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Testing an Adaptationist Theory of Trait Covariation: Relative Bargaining Power as a Common Calibrator of an Interpersonal Syndrome

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Abstract: This article provides the first test of an adaptationist 'common calibration' theory to explain the origins of trait covariation, which holds that (i) personality traits are often facultatively calibrated in response to cues that ancestrally predicted the reproductive payoffs of different trait levels and (ii) distinct traits that are calibrated on the basis of common input cues will exhibit consistent patterns of covariation. This theory is applied to explain the covariation within a 'personality syndrome' encompassing various interpersonal trait dimensions (e.g. extraversion, emotionality and attachment styles). Specifically, it is hypothesized that these traits are inter-correlated because each is calibrated in response to relative bargaining power (RBP)—a joint function of one's ability to benefit others and harm others. Path analyses from a correlational study compellingly supported this theoretical model: Objective and self-perceived measures of RBP-enhancing phenotypic features (physical attractiveness and physical strength) influenced an internal regulatory variable indexing RBP (i.e. self-perceived RBP), which in turn had robust effects on each of the focal personality traits. Moreover, in support of the theory's core postulate, controlling for self-perceived RBP greatly reduced the covariation within the interpersonal syndrome. These novel findings illustrate the promise of an evolutionary psychological approach to elucidating trait covariation. Copyright © 2013 John Wiley & Sons, Ltd.

Key words: behavioural syndrome; evolutionary psychology; facultative calibration; internal regulatory variable; latent variable; trait covariation

Perhaps the most important feature of the human personality landscape is its extreme multi-dimensionality. Indeed, one of the primary achievements of personality psychology has been to describe these patterns of trait covariation at various nested levels of specificity to arrive at comprehensive personality taxonomies (Ashton & Lee, 2007; Denissen & Penke, 2008a; Digman, 1997; Funder, 2001; John, Naumann, & Soto, 2008; McCrae & Costa, 2008; Rushton & Irwing, 2008). As such, it is not an overstatement to assert that consistent patterns of multi-trait correlation have formed the foundation for most personality research. Despite this fundamental significance, however, relatively little attention has been paid to explaining the origins of personality trait covariation per se. Why do logically, psychometrically and/or neuroanatomically distinct trait dimensions covary in consistent ways within individuals, rather than varying independently?

At present, the field is lacking in validated theories that explicitly address this basic mystery in the study of personality origins (John et al., 2008; Miller, 2011; Nettle, 2011). This is not necessarily due to a lack of interest in the question, as multiple ideas relevant to the explanation of trait covariation have been suggested. For instance, many personality psychologists subscribe to the notion that a set of inter-correlated traits (e.g. a trait factor) indicates the existence of an integrated 'latent psychological construct' that somehow exerts causal effects on many distinct aspects of thought, emotion and behaviour (Digman, 1997; Funder, 2001; McCrae & Costa, 2008; Rushton & Irwing, 2008; see Borsboom, Mellenbergh, & van Heerden, 2003; Cramer et al., 2012). Others, meanwhile, have pointed out that trait covariation could arise in part from genetic or neurobiological substrates with common influences on multiple aspects of manifest personality (e.g. McCrae & Costa, 2008; Miller, Zhu, Wright, Hansell, & Martin, 2012). However, even if these proximate explanations are plausible in some form, we are still left with the fundamental question of why human nature would be structured such that distinct traits covary in the first place.

Because evolutionary theories are unique in their ability to generate a priori predictions regarding the structural design of human nature, many recent theorists have recognized that complete explanations of trait covariation will likely require the application of an evolutionary perspective (e.g. Buss, 2009; Del Giudice, 2012; Dingemanse, Kazem, Reale, & Wright, 2010; Ellis, Figueredo, Brumbach, & Schlomer, 2009; Figueredo et al., 2011; Irwing, Booth, Nyborg, & Rushton, 2012; Lukaszewski, 2011; Lukaszewski & Roney, 2011; Miller, 2011; Nettle, 2011; Nettle & Penke, 2010; Penke, 2011; Penke, Denissen, & Miller, 2007; Sih, Bell, Johnson, & Ziemba, 2004; Tooby & Cosmides, 1990). To date, this bourgeoning literature has been largely focused on describing various possible scenarios under which correlations among multiple traits may evolve and enumerating proximate mechanisms that

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could potentially implement such covariation. Currently lacking, however, are empirical tests of theoretical models that explain trait covariation by linking specific evolutionary selection pressures to proposed proximate mechanisms—which will be crucial in demonstrating the value of an evolutionary psychological approach to the study of personality origins.

AN ADAPTATIONIST 'COMMON CALIBRATION' THEORY TO EXPLAIN TRAIT COVARIATION

To begin filling this lacuna, this article provides the first empirical test of an adaptationist theory to explain trait covariation that was originally advanced by Tooby and Cosmides (1990) over two decades ago in a seminal paper. In general, the adaptationist perspective suggests that personality trait levels are often facultatively calibrated via evolved conditional rules of the form 'given condition *x*, pursue behavioral strategy *y*'. Theoretically, such calibrational adaptations would have been incorporated into the universal human architecture as they improved the functional match between trait levels and individual circumstances over long stretches of evolutionary time (Lukaszewski & Roney, 2011; Penke, 2011; Tooby & Cosmides, 1990). To take an intuitive example, because physically stronger individuals are both more likely to obtain the benefits of aggression (e.g. successful resource acquisition) and less likely to experience the costs (e.g. injury), levels of aggressiveness are facultatively calibrated to physical formidability in many species (Archer, 1988), including humans (Archer & Thanzami, 2007; Sell, Tooby, & Cosmides, 2009).

As Tooby and Cosmides (1990) further explained, once the facultative calibration model of personality determination is taken as a starting point, it only requires a few additional logical steps to arrive at an adaptationist explanation for why and how distinct trait dimensions may come to covary within individuals. An elaborated argument for this general theory can be expressed as follows:

- Individual personality traits are often facultatively calibrated in response to cues that would have predicted the cost–benefit ratios of different trait levels across human evolutionary history.
- The magnitudes of costs and benefits associated with distinct trait dimensions may have been determined (or predicted) by some of the same ancestral cues.
- If so, two or more distinct trait dimensions may be facultatively calibrated on the basis of common input cues.
- To the extent that distinct trait dimensions are calibrated on the basis of common input cues, those traits will tend to exhibit consistent patterns of covariation within individuals.

To apply this 'common calibration' theory to explain any particular instance of trait covariation, it is necessary to (i) identify the reproductive cost–benefit tradeoffs that have occurred along each individual trait dimension, (ii) determine which ancestral cues would have reliably predicted these cost–benefit tradeoffs and (iii) ascertain which of these cues are common to the trait dimensions of interest. According to the logic of the theory, this basic formula will generate straightforward predictions regarding the common calibrators that drive specific patterns of trait covariation.

RELATIVE BARGAINING POWER AS A COMMON CALIBRATOR OF AN INTERPERSONAL SYNDROME

The current research applies the principles of the common calibration theory to develop a specific model that explains the covariation occurring within a circumscribed cluster of interpersonal trait dimensions—what may be referred to as a 'personality syndrome' (cf. Sih et al., 2004). The particular syndrome under analysis is composed of various interpersonal traits that have been found to predict one another in previous studies, including extraversion, approach motivation, emotionality, fear of rejection, avoidance motivation, interpersonal trust and attachment styles (e.g. Ashton, Lee, & Goldberg, 2007; Ashton, Lee, Visser, & Pozzebon, 2008; Brookings, Zembar, & Hochstetler, 2003; Campbell, Simpson, Stewart, & Manning, 2003; Carver & White, 1994; Erdle & Rushton, 2010; Gray, 1970; Haraishi, Yamagata, Shikishima, & Ando, 2008; Heimpel, Elliot, & Wood, 2006; Lee, Dean, & Jung, 2008; Shaver & Brennan, 1992). The operative question for the current analysis is: Why do these logically and psychometrically distinct traits covary within individuals, rather than varying independently?

