [-0.22, -0.03]	-0.16 [-0.26, -0.06]	-0.08 [-0.22, 0.06]	0.04 [-0.17, 0.27]	-0.18 [-0.27, -0.08]
Dependence	-0.21 [-0.30, -0.11]	-0.12 [-0.23, 0]	-0.22 [-0.32, -0.13]	0.03 [-0.07, 0.13]	0.06 [-0.03, 0.16]	-0.02 [-0.12, 0.07]
Fearfulness	-0.35 [-0.44, -0.25]	-0.22 [-0.32, -0.10]	-0.35 [-0.44, -0.26]	-0.01 [-0.11, 0.08]	0.08 [-0.07, 0.25]	-0.10 [-0.20, -0.01]
Sentimentality	0.00 [-0.10, 0.09]	-0.01 [-0.12, 0.09]	-0.07 [-0.17, 0.03]	0.08 [-0.01, 0.18]	0.10 [0, 0.20]	0.04 [-0.05, 0.13]
Emotionality	-0.28 [-0.39, -0.17]	-0.17 [-0.31, -0.02]	-0.30 [-0.39, -0.21]	0.00 [-0.10, 0.09]	0.10 [-0.04, 0.24]	-0.10 [-0.19, 0]

Note. N_{women} = 399. Multi-sample effects for Expressiveness facet do not include Social Self-Esteem correlation values in its computation. Factor variables are italicized. Bolded values represent 95% confidence interval that do not span zero.

perceived attractiveness, respectively, had significant positive associations with all four Extraversion facets. None of the Extraversion facets had significant relationships with women's objective attractiveness. Lastly, the Extraversion factor was significantly positively correlated with aggregated attractiveness and self-perceived attractiveness, but not objective attractiveness.

3.2. Emotionality factor and facets

Overall, the results of the multi-sample analysis provide support for the predicted negative relationship between physical strength and attractiveness and the Emotionality factor and facets

across the three samples for men and women. Among men (Table 5), the Emotionality factor had significant negative relationship with all three operational definitions of strength. The primary Emotionality facets driving these significant negative relationships with strength measures were Anxiety, Dependence, and Fearfulness. The Sentimentality facet had a significant negative relationship with aggregated strength and self-perceived strength. Among women (Table 6), similar patterns emerged. The Emotionality facets that had significant negative relationships with all three measures of strength were Anxiety, Dependence, and Fearfulness. The Emotionality factor likewise had significant negative relationships with all three measures of strength.

The predicted relationships of physical attractiveness with the Emotionality factor and facets were partially supported. Among men (Table 5), the Emotionality factor, as well as the Anxiety facet, had a significant negative relationship with all three measures of attractiveness. The Fearfulness facet had significant negative relationships with aggregated attractiveness and self-perceived attractiveness, but not objective attractiveness. All other facet-level relationships were small and tended to be null. Among women (Table 6), the Emotionality factor had a significant negative relationship with self-perceived attractiveness, but not objective or aggregated attractiveness. In addition, there was a significant negative relationship between self-perceived attractiveness and the Anxiety facet and Fearfulness facets. The Sentimentality facet also had a small, unpredicted, positive significant association with objective attractiveness.

4. Discussion

Across three samples, the results revealed correlations of physical strength and attractiveness (determinants of bargaining power) with variation in HEXACO Extraversion and Emotionality, at both the factor and facet levels. A conservative standard for determining whether meaningful correlations existed would be that all three operational definitions of strength or attractiveness demonstrated statistically significant associations across samples. Using this standard, attractiveness and strength each predicted the Extraversion and Emotionality factors, with the exception that women's objective attractiveness did not correlate with the Emotionality factor.

