

# Survival of the Scheming: A Genetically Informed Link Between the Dark Triad and Mental Toughness

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The present study is the first behavioral genetic investigation of the Dark Triad traits of personality, consisting of Machiavellianism, narcissism, and psychopathy, and the variable of mental toughness, reflecting individual differences in the ability to cope when under pressure. The purpose of this investigation was to explore a potential explanation for the success of individuals exhibiting the Dark Triad traits in workplace and social settings. Participants were adult twins who completed the MACH-IV, the Narcissistic Personality Inventory, and the Self-Report Psychopathy Scale assessing Machiavellianism, narcissism, and psychopathy, respectively, as well as the MT48, measuring mental toughness. Correlational analyses of the data revealed significant positive phenotypic associations between mental toughness and narcissism. Psychopathy and Machiavellianism, however, both showed some significant negative phenotypic correlations with mental toughness. Bivariate behavioral genetic analyses of the data were conducted to assess the extent to which these significant phenotypic correlations were attributable to common genetic and/or common environmental factors. Results indicate that correlations between narcissism and mental toughness were attributable primarily to common non-shared environmental factors, correlations between Machiavellianism and mental toughness were influenced by both common genetic and common non-shared environmental factors, and the correlations between psychopathy and mental toughness were attributable entirely to correlated genetic factors. Implications of these findings in the context of etiology and organizational adaptation are discussed.

■ **Keywords:** Dark Triad, mental toughness, twin study, behavioral genetics

The Dark Triad is a personality cluster, defined at the subclinical level, and composed of three distinct, but overlapping personality traits: narcissism, psychopathy, and Machiavellianism (Paulhus & Williams, 2002). Though conventionally seen as socially malevolent, these three traits have also been linked to socially desirable outcomes in the workforce and in short-term relationships (e.g., Jonason et al., 2009, 2010; Young & Pinsky, 2006). In an effort to explore the potentially adaptive nature of the Dark Triad traits, the present study assesses the personality cluster in relation to mental toughness, which has been identified as a key trait in human resiliency (Clough et al., 2001). Though associations between these sets of traits have not yet been examined, previous studies of mental toughness have shown that this construct's patterns of correlations with existing personality traits are sometimes reminiscent of those exhibited by the Dark Triad variables (e.g., Horsburgh et al., 2009; Vernon, et al., 2008), suggesting that the Dark Triad and mental toughness may exhibit significant associations. To explore the potential etiological

factors underlying these possible correlations, behavioral genetic analyses will also be carried out.

## The Dark Triad Traits: Description and Correlations

**Narcissism.** Subclinical narcissism, measured with the Narcissistic Personality Inventory (NPI; Raskin & Hall, 1979), is characterized by vanity, grandiosity, a sense of entitlement, self-enhancement, self-deception, an inflated sense of self-worth, and manipulateness (Campbell et al., 2011; Paulhus & Williams, 2002; Watson et al., 1984). Narcissism has been shown to fit within a conventional framework of personality through its associations with the dimensions of the Big Five model of personality (Vernon et al., 2008).

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Narcissistic individuals tend to obtain low scores on the Big Five dimension of Agreeableness, but high scores on the model's Extraversion and Openness to Experience factors (Vernon et al., 2008). This pattern of associations provides an accurate reflection of the manner in which narcissism is presently understood: a mixture of both maladjusted and adjusted tendencies that have both been shown to augment the resilience of narcissistic individuals Paulhus (1998).

**Psychopathy.** Individuals exhibiting high levels of subclinical psychopathy can be described as impulsive, uninhibited, and often self-enhancing, showing little regard for others (Cooke & Michie, 2001; Paulhus & Williams, 2002). Such individuals exhibit low anxiety, paired with high thrill-seeking behavior, and show limited capability of taking the perspective of others (Hare, 1985; Petrides et al., 2011). Psychopathy has been associated with low scores on the Big Five dimensions of Agreeableness, Neuroticism, and Conscientiousness, as well as high scores on Extraversion and Openness to Experience (Paulhus & Williams, 2002).