The primary hypothesis of the current investigation is that the traits within the focal interpersonal syndrome are intercorrelated because each is facultatively calibrated in response to individual differences in relative bargaining power (RBP). As explained by Sell, Tooby, and Cosmides (2009), an individual's RBP is a joint function of two broad phenotypic properties: (i) the ability to confer benefits on others and (ii) the ability to inflict costs on others. Generally speaking, the conferral of benefits and the infliction of costs are the primary currencies of social life: It is by possessing the capacity to benefit or harm the welfare (i.e. reproductive fitness interests) of others that they are either enticed or intimidated into placing value on one's own interests in their behavioural decisions, whether in the context of zero-acquaintance encounters, conflict, friendship, mateship, social exchange, hierarchy or collective action (e.g. Allan & Gilbert, 1995; Anderson & Kilduff, 2009; Archer, 1988; Cheng, Tracy, & Henrich, 2010; Hawley, 2011; Kirkpatrick & Ellis, 2001; Leary, Cottrell, & Phillips, 2001; Sell, Tooby et al., 2009; Sugiyama, 2005; Tooby & Cosmides, 1990, 1996; von Rueden, Gurven, & Kaplan, 2008, 2011). As such, individuals who are higher on characteristics that have predicted the ability to benefit and/or harm others should be perceived by others as higher in RBP and should therefore find themselves at a competitive advantage when it comes to attracting associates, maintaining existing relationships, achieving social status and extracting net benefits (as opposed to net costs) from participation in various types of interdependent social associations.

There is copious evidence to support the claim that the possession of RBP-enhancing phenotypic features affects the interpersonal evaluations, responses and affordances of others in important ways. One clear example is provided by

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physical attractiveness, which likely indexed health, fertility and formidability in human ancestral environments (Gangestad, Merriman, & Thompson, 2010; Sell, Cosmides et al., 2009; Sugiyama, 2005). Consistent with this, physically attractive people are seen as possessing valuable traits and abilities (e.g. Feingold, 1992; Langlois et al., 2000), preferred as friends, mates and allies (e.g. Sprecher & Regan, 2002; Sugiyama, 2005), given generous treatment in social exchange (e.g. Krupp, DeBruine, & Jones, 2010; Zaatari, Palestis, & Trivers, 2009) and afforded high social status (e.g. Anderson, John, Keltner, & Kring, 2001). Similar social advantages accrue to people who possess valuable knowledge, skills or abilities that enhance their apparent capacity to benefit associates (e.g. Anderson & Kilduff, 2009; Sugiyama & Scalise-Sugiyama, 2003; von Rueden et al., 2008, 2011). Likewise, physical formidability (i.e. fighting ability) has been an important determinant of one's ability to both benefit and harm others across human ancestral environments—especially among men, who have been subject to far more intense physical contest competition than women across evolutionary history (Puts, 2010). Consistent with this, measures of physical size and strength have been found to predict men's perceived fighting ability (Sell, Cosmides, et al., 2009), physical attractiveness (Lukaszewski & Roney, 2011), mating success (von Rueden et al., 2011), victory in interpersonal disputes (Archer & Thanzami, 2007; von Rueden et al., 2008), number of supportive trading partners and allies (von Rueden et al., 2008, 2011), achieved social status (von Rueden et al., 2008, 2011) and even financial income across a variety of white-collar professions (Judge & Cable, 2004).

It is because an individual's RBP has pervasive effects on the social evaluations, responses and affordances of others that it should be an important cue in the facultative calibration of numerous interpersonal trait dimensions—including those composing the personality syndrome that is the topic of the current investigation. Table 1 presents (i) a phenotypic description of each of the trait dimensions within the focal interpersonal syndrome, (ii) specific cost–benefit tradeoffs that are theorized to underpin the logic of variation along each of the trait dimensions and (iii) the hypothesized calibrational effect of overall RBP on each of the trait dimensions in question.

Common to these traits is that the optimal level along each dimension—that with the lowest cost–benefit ratio—should be influenced by the extent to which others are likely to place weight on one's interests in their behavioural decisions, which should be determined in part by RBP. For instance, a highly extraverted behavioural phenotype can lead to not only large potential reproductive benefits (e.g. relationship formation and social status) but also correspondingly large potential costs (e.g. opportunity costs, exposure to pathogens and social conflict) (Alvergne, Jokela, & Lummaa, 2010; Anderson & Shirako, 2008; Ashton & Lee, 2007; Lukaszewski & Roney, 2011; Nettle, 2005, 2011; Schaller & Murray, 2008). However, a person who is high in RBP can (validly) expect that others in his or her local environment will tend to defer to his or her interests, prefer to associate with his or her over others and confer status upon him or her. As such, high-RBP individuals will be more likely to obtain the benefits, and less likely to experience the costs, of a gregarious, status-oriented social strategy. It would have been adaptive, therefore, for extraversion levels to be facultatively calibrated to individual differences in RBP (Lukaszewski & Roney, 2011).

Similar analyses apply to each of the other trait dimensions composing the interpersonal syndrome (see Table 1). For example, because high-RBP individuals are differentially valuable as associates, others will be relatively inclined to aid them in the event that a risky decision results in social conflict, public embarrassment, injury or illness (Sugiyama & Scalise-Sugiyama, 2003). If so, higher RBP would have reliably decreased the optimal levels of avoidance motivation, emotionality and fear of rejection—each of which capture risk avoidance tendencies in different domains. Likewise, because low-RBP individuals will not, by definition, tend to be seen as highly valuable associates by most people, it would be adaptive for these individuals to be vigilant against possible abandonment (i.e. high in attachment anxiety) and to continually invest in established relationships to maintain a support system (which is theoretically facilitated by chronically low perceived social support). As a final example, high-RBP individuals should be able to expect that others will place significant weight on their interests when making decisions that affect both parties, and these individuals should therefore operate at a lower risk of exploitation by others for personal gain in the context of both close relationships and social exchange transactions—which should have reliably increased the optimal levels of comfort with closeness and interpersonal trust, respectively.

In sum, these sorts of detailed cost–benefit analyses lead to the prediction(s) that individual differences in RBP should exert positive calibrational effects on extraversion, approach motivation, perceived social support, comfort with closeness and interpersonal trust, and negative calibrational effects on emotionality, avoidance motivation, fear of rejection and attachment anxiety (Table 1). Consistent with this, extant evidence indicates that certain of these trait dimensions can be predicted from variations in RBP-enhancing phenotypic features such as physical attractiveness (Feingold, 1992; Langlois et al., 2000; Lukaszewski & Roney, 2011; Smith et al., 2009) and physical strength (Lukaszewski & Roney, 2011). The current study will conceptually replicate these findings as it examines each of the focal interpersonal traits in relation to measures of RBP.

The RBP index: an internal regulatory variable with radiating calibrational influences on multiple interpersonal traits

For personality strategies to be facultatively calibrated to variation in RBP, it is necessary for the mind to represent an estimate thereof. This is because overall RBP is a joint function of one's standing on numerous characteristics associated with benefit conferral and/or cost infliction—i.e. RBP-enhancing phenotypic features. For instance, Persons A and B may have identical RBP in most circumstances, despite the fact that Person A derives more from physical formidability, whereas Person B derives more from the possession of specialized skills. As such, natural selection should have favoured self-evaluative mechanisms that integrate cues to one's standing on numerous RBP-enhancing phenotypic features to compute an overall estimate

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Table 1. Hypothesized calibrational effects of relative bargaining power on distinct personality traits in relation to cost–benefit tradeoffs along each trait dimension