These observed associations at the factor level are qualified by the pattern of associations at the level of specific facets. An inspection of the secondary loadings across the HEXACO Extraversion and Emotionality facets (see Lee & Ashton, 2018) indicates that strength and attractiveness had the most consistent and robust associations with facets located at the quadrant of HEXACO factor space defined by high Extraversion and low Emotionality. For example, Sociability is the only Extraversion facet with a positive secondary loading on Emotionality, and attractiveness and strength measures were not consistently associated with this facet in either sex. Similarly, strength and attractiveness measures generally failed to predict Sentimentality, one of two Emotionality facets with positive secondary loadings on Extraversion. Conversely, Social Boldness, which has an appreciable negative secondary loading on Emotionality, associated positively with physical strength in both sexes. Fearfulness and Anxiety have negative secondary loadings on Extraversion, and they (especially Fearfulness) were particularly strong correlates of physical strength.

These sorts of findings at the facet level might facilitate the search for specific psychological mechanisms underpinning the functional coordination of strength and attractiveness with behavioral strategies captured descriptively by HEXACO personality scales. First, they may tell us where *not* to look: patterns from the present study indicate that physical strength does not likely influence the functionality of behavioral strategies captured by the Sociability or Sentimentality facets. This is noteworthy, given that it has been postulated—apparently incorrectly—that the cost-benefit ratio of behaviors described as sociable (e.g., seeking out interactions with lots of people) may be influenced by relative bargaining power (Lukaszewski & Roney, 2011). Additionally, the findings suggest that strength influences the cost-benefit calculus of behavioral strategies captured by (1) Extraversion facets that have negative secondary loadings on Emotionality (Social Boldness), (2) Emotionality facets with negative secondary loadings on Extraversion (Fearfulness, Anxiety), and (3) facets of Extraver-

sion (Expressiveness, Liveliness) and Emotionality (Dependence) that do not exhibit appreciable cross-factor secondary loadings.

Coordination of strength with facets in the high-Extraversion/low-Emotionality quadrant of factor space—Social Boldness, Fearfulness, and Anxiety—could partly reflect a common mechanistic underpinning. For example, it seems likely that psychological and behavioral variation described and experienced as bold (e.g. taking the lead in a group setting), anxious (e.g. being on edge while considering a future outcome), or fearful (e.g. experiencing the urge to flee from an ambiguously threatening situation) may be commonly influenced by an internal representation of one's vulnerability to the costs of social conflict or devaluation (Lukaszewski, 2013). Being physically weak relative to others increases one's vulnerability to the costs of interpersonal conflict (Sell, Tooby, & et al., 2009). Therefore, it makes good functional sense for weaker people to avoid adopting socially risky behavioral strategies (Mishra, Barclay, & Sparks, 2017), which is a testable hypothesis for future research.

Expressiveness and Liveliness—two facets that do not load secondarily on Emotionality—were consistently positively associated with physical strength in both sexes, and Liveliness also associated positively with men's attractiveness. The exact functional logic of these specific associations is unclear, but its discernment would be greatly facilitated by the identification of the psychological mechanisms and motivations that underpin variation described by these facets. It seems plausible that behavioral strategies described as expressive and lively, respectively, reflect the motivation to attain high status and influence via leadership or other pathways that depend on one's ability to attract positive social attention (De Vries, Tybur, Pollet, & van Vugt, 2016). This possibility may call for research that links unique variance in Expressiveness and Liveliness (and covariance of these facets with strength and attractiveness) with specific status-linked motivations and manifest behaviors, such as tactics of hierarchy negotiation (Kyl-Heku & Buss, 1996).