**Machiavellianism.** Machiavellian individuals, as measured by the MACH-IV inventory (Christie & Geis, 1970), are characterized by their frequent and extreme use of deception and manipulation (Paulhus & Williams, 2002). They are often perceived as being charming and attractive by their peers (Cherulnik et al., 1981), but individuals scoring high on Machiavellianism convey insincere emotions in order to engage others and manipulate them for their own benefit (Jakobwitz & Egan, 2006). Machiavellianism has been found to correlate negatively with Agreeableness and Conscientiousness in the Big Five model (Paulhus and Williams, 2002).

#### **Mental Toughness: Description and Correlations**

Mental toughness involves being dedicated, motivated, focused, resilient, and having an affinity for challenge (Clough et al., 2001). Consequently, it can be broken down into four components: control, commitment, challenge, and confidence. Control can be further divided into two subcategories: control over life, reflecting a belief that one is in control of one's own destiny and experiences; and emotional control, defined by one's ability to remain calm and relaxed under pressure. Commitment involves being mentally and physically committed to the tasks and challenges being undertaken. Challenge is defined by the ability to be welcoming of and adept at dealing with obstacles and life changes. Lastly, confidence can further be broken down into confidence in abilities, reflecting overall self-efficacy, and interpersonal confidence as defined by a sociable and outgoing demeanor.

Mental toughness is significantly and positively correlated with the Big Five dimensions of Extraversion, Openness to Experience, Agreeableness, and Conscientiousness and significantly negatively correlated with Neuroticism

(Horsburgh et al., 2009). The one exception to the pattern of positive correlations with Agreeableness is its significant negative correlation with the interpersonal confidence factor of mental toughness.

#### **Mental Toughness and the Dark Triad Traits**

The Dark Triad traits and mental toughness have been linked in various ways to achieving goals and personal success in competitive situations, given their links to confidence, motivated actions, and a strong belief in oneself and one's own ability. Roberts and Robins (2000) reported that aspects of subclinical narcissism, such as goal-striving, charisma, and high aspirations, can yield positive work outcomes. Feist (1993), in a study of eminent figures in the sciences, also found that narcissistic tendencies, when combined with additional skills and traits, could be quite adaptive in certain work contexts. A significant positive correlation has been noted between Machiavellianism and income in educated men, suggesting that the trait may play a role in the attainment of high work positions (Turner & Martinez, 1977). Furthermore, in studies of sales organizations, those scoring high on Machiavellianism tended to be most successful in unstructured environments in which they were able to manipulate others freely (Schultz, 1993). Lastly, those scoring high on subclinical psychopathy have been shown to be impulsive, and to feel little emotion or anxiety (Cooke & Michie, 2001). It is possible that these risk-taking tendencies can prove beneficial in competitive work environments that favor quick decision-making. Furthermore, the distorted, positive self-perceptions that stem from the low anxiety and exaggerated sense of control defining psychopathy may be adaptive in situations of high stress, such as those that arise in high-demand work environments (Taylor & Armor, 1996). Many of these features of the Dark Triad traits are echoed in the factors comprising mental toughness, suggesting that the two sets of traits may be more related than one might initially believe.

Both the Dark Triad cluster and mental toughness further share common personality trait correlates. Mental toughness and all of its defining factors are significantly and negatively related to the Big Five model's Neuroticism dimension (Horsburgh et al., 2009), as is psychopathy (e.g., Jakobwitz & Egan, 2006; Paulhus & Williams, 2002). High scores on mental toughness, narcissism, and psychopathy are further correlated with high levels of Extraversion and Openness to Experience (Horsburgh et al., 2009; Paulhus & Williams, 2002). Extraversion and Openness to Experience, in turn, are often associated with popularity and social success (van der Linden et al., 2010; Watson & Clark, 1997), supporting the notion that both mental toughness and the Dark Triad cluster may be adaptive in terms of reaching life goals. Furthermore, Machiavellianism is negatively correlated with the Big Five's Agreeableness, as is the interpersonal confidence facet of mental toughness (Horsburgh et al., 2009; Paulhus & Williams, 2002). Based on these findings, it seems

plausible that mental toughness and the three Dark Triad traits may themselves be positively related.