Trait dimension	Phenotypic description	Potential benefits of high levels	Potential costs of high levels	Calibrational effect of RBP
Extraversion (e.g. Ashton & Lee, 2007)	– Low levels: shy, submissive, inconspicuous– High levels: outgoing, assertive, socially conspicuous	– Alliance formation/maintenance– Broadcast of socially valued traits– Mating success– Resource acquisition– Social status	– Time/energy-related opportunity costs– Broadcast of devalued traits– Exposure to social conflict/ competition– Pathogen exposure	RBP ➔ higher extraversion
Emotionality (e.g. Ashton & Lee, 2007)	– Low levels: tough, brave, insensitive to pain, cool under stress– High levels: sensitive to pain, emotionally reactive under stress, fearful, dependent	– Avoidance of physical threats– Avoidance of social threats– Broadcasts need of social support to others	– Forgoing various opportunities entailing some physical or social risk– Signalling lack of competence in dealing with demanding situations	RBP ➔ lower emotionality
Fear of rejection (e.g. Mehrabian, 1970)	– Low levels: willing to brave potential rejection in social situations– High levels: avoidant of situations involving potential rejection	– Prevents failed investments in unsuccessful relationship initiation attempts– Prevents reputational damage resulting from public rejection	– Forgoing opportunities to initiate beneficial social relationships– Forgoing opportunities to extract benefits (e.g. favours) from existing relationships	RBP ➔ lower fear of rejection
Avoidance motivation (e.g. Carver & White, 1994)	– Low levels: comfortable with situations involving threat, risk and pain– High levels: motivated to avoid situations involving threat, risk and pain	– Avoidance of physical threats– Avoidance of social threats	– Forgoing various opportunities entailing some physical or social risk	RBP ➔ lower avoidance motivation
Approach motivation (e.g. Carver & White, 1994)	– Low levels: not activated by presence of desirable resources– High levels: highly activated by presence of desirable resources	– Successful pursuit and acquisition of resources– Promotion of desirable social outcomes	– Exposure to conflicts with competitors for resources– Opportunity costs of resource pursuit– Failing to fully analyse potential consequences of actions	RBP ➔ higher approach motivation
Perceived social support (e.g. Pierce et al., 1991)	– Low levels: perceives that social support is lacking– High levels: perceives adequate social support	– -pens up time/energy to pursue non-essential social relationships– Justifies participation in risky endeavours (given assumed risk-buffering system)	– Failing to invest in building and/or maintenance of essential social support relationships	RBP ➔ higher perceived social support
Interpersonal trust (e.g. Collins & Read, 1990)	– Low levels: reluctant to trust/depend on others– High levels: inclined to trust/depend on others	– Potential benefits of participation in social coordination (social exchange, reciprocity, collective action etc.)	– Exposure to costs of potential exploitation intrinsic to social coordination	RBP ➔ higher interpersonal trust

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Table 1. (Continued)

Trait dimension	Phenotypic description	Potential benefits of high levels	Potential costs of high levels	Calibrational effect of RBP
Comfort with closeness (e.g. Collins & Read, 1990)	– Low levels: reluctant to become intertwined with others– High levels: comfortable letting others get close	– Facilitates formation of close social relationships (e.g. friendships and mateships)	– Increases one's overall load of social obligation– Exposure to potential exploitation	RBP → higher ?comfort <?A3B2 show with closeness
Attachment anxiety (e.g. Collins & Read, 1990)	– Low levels: unconcerned about relationship dissolution– High levels: vigilant against potential relationship dissolution (esp. abandonment)	– Allocation of time and energy toward monitoring the status of existing close relationships and investing in their maintenance	– Allocation of time and energy away from other endeavours (e.g. self-maintenance, relationship formation and pursuit of status)	RBP → lower attachment anxiety

Note. Relative bargaining power (RBP) is theorized to affect the cost–benefit ratio—and thus the optimal level—along each trait dimension. When RBP is hypothesized to increase the optimal level of a trait, this means that RBP theoretically increases the probability of obtaining the benefits of high trait levels and/or buffers against experiencing the costs of high trait levels (and vice versa for traits whose optimal level RBP is hypothesized to decrease).

of RBP, which can then be stored and referenced by various behavioural regulation systems (Anthony, Holmes, & Wood, 2007; Buss, 2011; Kirkpatrick & Ellis, 2001; Leary, 2005; Leary et al., 2001; Sell, Tooby et al., 2009; Tooby, Cosmides, Sell, Lieberman, & Sznycer, 2008). In general, such integrated psychological magnitudes have been referred to as 'internal regulatory variables' (IRVs; see Tooby et al., 2008).

The current study thus hypothesizes the existence of an IRV with radiating calibrational influences on each of the focal personality traits: the RBP Index. In theory, the RBP Index has a fairly broad bandwidth and is superordinate to narrower IRVs that index one's standing on relevant phenotypic features (morphology, intelligence, ability etc.). For instance, under the model developed earlier, the RBP Index should be jointly influenced by IRVs that accurately represent one's relative standing on physical attractiveness and physical strength, respectively. By way of examining this proposed model, the current investigation will test not only whether the RBP Index (measured as self-perceived RBP) is influenced systematically by objective and self-perceived measures of RBP-enhancing phenotypic features but also whether this putative IRV mediates the common calibrational effects of these phenotypic features on interpersonal trait levels. If so, these findings could suggest a central role for IRVs in the study of personality covariation.

Hypotheses of the current study

Figure 1 depicts a hypothesized model of trait covariation wherein each individual trait dimension within the focal interpersonal syndrome is facultatively calibrated to the RBP Index (i.e. self-perceived RBP), whose magnitude is influenced, in turn, by one's actual possession of RBP-enhancing phenotypic features. The current study tests whether this model can explain the patterns of covariation among (i) objective and self-perceived measures of specific RBP-enhancing phenotypic features (physical attractiveness and physical strength/formidability), (ii) overall self-perceived RBP and (iii) each of the traits within the interpersonal syndrome.

The model is theorized to apply similarly to both sexes, with one exception: Hypothesized influences of physical strength/formidability on physical attractiveness, self-perceived RBP and personality variation, respectively, should theoretically be restricted to men. As stated earlier, this is because men have been subjected to a much a more intense evolutionary history of physical contest competition than women (Puts, 2010), which is evidenced by the fact that men have evolved to have at least 80% greater upper-body muscle strength than women on average (Lassek & Gaulin, 2009; Puts, 2010). Consistent with the idea that physical formidability should be a more influential determinant of RBP and personality among men than women, physical strength is a positive predictor of men's physical attractiveness but a null or negative predictor of women's attractiveness (e.g. Lukaszewski & Roney, 2011), formidability-related traits are more important in defining men's than women's self-concepts (e.g. Campbell & Wilbur, 2009) and the calibrational effects of physical strength on personality variation have been restricted to men in previous studies (e.g. Lukaszewski & Roney, 2011; Sell, Tooby et al., 2009).

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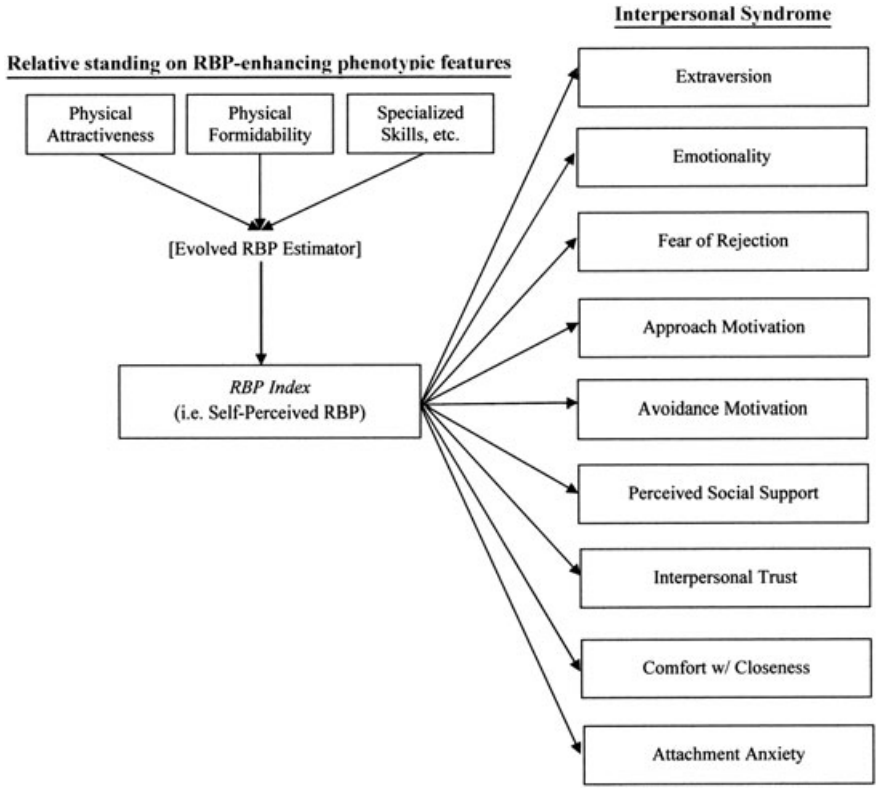

Figure 1. Theoretical model of common calibration explaining the covariation within the focal interpersonal syndrome.