The conclusions drawn above regarding the existence of associations between strength and attractiveness with personality scales were based on a conservative criterion: that a given personality scale associated significantly with all three operational definitions of strength or attractiveness. However, if we were to rely on self-perceived or aggregated measures of strength and attractiveness, we could conclude that many more associations exist. For example, both self-perceived and aggregated measures of attractiveness were significantly correlated with the Extraversion factor, and all of its facets, among both sexes. It is therefore important to consider which operationalizations of strength and attractiveness are most inferentially appropriate. As we argued above, each type of measure—self-perceptions, objective measures, and aggregates of these—has likely strengths and weaknesses. Self-perceptions alone may capture rating biases and thereby inflate correlations of strength and attractiveness with personality scales. However, an advantage of self-perceptions is that they are likely formed based on comparisons made in daily life with people toward whom participants actually direct their behavior. Because the calibration of behavioral strategies to one's relative bargaining power must occur via reference to an internal estimate thereof (Lukaszewski, 2013), it is possible that self-perceptions capture the exact parameters that directly influence a person's behavioral variation. More objective measures, on the other hand, may in effect compare subjects to a participant sample with a different distribution of strength or attractiveness than the reference groups they compare themselves to (and direct their behavior toward) in real life which may lead to the systematic underestimation of correlations with personality. If self-perceptions tend to overestimate correlations of strength and attractiveness with personality, whereas objective measures tend to underestimate them, the aggregated measures that take the

average of these may balance the inferential advantages and limitations of each type used in isolation. Thus, it will be important for future research to devise ways of determining which measures of phenotypic features, such as strength and attractiveness, align most closely with the estimates in the mind that actually calibrate behavioral decisions.

Additional outstanding questions pertain to how the current findings with the HEXACO facets relate to findings from one previous study that examined correlations with the Big Five facets. von Borell et al. (2019) found that indicators of men's physical strength associated selectively with the Activity and Assertiveness facets of NEO-PI-R Extraversion. Insofar as Assertiveness overlaps with HEXACO Social Boldness, or Activity with HEXACO Liveliness, these findings may align to some extent with our findings here. However, von Borell et al. (2019) found little evidence that indicators of strength or attractiveness (other than self-perceived attractiveness) correlated with Big Five Neuroticism or its facets. This does not align with the current findings in relation to HEXACO Emotionality, or with other previous findings at the Emotionality factor level (Lukaszewski, 2013). Neither does it converge with studies documenting associations of strength with the Big Five Neuroticism factor (Fink et al., 2016; Kerry & Murray, 2018), nor with one forthcoming study demonstrating that handgrip strength selectively predicts the Anxiety facet of the Big Five Inventory (Kerry & Murray, in press). Whether this lack of correspondence across studies pertains to differences between HEXACO Emotionality and Big Five Neuroticism, genuine differences between populations in the predictors of personality, variable statistical power across studies, or something else, is an important direction for future research.

Finally, it is important to reiterate that different, non-mutually exclusive hypotheses exist about the causal links among phenotypic components of bargaining power and personality traits. Some researchers have proposed that personality strategies are facultatively calibrated over development in response to variation in relative bargaining power (Kerry & Murray, 2018; Lukaszewski, 2013; Lukaszewski & Roney, 2011). Other researchers, meanwhile, have proposed an inverse direction of causality, such that phenotypic determinants do not cause an individual to adopt certain behavioral strategies over development. Instead, an individual's behavioral/personality strategies could theoretically influence or shape one's investment into their physical features (von Borell et al., 2019; Haysom et al., 2015). The current findings, however, cannot be used to adjudicate between these alternative causal hypotheses. Future research employing longitudinal designs (see, e.g., Petersen & Dawes, 2017) will be necessary to decide between these non-mutually exclusive causal pathways between personality and determinants of bargaining power.

5. Conclusion

In sum, the current research revealed which specific HEXACO facets drive associations of physical strength and attractiveness with the broadband Extraversion and Emotionality factors. Strength was unambiguously coordinated with more facets than attractiveness among both sexes and appeared to be particularly important for predicting levels of Fearfulness, as well as facets of Extraversion with negative secondary loadings on the Emotionality factor. These findings provide clues about the possible mechanistic underpinnings of the phenotypic content captured by facets and suggest that future research would benefit by continuing to consider the role of physical features in moderating the cost-benefit tradeoffs of variation in behavioral strategies.

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CRediT authorship contribution statement

Nina N. Rodriguez: Formal analysis, Writing - original draft, Writing - review & editing. **Aaron W. Lukaszewski:** Conceptualization, Investigation, Writing - review & editing.

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jrp.2020.104040>.

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