### Behavioral Genetic Analyses of the Dark Triad Traits and Mental Toughness

Comparing the responses of monozygotic (MZ) and same-sex dizygotic (DZ) twins on a given trait makes it possible to determine the extent to which genetics play a role in the etiology of the trait (Rijsdijk & Sham, 2002). Assuming equal environments among identical and fraternal twins, the only way in which they differ is via their genes, given that MZ twins share 100% of their genotype, whereas DZ share only about 50% of their genes (Rijsdijk & Sham, 2002). Thus, if genetics play a large role in the development of a given trait, MZ twins should provide more similar responses regarding that trait than should DZ twins.

Previous univariate behavioral genetic studies of the Dark Triad traits have shown that individual differences in each of these variables are largely influenced by genetic factors (Vernon et al., 2008; Veselka et al., 2011). In a direct univariate behavioral genetic investigation of mental toughness, Horsburgh et al. (2009) concluded that individual differences in mental toughness were largely attributable to both genetic and non-shared environmental factors. The existence of underlying genetic components has also been demonstrated for specific constructs such as behavioral and cognitive resilience and task persistence, which are related to mental toughness (Deater-Deckard et al., 2006).

### Present Study

The present investigation serves to determine whether significant relations exist between the Dark Triad traits and mental toughness factors (Clough et al., 2001). We are also interested in determining why relations between these traits may exist, by assessing the extent to which these associations are attributable to common genetic and/or common environmental factors. A bivariate behavioral genetic analysis will be employed to address this.

We predict that significant positive associations will emerge between each of the Dark Triad traits and mental toughness at the global and factor levels. Furthermore, given that primarily genetic and non-shared environmental factors underscore individual differences in each of the variables of interest at the univariate level, it is further hypothesized that these correlations will largely be attributable to genetic and non-shared environmental factors at the bivariate level.

## Method

### Participants

Participants in the present study were 210 same-sex twin pairs, which yielded a sample of 420 individual participants. Of these pairs, 152 were MZ — 128 female pairs and 24 male pairs. A total of 58 same-sex DZ pairs were also

included in the sample — 53 female pairs (DZF) and five male pairs (DZM). Participants were from Canada and the United States, and ranged in age from 17 to 92 years ( $M = 41.42$ ,  $SD = 17.54$ ). Participants completed the necessary questionnaires individually. As compensation for participation, participants received \$20.00 and were entered into a draw to win one of ten \$100.00 prizes.

### Materials

**Narcissistic Personality Inventory (NPI).** Variation in subclinical narcissism was measured via the 40-item NPI (Raskin & Hall, 1979). According to a factor analysis by Emmons (1984), the measure's items load on four distinct factors: exploitativeness/entitlement, leadership/authority, superiority/arrogance, and self-absorption/self-admiration. Higher scores on the NPI, therefore, are representative of a greater tendency to engage in behaviors and possess traits characteristic of these factors. Each of the items comprising the questionnaire consists of two conflicting, self-reflective statements. Participants are asked to select the one statement of the pair that best reflects their own beliefs and feelings. The NPI shows strong psychometric properties and is thus considered an accurate measure of subclinical narcissism (e.g., Emmons, 1984; Paulhus & Williams, 2002; Raskin & Terry, 1988).