In sum, this model makes the following specific predictions, each of which will be tested in the current study:

- *Prediction 1*: Extraversion, emotionality, approach motivation, avoidance motivation, fear of rejection, perceived social support and three dimensions of adult attachment (interpersonal trust, comfort with closeness and attachment anxiety) will be inter-correlated—thereby confirming that these distinct interpersonal traits constitute a fairly cohesive personality syndrome.
- *Prediction 2*: Objective measures of physical attractiveness and (men's) physical strength will predict self-perceived RBP, and these associations will be mediated by self-perceived attractiveness and self-perceived formidability, respectively.
- *Prediction 3*: On the basis of the hypothesis that each of the traits within the focal interpersonal syndrome is facultatively calibrated to individual differences in RBP, measures of physical strength/formidability, physical attractiveness and self-perceived RBP will predict each of the individual personality traits (with effects of physical strength/formidability likely restricted to men).
- *Prediction 4*: The effects(s) of physical attractiveness and (men's) physical strength/formidability on personality trait levels will be mediated through self-perceived RBP.
- *Prediction 5*: To the extent that the covariation among the traits within the interpersonal syndrome is in fact due to common calibrational influences of the RBP Index, controlling for self-perceived RBP will reduce the observed patterns of multi-trait covariation.

METHODS

Participants

Participants were 209 undergraduates from a large west-coast university in the USA (110 men; M age = 20.58, SD = .89), who were issued course credit in return for participation.

Materials and procedures

Participants completed all measures in same-sex groups of 5–10. They first completed all survey measures (personality scales, self-perceived physical attractiveness, self-perceived physical formidability and self-perceived RBP). Thereafter, participants were taken into a private room, where they posed for photographs and provided actual measures of physical strength. Operational definitions were as follows:

RBP-enhancing phenotypic features: physical attractiveness and physical strength/formidability

Other-rated Physical Attractiveness. A full-body photograph was taken of each participant against a solid white wall at a standardized distance. Participants posed with a neutral facial expression with their hands at their sides. These photographs were then rated for overall physical attractiveness by 12 undergraduate research assistants (six men) who were blind to the purpose of the study. There was high internal consistency reliability across raters (*Average Intra-class Correlation* = .91), and the ratings were therefore averaged to form a 12-item composite attractiveness score for each participant.

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Self-perceived Physical Attractiveness was measured by a 10-item scale ($\alpha = .93$) similar to those employed in previous studies (e.g. Lukaszewski & Roney, 2011). Example items include 'I am a physically attractive person'; 'At a purely physical level, I am more attractive than most people of my same age and sex' and 'I am not a physically attractive person' (reverse scored).

Actual Physical Strength was measured via procedures validated with weightlifting machines by Sell, Cosmides et al. (2009) (see also Archer & Thanzami, 2007; Lukaszewski & Roney, 2011; Sell, Tooby et al., 2009; von Rueden et al., 2008). Two measures of strength were obtained using a Jamar® hydraulic dynamometer: chest/arm strength and grip strength. For chest/arm strength, participants held the dynamometer in front of their chest and pressed inward with both arms until they felt they could not apply additional pressure. For grip strength, participants held the dynamometer at their side and squeezed with their dominant hand until they felt they could not apply additional pressure. These two items were *Z*-scored before being averaged to form a composite variable ($\alpha = .90$).

Self-perceived Physical Formidability was measured by a 10-item scale ($\alpha = .85$) similar to those employed in previous studies (e.g. Sell, Cosmides et al., 2009). Example items include 'I am physically strong relative to most people of my same age and sex', 'I could beat most people of my same age and sex in a fight' and 'Most people of my same age and sex are physically stronger than me' (reverse scored).

The RBP index (self-perceived RBP)

Self-perceived RBP was measured with selected items from Allan and Gilbert's (1995) Social Comparison Scale ($\alpha = .88$). For the items on this scale, participants simply rate themselves relative to others on 1–7 bipolar adjective scales. The overall composite included three items from the Rank subscale (inferior–superior, incompetent–competent and untalented–more talented) and two items from the Social Attractiveness subscale (unlikeable–likeable and undesirable–more desirable) (the items 'weaker–stronger' and 'unattractive–more attractive' were excluded because of their content overlap with the specific self-perceptions described earlier). Whereas personality scales tap into the types of cognitive, emotional and behavioural responses individuals tend to exhibit, the items that comprise this scale do not make any reference to one's characteristic social responses but are rather purely evaluative. As such, the items in this measure are assumed to tap into something different than personality: an IRV indexing one's overall RBP.

Personality scales

IPIP HEXACO Extraversion is a 40-item scale developed by the International Personality Item Pool (IPIP) project (http://ipip.ori.org/) intended to measure the extraversion factor identified by Lee and Ashton (2008). Example items include 'I talk a lot' and 'I have a strong personality' ($\alpha = .90$).

IPIP HEXACO Emotionality is a 40-item scale developed by the IPIP project (http://ipip.ori.org/) intended to measure the emotionality factor identified by Lee and Ashton (2008). Example items include 'I often worry about things that turn out to be unimportant' and 'I begin to panic when there is danger' ($\alpha = .87$).

Approach Motivation was measured by the Behavioral Activation System (BAS) subscale of Carver and White's (1994) BIS/Behavioral Inhibition System (BAS) scales (e.g. 'When I see an opportunity for something I like, I get excited right away') ($\alpha = .92$).

Avoidance Motivation was measured by the BIS subscale of Carver and White's (1994) BIS/BAS scales (e.g. 'If I think something unpleasant is going to happen, I usually get pretty worked up') ($\alpha = .93$).

Fear of Rejection was measured by Mehrabian's (1970) 24-item scale (e.g. 'I am very sensitive to any signs that a person might not want to talk to me') ($\alpha = .91$).

Attachment Styles were measured by Collins and Read's (1990) Adult Attachment Scale, which measures three moderately correlated dimensions of attachment in normal adults: *Comfort with Closeness* (eight items; e.g. 'I do not often worry about others getting too close to me'; $\alpha = .88$), *Interpersonal Trust* (eight items; e.g. 'I am comfortable depending on others'; $\alpha = .95$) and *Attachment Anxiety* (eight items; e.g. 'I do not often worry about being abandoned'; $\alpha = .93$).

Perceived Social Support was measured with an adapted six-item version of Pierce, Sarason, and Sarason's (1991) Counting on your Social Network scale from the Quality of Relationships Inventory (e.g. 'To what extent do you feel that could you count on your friends and family for help with a problem') ($\alpha = .87$).

Statistical analyses

The proposed theoretical model was evaluated in three sequential phases. First, predictions 1–3 were evaluated by an inspection of the zero-order correlations among all measured variables. Second, to more comprehensively test the causal model presented in Figure 1 (predictions 2–4), a complete path model was computed in AMOS by using maximum likelihood (ML) estimation procedures (Kline, 2005). Finally, to test the prediction that controlling for self-perceived RBP would reduce the syndrome's covariation (prediction 5), zero-order correlations among the interpersonal traits were compared with corresponding partial correlations controlling for self-perceived RBP. Throughout, all predictions involving mediation or correlation reduction were tested via standard ML bootstrapping techniques by using 5000 bootstrap iterations (Preacher & Hayes, 2008).

In the following analyses, each personality scale is analysed as a distinct trait, with the exception of the Emotionality and BIS scales, whose very strong positive correlation ($r = .82$) suggested that these scales were not in fact measuring distinct constructs. As such, these scales were combined into a single Emotionality/Avoidance Motivation composite. To simplify presentation and interpretation, Emotionality/Avoidance Motivation, Fear of Rejection and Attachment Anxiety were reverse scored, because of their (expected) negative correlations with the other traits within the interpersonal syndrome.

DOI: 10.1002/per

RESULTS

Zero-order correlations

As can be seen in Table 2, in support of prediction 1, all of the 28 pairwise correlations were in the predicted direction (positive) among both men and women, and the great majority of these effects were statistically significant. On average, the traits shared 12% of their variance within each sex, which is consistent with the idea that they represent a fairly cohesive interpersonal syndrome.

The correlations presented in Table 3 were consistent with the effects posited by the proposed causal model (predictions 2–3). In both sexes, other-rated attractiveness predicted self-rated attractiveness. Additionally, actual physical strength predicted self-perceived formidability in both sexes, and in men only, actual physical strength and self-perceived formidability also predicted both measures of physical attractiveness. These findings indicate that participants' perceptions of their own RBP-enhancing phenotypic features were fairly consistent with more objective measures thereof.