**Self-Report Psychopathy Scale (SRP-III).** Individual differences in subclinical psychopathy were measured via the 62-item Self-Report Psychopathy Scale (SRP-III; Hare, 1985). The items comprising the measure can be divided into four subscales: interpersonal manipulation, callous affect, erratic lifestyle, and antisocial behavior (Wheeler et al., 2009). Each item presents a self-reflective statement to participants, to which they respond using a five-point Likert scale (where 1 = *disagree strongly* and 5 = *agree strongly*). As a result, higher scores on the SRP-III represent higher levels of subclinical psychopathy, as defined by its four subscales. Investigations of the psychometric properties of the SRP-III indicate that it is a reliable and valid measure of subclinical psychopathy (e.g., Derefinco & Lynam, 2006; Mahmut et al., 2011; Nathanson et al., 2006).

**MACH-IV.** The 20-item MACH-IV (Christie & Geis, 1970) was used to measure individual differences in subclinical Machiavellianism. Four subscales comprise this particular measure: cynical view of human nature, positive view of human nature, negative interpersonal tactics primarily defined by manipulateness, and positive interpersonal tactics chiefly identifiable through honesty (Andrew et al., 2008). Each item of the MACH-IV presents a self-reflective statement to participants. Participants respond to each of these statements via a five-point Likert scale (where 1 = *disagree strongly* and 5 = *agree strongly*). Consequently, higher scores on the MACH-IV indicate greater Machiavellian tendencies in an individual on both a global level and

as defined by its subscales. The MACH-IV has been shown to be a sound measure of Machiavellianism (e.g., Kline & Cooper, 1983; Wrightsman, 1991; Zook, 1985).

**MT48.** The MT48 (Clough et al., 2001) is a 48-item scale, which measures individual differences in mental toughness by assessing an individual's ability to withstand mental and emotional pressure in a variety of situations. Clough et al. (2001) determined that the scale's items load onto the four distinct factors of challenge, control (control over life, emotional control), commitment, and confidence (confidence in abilities, interpersonal confidence). In the scope of the present study, the subfactors pertaining to control and confidence were not assessed. To complete this measure, participants respond to items via a five-point Likert scale (where 1 = *strongly agree* and 5 = *strongly disagree*). Higher scores on the MT48 represent higher levels of mental toughness as defined by the factors. The MT48 has been shown to be a valid scale for the measure of the mental toughness construct (e.g., Clough et al., 2001; Crust, 2008).

### Procedure

Potential participants were contacted via telephone and e-mail. Individuals who expressed interest were sent a package via standard mail, which contained the MACH-IV, the NPI, the SRP-III, the MT48, a letter of information, a consent form, and a self-addressed stamped envelope. Participants who wished to take part in the study were asked to read and sign the consent form and to send it, along with the completed questionnaires, back to the researchers using the provided self-addressed envelope. Participants were then sent a debriefing form providing further details about the present study, along with their compensation. Over 90% of the twins who were originally contacted agreed to participate and submitted their completed questionnaires.

### Analyses

Even though the majority of participants completed all of the items on the four measures used in the present study, on rare occasions an item was left blank. In such instances, the missing data were replaced with the average of the Likert scale used. For the purpose of analysis, the items on the MT48 were converted into four scores, one for each of the major mental toughness dimensions. The remaining questionnaires each yielded one general score, corresponding to each of the Dark Triad variables.

To determine the extent to which correlated genetic and/or correlated environmental factors play a role in the co-occurrence of the Dark Triad traits and mental toughness factors, a multivariate behavioral genetic analysis was conducted using Mx, a software program (Neale et al., 2006). In these analyses, MZ and DZ cross-correlations were computed, and the method of Cholesky or triangular decomposition was applied (Neale & Cardon, 1992). A full ACE model was first fit to the data to assess the significance of

**TABLE 1**  
Mean (M) and Standard Deviation (SD) for the NPI, SRP-III, MACH-IV, and MT48

Variables	M	SD
Dark Triad		
Narcissism <sup>a</sup>	0.38	0.18
Psychopathy <sup>b</sup>	2.14	0.41
Machiavellianism <sup>c</sup>	2.54	0.38
Mental toughness <sup>d</sup>		
Challenge	3.70	0.53
Commitment	3.84	0.49
Control	3.39	0.45
Confidence	3.75	0.53

Note: <sup>a</sup>Measured by the NPI; <sup>b</sup>Measured by the SRP-III; <sup>c</sup>Measured by the MACH-IV; <sup>d</sup>Measured by the MT48.

genetic (A), common environmental (C), and/or non-shared environment (E) effects. Following this step, reduced AE and CE models were further tested in order to explore more parsimonious solutions. The best-fitting models were those that yielded the lowest AIC value and the lowest  $\chi^2$  change relative to the full model.

## Results

Descriptive statistics for the three Dark Triad traits are presented in Table 1. Descriptive statistics are also provided for the four factors of mental toughness in the same table.

### Phenotypic Correlations

A correlational analysis of participants' scores on the NPI, MACH-IV, SRP-III, and the four major dimensions of the MT48 was conducted to investigate the magnitude of any possible relations between the Dark Triad and mental toughness variables. As can be seen in Table 2, all factors of mental toughness were positively and significantly correlated with narcissism, while being negatively and significantly correlated with psychopathy, with the exception of the association between psychopathy and the challenge factors of mental toughness, which was non-significant. Correlations were more diverse for Machiavellianism, which was significantly and positively associated with commitment and control, but significantly and negatively associated with challenge and confidence. These significant effects were primarily moderate in effect sizes, and the strongest of these were the associations involving Machiavellianism.

### Behavioral Genetic Analysis

The results of the bivariate BG analyses (see Table 2) show that the associations between narcissism and the mental toughness factors are largely influenced by non-shared environmental factors. Common non-shared environmental factors accounted for the significant correlation between narcissism and three of the four factors of mental toughness (commitment, control, and confidence). Results indicate that the correlation between narcissism and the fourth

**TABLE 2**  
Phenotypic (*rp*), Genetic (*rg*), Shared Environmental (*rc*), and Non-Shared Environmental (*re*) Correlations Between the Dark Triad Traits and the Mental Toughness Factors

Mental toughness factors	Dark Triad variables		
	Narcissism	Psychopathy	Machiavellianism
Challenge	<i>rp</i> = 0.18** <i>rg</i> = 0.23 (0.01 to 0.43) <i>rc</i> = – <i>re</i> = 0.12 (-0.03 to 0.27)	<i>rp</i> = -0.05 <i>rg</i> = -0.14 (-0.37 to 0.09) <i>rc</i> = – <i>re</i> = 0.03 (-0.12 to 0.18)	<i>rp</i> = -0.24** <i>rg</i> = -0.34 (-0.10 to -0.56) <i>rc</i> = – <i>re</i> = -0.22 (-0.07 to -0.36)
Commitment	<i>rp</i> = 0.23** <i>rg</i> = – <i>rc</i> = 0.17 (-0.08 to 0.40) <i>re</i> = 0.29 (0.16 to 0.41)	<i>rp</i> = -0.23** <i>rg</i> = -0.38 (-0.14 to -0.61) <i>rc</i> = – <i>re</i> = -0.14 (-0.28 to 0.01)	<i>rp</i> = 0.30** <i>rg</i> = -0.42 (-0.16 to -0.65) <i>rc</i> = – <i>re</i> = -0.26 (-0.12 to -0.40)
Control	<i>rp</i> = 0.13** <i>rg</i> = 0.15 (-0.06 to 0.34) <i>rc</i> = – <i>re</i> = 0.22 (0.07 to 0.36)	<i>rp</i> = -0.18** <i>rg</i> = -0.26 (-0.04 to -0.47) <i>rc</i> = – <i>re</i> = -0.07 (-0.22 to 0.08)	<i>rp</i> = 0.28** <i>rg</i> = -0.49 (-0.26 to -0.69) <i>rc</i> = – <i>re</i> = -0.16 (-0.01 to -0.31)
Confidence	<i>rp</i> = 0.21** <i>rg</i> = 0.21 (-0.01 to 0.41) <i>rc</i> = – <i>re</i> = 0.31 (0.17 to 0.45)	<i>rp</i> = -0.20** <i>rg</i> = -0.36 (-0.13 to -0.56) <i>rc</i> = – <i>re</i> = -0.05 (-0.20 to 0.10)	<i>rp</i> = -0.26** <i>rg</i> = -0.36 (-0.12 to -0.58) <i>rc</i> = – <i>re</i> = -0.18 (-0.03 to -0.32)