More importantly, the measures of RBP-enhancing phenotypic features exhibited the predicted patterns of correlation with self-perceived RBP (Table 3). Among men, measures of physical attractiveness and physical strength/formidability were all significantly correlated with self-perceived RBP. Among women, on the other hand, the measures of physical attractiveness were significantly correlated with self-perceived RBP, but actual physical strength was uncorrelated with self-perceived RBP. Overall, these findings support the idea that a putative RBP Index is systematically influenced by one's actual and self-perceived standing on relevant RBP-enhancing phenotypic features.

The zero-order correlations of attractiveness, strength/formidability and RBP with each individual personality scale provided partial support for prediction 3 (Table 3). Consistent with predictions, self-perceived RBP was robustly associated with each of the interpersonal traits, and self-perceived physical attractiveness exhibited significant associations with nearly all of the personality traits in both sexes. However, measures of other-rated attractiveness, actual physical strength and self-perceived physical formidability only sporadically exhibited significant zero-order associations with the personality scales (although almost all of these correlations were in the predicted direction and many approached significance).

Taken together, the zero-order correlations provide strong support for most of the model's predictions and qualified support for the associations of measures of attractiveness and strength with the interpersonal traits. As will be seen in the following, however, once all the variables were included simultaneously in a comprehensive path model, the predictions received unequivocal support.

Path analyses

Figure 2 presents the final results of a comprehensive path model that contains all hypothesized causal relations (predictions 2–4). Because certain of the predictions were sex specific, path coefficients were allowed to vary freely for men and

Table 2. Zero-order correlations among individual traits composing the focal interpersonal syndrome and corresponding semi-partial (part) correlations controlling for self-perceived RBP

	Extraversion	Emotionality/avoidance (R)	Fear of rejection (R)	Approach motivation	Perceived support	Interpersonal trust	Attachment anxiety (R)	Comfort with closeness
Extraversion	—	.32***(.12)	.52***(.32***)	.34***(.12)	.48***(.19*)	.31***(.19*)	.36***(.19*)	.50***(.25*)
Emotionality/avoidance (R)	.23*(.11)	—	.59***(.48***)	.08(−.26**)	.13(−.12)	.12(.04)	.57***(.35***)	.35***(.20*)
Fear of rejection (R)	.38***(.21*)	.52***(.46***)	—	.19*(.02)	.19*(−.04)	.08(.00)	.46***(.35***)	.38***(.19*)
Approach motivation	.44***(.30***)	.15(.07)	.26**(.14)	—	.33***(.10)	.12(.02)	.01(−.01)	.27**(.06)
Perceived support	.43***(.25**)	.07(−.22**)	.21*(.06)	.21*(.09)	—	.23**(.10)	.18*(−.01)	.38***(.10)
Interpersonal trust	.34***(.13)	.10(−.05)	.29**(.11)	.03(−.13)	.53***(.37***)	—	.39***(.30**)	.45***(.34***)
Attachment anxiety (R)	.39***(.24**)	.42***(.47**)	.32**(.19*)	.07(−.07)	.30**(.07)	.45***(.28**)	—	.36***(.20*)
Comfort with closeness	.54***(.37***)	.12(.00)	.29**(.15)	.26**(.14)	.47***(.32***)	.53***(.34***)	.37***(.26**)	—

Note: Correlations for men are above the diagonal and correlations for women are below the diagonal. Zero-order correlations among individual traits are presented above in each cell, whereas relative bargaining power (RBP)-partialed correlations are presented below within parentheses in each cell.
*$p < .05$; **$p < .01$; ***$p < .001$.

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Table 3. Zero-order correlations among physical strength, physical formidability, physical attractiveness and self-perceived RBP, and their zero-order correlations with personality traits

	Men					Women				
	Physical strength	Self-perceived formidability	Other-rated attractiveness	Self-perceived attractiveness	Self-perceived RBP	Physical strength	Self-perceived formidability	Other-rated attractiveness	Self-perceived attractiveness	Self-perceived RBP
Physical strength (actual)	—	.57***	.45***	.45***	.38***	—	.32**	.05	.06	.00
Physical formidability (self-perceived)		—	.21*	.44***	.50***		—	.09	.13	.19*
Physical attractiveness (other-rated)			—	.42***	.24**			—	.45***	.23*
Physical attractiveness (self-perceived)				—	.68***				—	.60***
Extraversion	.25**	.28**	.13	.51***	.56***	.25**	.30**	.18	.44***	.50***
Emotionality/avoidance (R)	.26**	.25**	.18	.31**	.40***	.18	.23*	.02	.07	.26**
Fear of rejection (R)	.21*	.25**	.03	.35***	.39***	.11	−.09	.11	.19	.38***
Approach motivation	.09	−.03	.00	.29**	.42***	.04	−.12	.16	.35***	.32**
Perceived support	.22*	.17	.12	.37***	.58***	.01	−.05	.17	.28**	.42***
Interpersonal trust	.09	.03	.00	.12	.28***	.05	.05	.13	.27**	.50***
Attachment anxiety (R)	.14	.17	.06	.25**	.37***	.18	−.07	.18	.35***	.39***
Comfort with closeness	.20**	.13	.13	.48***	.53***	.24*	.20*	.02	.32**	.45***

Note: RBP, relative bargaining power.
*$p < .05$; **$p < .01$; ***$p < .001$.

women in a multi-group model. In the analysis, the exact model presented in Figure 2 was calculated with a complete set of pairwise correlated disturbances among the interpersonal traits. In support of the theory at hand, this model provided a close fit to the data [$\chi^2(72) = 94.15$, $p < .05$; $CFI = .97$; $RMSEA = .04$ (90% confidence interval: .01–.06)].

As can be seen in Table 4, direct and mediated effects computed in AMOS via ML bootstrapping techniques provided strong support for each of the model's specific predictions (predictions 2–4). First, all of the confirmed predictions from the zero-order correlations held up in the path analyses. Additionally, the predictions that were only partially supported by the zero-order correlations garnered solid support once all variables were included in the model. Specifically, other-rated attractiveness and (men's) actual physical strength had effects on self-perceived RBP that were mediated through self-perceived attractiveness and/or (men's) formidability. Moreover, all measures of physical attractiveness and (men's) physical strength had significant effects on each of the interpersonal traits that were ultimately mediated through self-perceived RBP—which, as predicted, exhibited robust independent associations with each of the traits composing the interpersonal syndrome.

Overall, then, these path analyses support the proposed causal model (predictions 2–4), which posits that (i) self-perceived RBP is based on accurate self-assessments of one's standing on specific RBP-enhancing phenotypic features (physical attractiveness and physical strength) and (ii) each of the focal interpersonal traits is, in turn, independently calibrated to self-perceived RBP.

Did controlling for self-perceived RBP reduce the trait covariation within the interpersonal syndrome?

Finally, to test the model's core postulate—that the observed trait covariation within the interpersonal syndrome is explained by common calibration to the RBP Index (prediction 5)—the zero-order correlations among the interpersonal traits were compared with semi-partial (part) correlations controlling for self-perceived RBP (see Table 2). In strong support of prediction 5, controlling for self-perceived RBP substantially reduced each of the pairwise correlations from their zero-order magnitudes, and bootstrapping mediation tests confirmed that all of these reductions were statistically significant at $p < .05$ (i.e. that the correlation between any given pair of traits was significantly mediated through self-perceived RBP). Indeed, at the zero-order level, the traits shared 12% of their variance on average within each sex. After controlling for self-perceived RBP, however, the traits shared only 3% of their variance among men and 5% among women—which amounts to a 75% reduction in covariation for men and a 58% reduction for women.

DISCUSSION

Despite the fact that trait covariation forms the foundation for most personality research, the field has heretofore lacked in validated theories to explain why distinct traits covary in

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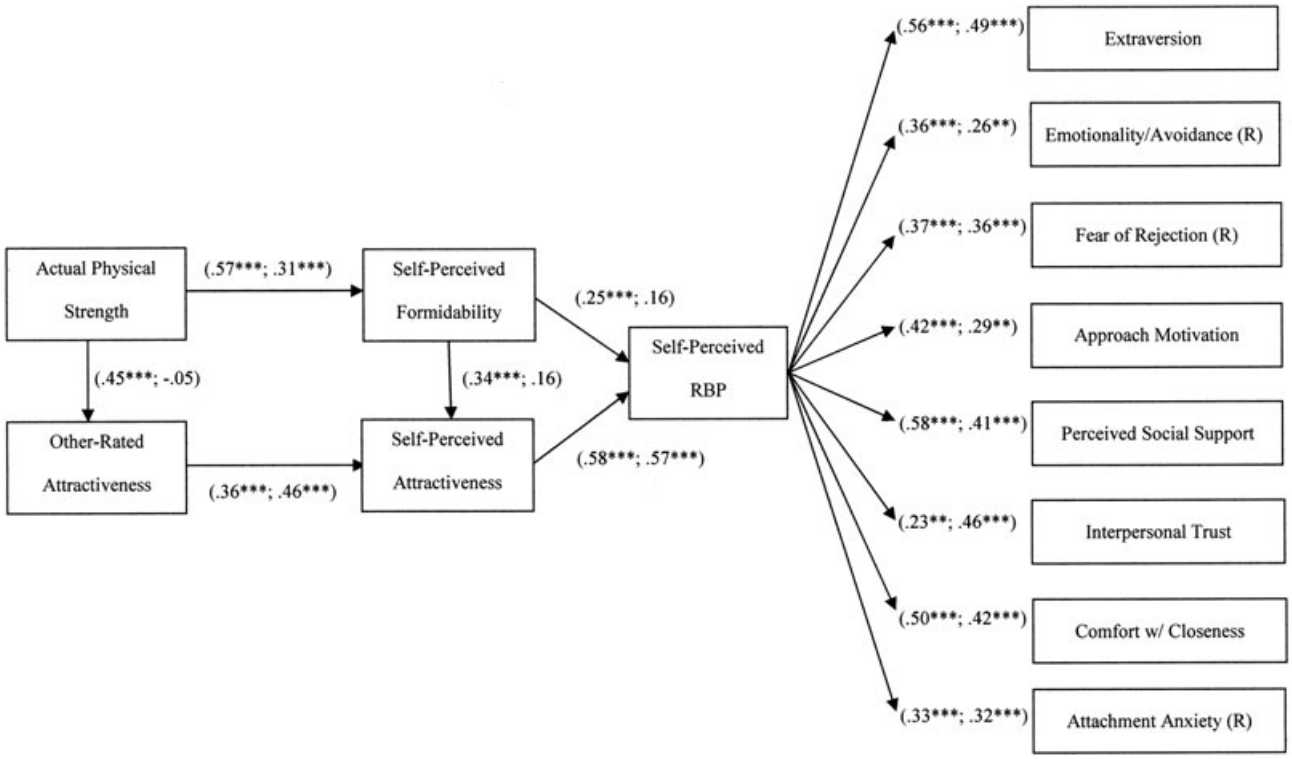

Figure 2. Results of a comprehensive path model testing all hypothesized causal relations. Standardized path coefficients for men are on the left within parentheses, whereas coefficients for women are on the right within parentheses. As explained in text, the model includes a complete set of pairwise correlated disturbances among the interpersonal traits. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

consistent configurations within individuals. To begin filling this lacuna, the current article provided the first empirical test of an adaptationist 'common calibration' theory to explain trait covariation that was originally advanced by Tooby and Cosmides (1990) over two decades ago in a seminal paper. The principles of this generic theory were applied to derive an explanation of the trait covariation occurring within a particular 'interpersonal syndrome' encompassing moderate correlations among extraversion, emotionality, approach motivation, avoidance motivation, fear of rejection, perceived social support, interpersonal trust, comfort with closeness and attachment anxiety. Specifically, it was theorized that these traits are inter-correlated because each is facultatively calibrated in response to the RBP Index—an IRV whose magnitude is influenced, in turn, by one's relative standing on numerous RBP-enhancing phenotypic features.

Path analyses from a correlational study provided compelling support for the proposed model. Specifically, (i) robust correlations between objective and self-perceived measures of physical attractiveness and physical strength/formidability indicated that people were accurate in perceiving their own standing on these RBP-enhancing phenotypic features; (ii) objective measures of physical attractiveness and (men's) physical strength jointly influenced self-perceived RBP, and these associations were mediated through self-perceived measures of attractiveness and formidability, respectively; and (iii) self-perceived RBP, in turn, had radiating calibrational influences on each of the interpersonal traits within the focal syndrome—which, as predicted, mediated effects of RBP-enhancing phenotypic features on each of the interpersonal traits. Moreover, in support of the theory's core premise, controlling for self-perceived RBP eliminated the great majority of covariation within the interpersonal syndrome.

Thus, taken together, the results of the current study provided support for all of the proposed model's a priori predictions. Indeed, this study not only successfully explained a particular instance of trait covariation but also generated novel findings suggesting that a wide array of interpersonal trait dimensions are facultatively calibrated to variations in physical attractiveness and physical strength. Although the correlational and cross-sectional design cannot rule out all possible alternative explanations that could explain the observed patterns, it is unclear that any other extant theoretical framework would have led to these same a priori predictions and empirical discoveries.

Despite the impressive overall fit of the data to the theoretical model, two results were not fully consistent with predictions. First, counter to expectation, women's physical strength exhibited zero-order correlations with a few of the interpersonal traits, despite the fact that women's strength did not (as predicted) correlate positively with self-perceived RBP. As such, this leaves open the possibility that women's strength may influence certain aspects of personality through some alternative pathway. Second, measures of other-rated attractiveness and (men's) strength/formidability exhibited significant zero-order associations with the interpersonal traits only sporadically (although almost all of these effects were in the predicted direction). However, concerns regarding this limitation should be assuaged by the results of the comprehensive path model—wherein the measures of RBP-enhancing

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Table 4. Decomposition of direct and mediated effects among RBP-enhancing phenotypic features, self-perceived RBP and the focal interpersonal traits

Endogenous variables		Causal variables				
		Men				
		Physical strength	Self-perceived formidability	Other-rated attractiveness	Self-perceived attractiveness	Self-perceived RBP
Self-perceived formidability						
	Direct effect	.57***	—	—	—	—
	Mediated effect	—	—	—	—	—
Other-rated attractiveness						
	Direct effect	.45***	—	—	—	—
	Mediated effect	—	—	—	—	—
Self-perceived attractiveness						
	Direct effect	—	.34***	.36***	—	—
	Mediated effect	.36***	—	—	—	—
Self-perceived RBP						
	Direct effect	—	.25***	—	.58***	—
	Mediated effect	.35***	.20***	.21***	—	—
Extraversion						
	Direct effect	—	—	—	—	.56***
	Mediated effect	.20***	.26***	.12***	.33***	—
Emotionality/avoidance (R)						
	Direct effect	—	—	—	—	.36***
	Mediated effect	.13***	.17***	.08***	.21***	—
Fear of rejection (R)						
	Direct effect	—	—	—	—	.37***
	Mediated effect	.13***	.17***	.08***	.22***	—
Approach motivation						
	Direct effect	—	—	—	—	.42***
	Mediated effect	.15***	.19***	.09***	.24***	—
Perceived support						
	Direct effect	—	—	—	—	.58***
	Mediated effect	.21***	.26***	.12***	.34***	—
Interpersonal trust						
	Direct effect	—	—	—	—	.23**
	Mediated effect	.08**	.11**	.05**	.13**	—
Attachment anxiety (R)						
	Direct effect	—	—	—	—	.33***
	Mediated effect	.12***	.15***	.07**	.19***	—
Comfort with closeness						
	Direct effect	—	—	—	—	.50***
	Mediated effect	.18***	.23***	.10***	.29***	—
		Women				
		Physical strength	Self-perceived formidability	Other-rated attractiveness	Self-perceived attractiveness	Self-perceived RBP
Self-perceived formidability						
	Direct effect	.31**	—	—	—	—
	Mediated effect	—	—	—	—	—
Other-rated attractiveness						
	Direct effect	−.05	—	—	—	—
	Mediated effect	—	—	—	—	—
Self-perceived attractiveness						
	Direct effect	—	.16	.46***	—	—
	Mediated effect	.02	—	—	—	—
Self-perceived RBP						
	Direct effect	—	.16	—	.57***	
	Mediated effect	.05	.09	.27***	—	
Extraversion						
	Direct effect	—	—	—	—	.49***
	Mediated effect	.03	.11*	.13***	.29***	—

(Continues)

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Table 4. (Continued)

Endogenous variables		Causal variables				
		Women				
		Physical strength	Self-perceived formidability	Other-rated attractiveness	Self-perceived attractiveness	Self-perceived RBP
Emotionality/avoidance (R)						
	Direct effect	—	—	—	—	.26**
	Mediated effect	.02	.06	.08*	.15*	—
Fear of rejection (R)						
	Direct effect	—	—	—	—	.36***
	Mediated effect	.02	.09*	.11**	.21***	—
Approach motivation						
	Direct Effect	—	—	—	—	.29**
	Mediated effect	.03	.08*	.08*	.18**	—
Perceived support						
	Direct effect	—	—	—	—	.41***
	Mediated effect	.03	.09*	.11**	.24***	—
Interpersonal trust						
	Direct effect	—	—	—	—	.46***
	Mediated effect	.02	.11*	.13**	.27***	—
Attachment anxiety (R)						
	Direct effect	—	—	—	—	.32***
	Mediated effect	.03	.10*	.09*	.19**	—
Comfort with closeness						
	Direct effect	—	—	—	—	.42***
	Mediated effect	.02	.08*	.12***	.24***	—

Note: Standardized path coefficients map onto to the model depicted in Figure 2. RBP, relative bargaining power.
*$p < .05$; **$p < .01$; ***$p < .001$.

phenotypic features had significant mediated effects on all of the interpersonal traits (see, e.g., Rucker, Preacher, Tormala, & Petty, 2011).