Note: Numbers appearing in brackets represent the 95% confidence interval values. All correlations whose confidence intervals do not include zero are deemed to be significant at the 0.05 level. The best fitting model is presented.

\*\**p* < .01 (two-tailed).

factor of mental toughness, challenge, was best explained by correlated genetic factors only. The three significant phenotypic associations between psychopathy and mental toughness were shown to be entirely attributable to common genetic factors, all of moderate effect size. Lastly, the four significant observed correlations between Machiavellianism and mental toughness were entirely accounted for by correlated genetic and correlated non-shared environmental factors. In all cases, the significant genetic correlations were larger than the corresponding non-shared environmental effects.

## Discussion

To explore the nature of the Dark Triad, mental toughness, and any potential interaction between them, correlational analyses were employed. We also conducted a behavioral genetic analysis to reveal the extent to which any phenotypic correlations could be attributed to common genetic and/or common environmental factors. Along with some predicted findings, a number of unexpected, yet significant relations were found between the Dark Triad traits and the factors of mental toughness.

### Phenotypic Correlations

As predicted, narcissism correlated positively with all factors of mental toughness. However, contrary to our hypotheses, both psychopathy and Machiavellianism showed moderate to strong negative correlations with most of the mental toughness factors. One interpretation of this finding is that narcissism is qualitatively unique among the Dark Triad cluster in that it is associated with prosocial and adaptive tendencies as well as socially aversive behaviors (e.g., Veselka

et al., 2012). Petrides et al. (2011) have reported that narcissism behaves appreciably differently from the other Dark Triad variables when examined in the context of trait emotional intelligence (trait EI). While psychopathy and Machiavellianism correlate negatively with many factors of trait EI, suggesting a deficiency in understanding and processing emotion-related information, narcissism exhibits positive associations with EI. To account for these findings, Petrides et al. suggested that the exaggerated sense of self-worth and pride associated with narcissism can render a narcissist optimistic, motivated, assertive, and successful in relationships.

An alternative explanation for the differences in the nature of the correlations found between mental toughness and the Dark Triad are potential errors in the way we understand and measure the Dark Triad traits. Previous research highlights the complex nature of the personality cluster and the potential problems faced when trying to measure it. McDonald et al. (2012) have suggested that the questionnaires most often used to measure narcissism do not capture a unitary construct. For example, the NPI, employed in the current investigation appears to assess multiple, conflicting constructs of narcissism, which can be socially desirable (leadership skills, and social influence) or socially toxic (entitlement and exploitativeness). As a result, a single coherent construct may be difficult to investigate with this inventory. The validity of the NPI is further criticized for similar reasons by Brown et al. (2009), who conclude that many of the tendencies measured by the NPI are more representative of healthy self-esteem, which is considered a prosocial trait, than of antisocial narcissism. Items designed to measure the more antisocial dimensions of narcissism are underrepresented in the NPI. Consequently, scores obtained using the NPI may be biased toward assessing only the more adaptive

qualities of narcissism, therefore yielding results suggesting that it is indeed linked to positive outcomes, even though that may not necessarily be the case. It is possible that the positive correlations between narcissism and mental toughness — considered a prosocial trait — may be a product of such biasing.