Past providing replication and resolving these few outstanding issues, the findings of the current investigation suggest a number of promising directions for future research. The most important of these are discussed briefly in the following.

Internal regulatory variables: a key concept in the study of personality calibration and trait covariation

This work extended the findings of previous studies (Archer & Thanzami, 2007; Lukaszewski & Roney, 2011; Sell, Tooby et al., 2009) in providing evidence that personality trait levels are facultatively calibrated to variations in other phenotypic features such as physical attractiveness and formidability. In these previous investigations, however, the specific design features of the conditional adaptations that implement such calibration over ontogeny had not been explored, either theoretically or empirically. The current article proposed that IRVs (Tooby et al., 2008) may play an important role in this regard and marshalled empirical support for the hypothesis that a specific self-evaluative IRV—the RBP Index—acts as a mediating mechanism in the facultative calibration of numerous interpersonal trait dimensions to variations in RBP-enhancing phenotypic features.

It is important to note that physical attractiveness and formidability are but two of many phenotypic features that likely input to the RBP Index and that may therefore influence personality calibration through this IRV. In our initial investigations (see also Lukaszewski & Roney, 2011), these physical characteristics were studied because they are relatively straightforward to operationalize and provide clear examples of traits that would have reliably determined RBP under ancestral conditions. However, this should not be taken to imply that morphological traits are the most important determinants of social value or the only determinants of formidability. Indeed, recent models of social status hold that rank is afforded to others largely on the basis of the apparent possession of knowledge, skills or abilities that enhance his or her ability to make valuable contributions to a group's collective goals (e.g. Anderson & Kilduff, 2009; Cheng et al., 2010; von Rueden et al., 2008, 2011). In addition, physical strength should not be the only determinant of the ability to inflict costs on others: because humans are highly cooperative and coalitional, even physically weak individuals may be quite formidable in effect by virtue of the size and/or strength of their alliance networks (von Rueden et al., 2008, 2011). In light of these considerations, future research should examine the joint influences of physical appearance, physical ability, alliances, intelligence(s) and other relevant variables to construct comprehensive theoretical models of the RBP Index in relation to personality calibration.

In general, the introduction of the IRV concept to the study of self-evaluation and personality origins could unite a number of related theoretical concepts and research traditions. Buss (2011), for example, has proposed explicitly that natural selection should have favoured self-evaluative mechanisms designed to estimate one's standing on socially

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relevant characteristics for reference in adaptive behavioural regulation. Similarly, self-esteem has been conceptualized as the output of a 'sociometer' mechanism that estimates one's degree of social inclusion and regulates responses to ostracism and exclusion (e.g. Anthony et al., 2007; Denissen & Penke, 2008b; Denissen, Penke, Schmidt, & van Aken, 2008; Kirkpatrick & Ellis, 2001; Leary, 2005; Leary et al., 2001). Upon inspection, it is clear the sorts of self-evaluative constructs envisioned by these theorists could easily be construed as IRVs—evolved mechanisms that (i) store cue-based estimates of variables that have predicted the fitness payoffs of alternative strategies across evolutionary history and (ii) are consulted by various psychological adaptations in the course of strategic behavioural regulation (Tooby et al., 2008). To the extent that it is desirable to have common terminology to refer to this class of psychological construct, the IRV concept provides a viable candidate that is generic in its applicability but potentially precise in depicting the input–output relations that constitute the form and function of self-evaluative psychological mechanisms.

Thus, the current findings pertaining to the RBP Index—although in need of refinement and elaboration—may provide a model for future research on the role of IRVs in driving covariation among multiple phenotypic dimensions. Importantly, IRVs should not only be important in orchestrating the calibration of personality traits to other phenotypic features but also mediate previously documented calibrational effects of 'external' socio-ecological cues such as pathogen prevalence (e.g. Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010; Schaller & Murray, 2008) and local sex ratio (e.g. Del Giudice, 2012; Griskevicius, Tybur, Delton, & Robertson, 2011). In theory, then, a large number of imaginable IRVs could drive instances of trait covariation across the human personality landscape. If so, this concept may eventually be seen as indispensible for the study of personality calibration and trait covariation.

Implications for explaining the heritability of interpersonal traits

Although the current study did not incorporate genetic measures, the common calibration of various personality traits to the RBP Index may nonetheless have significant implications for understanding the substantial heritability of human personality variation. Behavioural geneticists (e.g. Bouchard & Loehlin, 2001), evolutionary theorists (e.g. Penke et al., 2007) and personality psychologists (McCrae & Costa, 2008) have tended to interpret the substantial heritability of personality traits as prima facie evidence for the existence of specific polymorphic gene loci that encode for the endophenotypes of personality in reliable ways (see Johnson, Penke, & Spinath, 2011). An alternative hypothesis, however, pertains to what theorists have referred to as 'reactive heritability', which occurs when a personality trait is facultatively calibrated over development to variations in other heritable traits (Lukaszewski, 2011; Lukaszewski & Roney, 2011; Tooby & Cosmides, 1990). The current study, for instance, added to previous evidence that the focal personality syndrome is calibrated to variations in physical attractiveness and strength (Lukaszewski & Roney, 2011). Importantly, because these RBP-enhancing phenotypic features are both highly heritable (Rowe, Clapp, & Wallis, 1987; Silventoinen, Magnusson, Tynelius, Kaprio, & Rasmussen, 2008), the personality syndrome should also exhibit substantial heritability even if there are no common gene variants that reliably influence the neural substrates of these traits across individuals.

If the focal personality syndrome is indeed reactively heritable in response to RBP, this in turn raises the question of what maintains heritable variation in RBP-enhancing phenotypic features. In general, the traits that increase RBP (e.g. attractiveness and intelligence) will, by definition, reliably promote social and therefore reproductive success (Penke et al., 2007). As such, we should expect that any genes with systematically depressive effects on these reproductively beneficial characteristics will be selected against and eventually eliminated from the population. However, natural selection can never completely eliminate heritable variance in RBP-enhancing phenotypic features, not least because new genetic mutations are constantly introducing themselves into reproducing populations before natural selection can remove them—and these mutations almost always cause at least mildly harmful deviations from the optimal phenotypic design (Tooby & Cosmides, 1990). This ongoing balance between mutation and selection thus ensures the perpetual maintenance of heritable variance in RBP-enhancing phenotypic features such as attractiveness, strength and intelligence (Gangestad, 2011; Penke et al., 2007). As a direct corollary of this, we should expect that the genetic variance in RBP—and therefore in any personality traits that are reactively heritable in relation to RBP—is largely explained by the disordering effects of mutations scattered across the human genome.

Consistent with this, recent behavioural genetic research on personality traits conceptually similar to some of those in the current study (e.g. harm avoidance and reward dependence) indicates that much of the heritable variance in these dimensions reflects the combined effects of many different low-frequency gene variants—the signature of mutation–selection balance (Verweij et al., 2012). Furthermore, the apparent effects of these mutations on personality trait levels are not directionally random: they tend to influence trait levels in the same way as would lower RBP (e.g. higher avoidance motivation and lower reward dependence). These discoveries, in conjunction with those of the current study, suggest the need for future research that specifically tests for the reactive heritability of interpersonal traits in response to RBP—in particular addressing the possibility that effects of genetic mutations on these personality traits are at least partially mediated (through common calibration) by their depressive effects on RBP-enhancing phenotypic features. If so, this could not only help explain the existence of widespread genetic correlations among commonly calibrated interpersonal dimensions (see Johnson et al., 2011) but also imply that most specific gene variants responsible for these effects will vary dramatically across individuals and never be common enough to pin down (for a broader discussion of these issues, see Gangestad, 2011; Lukaszewski, 2011; Lukaszewski & Roney, 2011; Miller, 2011; Penke et al., 2007; Roberts & Jackson, 2008; Verweij et al., 2012).