While the common correlates of the Big Five model's Extraversion and Openness dimensions hinted at a potential positive relation between psychopathy and mental toughness, it seems that differences between these variables far outweigh their similarities. Psychopathy, a generally antisocial trait, comprises impulsivity, irresponsibility, and socially deviant behaviors (Levenson et al., 1995). In contrast, mental toughness is characterized by the ability to stay calm and responsible in stressful situations, as well as the ability to remain committed to a goal (Clough et al., 2001). Although it appears to be the case that psychopathy can yield some positive outcomes in high-demand, competitive settings (Taylor & Armor, 1996), it may ultimately be the case that these outcomes stem from more conniving practices rather than from overall resilience in the face of pressure (Jonason et al., 2012).

The predicted positive correlations between Machiavellianism and the mental toughness dimensions were only partially established. In particular, positive associations were noted between Machiavellianism and the factors of commitment and control. These associations make sense on a conceptual level, and are in line with past research on Machiavellianism in organizational and workplace settings. Specifically, control is defined by a sense of power over one's own experiences and emotions, while commitment is characterized by dedication to the goals and tasks at hand (Clough et al., 2001). In the case of Machiavellianism, those who score high on the trait also tend to exhibit high self-related work commitment where the focus is on the achievement of one's own goals (Zettler et al., 2011), a high need for control in the workplace (Rayburn & Rayburn, 1996), and a propensity toward manipulation, which can further be seen as an effort on the part of the Machiavellian individual to exert control over one's own outcomes (e.g., Kessler et al., 2010). Contrary to our predictions, however, Machiavellianism correlated negatively with challenge and confidence. From a theoretical perspective, these findings seem unusual, given the self-importance and general hardiness and adaptability attributed to those who score high on Machiavellianism (e.g., Den Hartog & Belschak, 2012). That being said, past studies of personality have found inverse patterns of correlations for the two sets of constructs, suggesting that the two mental toughness dimensions and Machiavellianism may indeed be negatively related (e.g., Horsburgh et al., 2009; Jakobwitz & Egan, 2006). Overall then, it seems to be the case that Machiavellian individuals exhibit confidence and task-orientation in a complex manner, and future investigations may wish to tease apart this intricate association.

### Behavioral Genetic Analysis

Predictions regarding the behavioral genetic analysis of relations between mental toughness and the Dark Triad were partially supported by the results. As predicted, based on previous behavioral genetic studies of personality traits (Blonigen et al., 2006; Horsburgh et al., 2009; Vernon et al., 2008), phenotypic correlations between mental toughness and the Dark Triad traits of psychopathy and Machiavellianism showed some underlying genetic effects. The associations between psychopathy and mental toughness were entirely accounted for by common genetic factors. These findings support previous investigations of both psychopathy and mental toughness at the univariate level, which have implicated genetic effects in individual differences in these traits (e.g., Horsburgh et al., 2009; Vernon et al., 2008). Genetic correlations imply the existence of biological structures that contribute to the co-occurrence of these traits, and it may be fruitful to investigate these structures in subsequent work.

The observed associations between mental toughness and Machiavellianism were attributable not only to common genetic factors but also to common non-shared environmental factors, indicating that experiences and social interactions outside of the family likely play a role in the co-development of Machiavellianism and low mental toughness. In support of genetic underpinnings, the evolutionary game theory proposed by Wilson et al. (1996) is relevant. According to this theory, social strategies — that is, stable patterns of interacting with others — are not adopted consciously by rational choice, but rather they compete in a Darwinian fashion for manifestation and prevalence. Because unique strategies are believed to facilitate adaptation, they are thought to be naturally selected for and therefore passed along from parent to offspring. In the case of Machiavellianism, the corresponding social strategy is one that involves manipulation of others to maximize short-term gains. In line with this theory, it has been noted that individuals high on Machiavellianism tend to exhibit an exploitative and self-serving social strategy (Jonason et al., 2010), and report using short-term and emotionally distant mating styles (Jonason & Kavanagh, 2010). Because Machiavellian individuals strive to employ the right behavior in the right situation in order to reap maximum benefits, however, they may also be cooperative and convivial if it is advantageous (Wilson et al., 1996). Consequently, they may share aspects of the social strategy employed by individuals high on mental toughness — one defined by sociability, loyalty, and self-assurance — in addition to exhibiting tendencies that lie in contrast to these prosocial inclinations. This may account for the complex phenotypic correlations and corresponding common genetic underpinnings observed in the current study.