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Because such a large amount of research is focused on searching for specific gene–personality linkages, these possibilities represent important questions for future studies.

Distinct mechanisms of trait covariation: common calibration versus intrinsic inter-linkages

Because multiple theorists have offered evolutionary explanations for trait covariation, it is important to briefly consider the theory tested in the current article in relation to these other ideas. To recap, the common calibration theory posits that certain traits tend to covary because they are each calibrated in response to some of the same input cues. For example, this study supported the prediction that extraversion and attachment anxiety are negatively correlated across individuals because the RBP Index exerts positive calibrational effects on extraversion but negative effects on attachment anxiety. However, an important assumption of this theory is that any particular individual could defy this overall trend and manifest both high extraversion and high attachment anxiety. In theory, such operational independence among correlated trait dimensions is to be expected when distinct traits are calibrated by partially non-overlapping suites of input cues. For instance, the RBP Index may influence levels of both extraversion and attachment anxiety, but attachment anxiety may also be calibrated in response to various other cues that do not influence extraversion (and vice versa). In such cases, it makes functional sense for each trait dimension to be calibrated independently according to its own adaptive logic.

However, this is not to say that there are no personality syndromes whose components are intrinsically inter-linked. In fact, numerous theorists have explained reasons to expect that natural selection would have actively designed constraints on the extent to which certain traits can vary independently within individuals (Ashton & Lee, 2007; Buss, 2009; Del Giudice, 2012; Ellis et al., 2009; Figueredo et al., 2011; Irwing et al., 2012; Nettle, 2011; Penke, 2011; Rushton & Irwing, 2008; Sih et al., 2004). Specifically, we should expect that intrinsic inter-linkages will have evolved among trait clusters that are part of 'coordinated strategies'—that is, component strategies that work well when implemented together but not so well when broken apart. For instance, a gregarious social strategy characterized by widespread social coordination may have only tended to promote net reproductive benefits when accompanied by at least a moderate level of assertiveness, which was likely necessary to defend one's interests in the face of potential exploitation by a large number of cooperative partners. Because of such correlated (i.e. synergistic) selection across traits, natural selection may have acted to inter-link the settings of the psychological mechanisms that regulate these distinct aspects of social strategy to constrain their discordance within individuals—in this case explaining why the sociability and assertiveness facets of extraversion are always tightly inter-correlated (for additional examples, see Del Giudice, 2012; and Nettle, 2011).

This distinction between common calibration and intrinsic inter-linkages may prove especially relevant for explaining trait covariation that occurs at different levels in hierarchical personality taxonomies. For the sorts of reasons discussed briefly earlier, very tightly inter-correlated traits such as the facets within the Big Five and HEXACO trait factors (e.g. the narrow facets of extraversion) may be quite likely to reflect intrinsic inter-linkages, at least to some extent. If so, (i) people who are very discordant on different facets within the same broadband factor should be few and far between (or non-existent), and (ii) it should be difficult (or impossible) to eliminate covariation among lower order facets by controlling for common calibrators.

On the other hand, however, common calibration may be more likely to explain the covariation occurring within moderately inter-correlated personality syndromes such as that under analysis in the current study. For example, Digman (1997) has proposed the existence of two higher order trait factors—labelled alpha and beta—that capture loose associations among the Big Five traits, whereas others have interpreted the positive correlation between alpha and beta as a 'general factor of personality' that sits atop the personality hierarchy (Irwing et al., 2012; Rushton & Irwing, 2008). Although data from studies employing multi-rater methods suggest that the general factor of personality is likely an artefact of shared method variance rather than a substantive trait factor (Chang, Connelly, & Geeza, 2012; Pettersson, Turkheimer, Horn, & Menatti, 2012; Riemann & Kandler, 2010), the same studies support the phenotypic reality of the alpha and beta factors (but see Ashton, Lee, Goldberg, & de Vries, 2009). Thus, the apparent existence of substantive correlations among certain broadband personality dimensions represents a phenomenon awaiting causal explanation.

In this context, it is interesting to note that, by controlling for self-perceived RBP, the current study was able to eliminate the observed negative correlation between extraversion and emotionality—both of which are broadband dimensions from the HEXACO taxonomy (Lee & Ashton, 2008). As such, this finding illustrates how the sorts of inter-correlations that form the basis of higher order trait factors can be explained through common calibration and without appeal to unspecified 'latent psychological constructs' from which multiple aspects of thought, emotion and behaviour supposedly emanate (e.g. McCrae & Costa, 2008; Rushton & Irwing, 2008). Whether common calibration to RBP (and/or other cues) drives the broader patterns of covariation within higher order trait factors is an intriguing question for future research.

Toward an integrative framework for explaining trait covariation in humans and other animals

Moving forward, it will be beneficial for researchers working to generate causal explanations of trait covariation to establish common theoretical frameworks. Previously, common calibration and intrinsic inter-linkages, respectively, were differentiated as two types of mechanisms that could underlie different instances of trait covariation, and these concepts are consistent with ideas discussed by others. For example, intrinsic inter-linkages could be conceptualized within the network perspective described by Cramer et al. (2012), whereas the common calibration theory is in line with functionalist hypotheses advanced by Wood and Hensler (2011). In parallel with these developments, behavioural ecologists interested in animal personality have adopted an evolutionarily

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informed approach to explaining trait covariation that bears much resemblance to the current evolutionary psychological perspective (e.g. Dingemanse et al., 2010; Sih et al., 2004). Indeed, this article borrowed the term 'personality syndrome' from the animal personality literature (Sih et al., 2004) in part to facilitate cross-talk between human and non-human personality researchers. Currently, there is still incomplete agreement as to how different terms and concepts should be applied in the study of trait covariation (e.g. 'syndrome' and 'reaction norm'). As argued by Nettle and Penke (2010), it is likely that the construction of an integrative evolutionary framework will facilitate synergistic advances in knowledge derived from personality research conducted on different species.

Limitations

The current empirical study contained some methodological limitations that are important to consider when interpreting the reported findings. First, only self-reports were used in the measurement of self-perceived RBP and the focal interpersonal traits. Given evidence that self-reports produce somewhat inflated inter-correlations among different psychometric scales due to several sources of shared method variance (e.g. Chang et al., 2012; Pettersson et al., 2012; Riemann & Kandler, 2010), future research should replicate these findings with personality measurements made through both self- and peer-reports (and/or behavioural observations). In addition, self-perceived RBP was measured with selected bipolar self-report items from the Social Comparison Scale (Allan & Gilbert, 1995), and this operationalization does not map perfectly onto the theoretical description of RBP. Although incomplete measurement is obviously sub-optimal, this state of affairs implies that a more comprehensive measure of the RBP Index might have actually explained a larger proportion of the interpersonal syndrome's covariation than did the one employed in the current study. Because of these limitations, it will be important for future research to develop and validate more sophisticated psychometric instruments for the measurement of RBP-related constructs.

Conclusions

This article began by posing the fundamental question: What causes distinct personality traits to covary in consistent patterns within individuals, rather than varying independently? In providing the first empirical test of the common calibration theory (Tooby & Cosmides, 1990), I advanced a novel theoretical model that was able to explain a majority of the covariation within a particular interpersonal syndrome encompassing a wide array of correlated trait dimensions. In contrast to the notion of a 'latent psychological construct'—an unspecified internal entity from which trait correlations are often presumed to arise (see Cramer et al., 2012; Wood & Hensler, 2011)—this model was very specific about both the ultimate (evolutionary) and proximate (mechanistic) causes of the focal syndrome's covariation. To be sure, more work remains to be done in establishing the causality of the reported effects and characterizing the design features of the proposed mechanisms. Nonetheless, the findings, if valid, may serve to illustrate the potential explanatory power of an evolutionary psychological approach to elucidating trait covariation—which has heretofore been touted by theorists but slow to gain empirical validation. As such, future research should pursue additional tests of theoretical models that explain trait covariation by searching for the common calibrators that generate specific personality syndromes.

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