It was expected based on previous research (Horsburgh et al., 2009; Vernon et al., 2008) that an analysis of the correlation between narcissism and mental toughness

would reveal a strong underlying genetic component. However, a significant genetic correlation was only found between narcissism and the challenge factor of mental toughness. All remaining associations were attributable to common non-shared environmental factors. This finding is contrary to various behavioral genetic research studies on personality traits that suggest that while common non-shared environmental effects often contribute to variations in traits, genetic factors also play an important part (Livesley et al., 1993; Vernon et al., 2008). This finding may be the result of the potential mismeasure of narcissism using the NPI, as discussed earlier, which may have yielded misleading findings in the current sample. More likely, however, it may be the case that, when assessing the joint manifestation of narcissism and mental toughness, rather than addressing each set of variables separately, non-shared environmental effects may indeed play a role in the extent to which these traits are exhibited. Washburn and Paskar (2011) describe an ecological systems theory encompassing four distinct interpersonal systems thought to influence narcissism (the microsystem, the mesosystem, the exosystem, and the macrosystem), which highlights the many levels at which environmental factors can be influential to the trait. By extension, these same factors may also contribute to higher levels of mental toughness. Similarly, in samples of athletes, studies have shown that mental toughness is shaped by individuals' training and support networks (i.e., teammates and coaches) and the motivational climate in which they find themselves (e.g., Bull et al., 2005; Thelwell et al., 2010), suggesting numerous levels of social influence on this trait as well. Consequently, it may be the case that, while specific predispositions account for the independent display of narcissism and mental toughness, the extent to which they are jointly exhibited and balanced against one another is primarily determined by the unique environments that individuals seek out.

The present study is not without limitations. Although we employed conventional measures of the constructs of interests in our investigation, recent research suggests that these measures may not be effective in capturing adequately the full complexity of the constructs. Of particular concern may be the NPI, as used to assess narcissism. Although there is support for use of this measure (e.g., Emmons, 1984; Paulhus & Williams, 2002; Raskin & Terry, 1988), there also exist compelling criticisms (Brown et al., 2009). Future investigations may wish to replicate the current findings using alternative inventories. A further limitation is the present study's reliance on self-report responding, particularly in the context of the assessment of antisocial traits. Although studies have found that even in investigations of pathological socially aversive variables, social desirability bias does significantly impact upon the results (e.g., Mills et al., 2003); subsequent studies may wish to apply other methods to their data collection. Lastly, the sample employed in the current study was composed primarily of female partici-

pants, and therefore the findings may not be generalizable to all individuals. Specifically, because it has been shown that males more strongly exhibit Dark Triad tendencies, scoring higher on all three traits relative to females (e.g., Paulhus & Williams, 2002), it is possible that some of the effects presented in the present report are more muted than may actually be the case. Subsequent studies may wish to replicate the current findings with a more balanced sample.

By exploring the nature of the Dark Triad and its interaction with more prosocial traits, such as mental toughness, we begin to better understand both the adaptive and maladaptive qualities associated with the Dark Triad. It may be beneficial in the future to further examine the nature of the individual traits of the Dark Triad, in order to fully understand these constructs and to fine-tune the way in which we measure them. With a better understanding of the traits, it may become easier to minimize the negative effects and increase the positive impact that individuals exhibiting higher levels of these behaviors have on themselves and others.

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