



Physiological tests of the cheater hypothesis for the Dark Triad traits: Testosterone, cortisol, and a social stressor[☆]



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ABSTRACT

In order to test the cheater hypothesis in relation to the Dark Triad traits (i.e., psychopathy, narcissism, and Machiavellianism), we conducted ($N = 25$ men) a pre- and post-test assessment of testosterone and cortisol with a social evaluative stress (i.e., lying while being video-taped) in between. Machiavellianism was positively correlated with pre-test testosterone, while psychopathy and Machiavellianism were positively correlated with pre-test cortisol. Cortisol decreased in men who were higher in Machiavellianism immediately after completing the lie-task and the patterns for narcissism and psychopathy were in the same direction, suggesting that these individuals were less stressed after the two truths and a lie task. Testosterone increased in those high in psychopathy and narcissism post-task, possibly reflecting, at least among narcissists, their enjoyment of the challenge to deceive others. Results provide physiological support to the hypothesis of the Dark Triad traits represent a “cheater strategy”.

In the last decade, the Dark Triad traits (i.e., narcissism, psychopathy, and Machiavellianism; Paulhus & Williams, 2002) have become an area of personality research of intense interest (Furnham, Richards, & Paulhus, 2013). Psychopathy is characterized by callous affect, interpersonal manipulation, erratic lifestyle, and antisocial behaviors (Williams, Paulhus, & Hare, 2007), whereas Machiavellianism is characterized by manipulation and a calculative style (Christie & Geis, 1970), and narcissism is characterized by grandiosity, self-entitlement, and perceptions/actions related to self-gain (Raskin & Hall, 1979). Recently, these traits have been successfully integrated into an evolutionary paradigm (Jonason, Koenig, & Tost, 2010; Jonason, Li, Webster, & Schmitt, 2009; McDonald, Donnellan, & Navarrete, 2012). From this perspective, the traits have been labeled as representing a “cheater strategy” (Jonason & Webster, 2012; Mealey, 1995). Tests of this hypothesis have come in the form of, for example, linking the traits to lying (Baughman, Jonason, Lyons, & Vernon, 2014), crime (Lee et al., 2013), tactics of social influence (Jonason & Webster, 2012), short term mating (Jonason et al., 2009), and mate-poaching (Sunderani, Arnocky, & Vaillancourt, 2013). However, two limitations of this work are that it tends to be self-report in nature and does not provide a particularly strong test of their purported cheater functions. One way to test the cheater hypothesis would be to have participants engage in a context-specific social stressor (e.g., trying to deceive others) and

measure their physiological—in this case hormonal—responses to the task. If these traits are adaptations that facilitate the exploitation of others, engaging in behavior that matches their “design” function should result in hormonal feedback similar to winning a social challenge and/or lacking stress reactivity (i.e., increased testosterone and diminished cortisol).

From an evolutionary perspective, these traits may represent a pseudopathology (Crawford & Anderson, 1989), whereby they cost the group but benefit the individual and tend to be labeled as “pathologies” or “undesirable” because of the externalities they impose on others (Ellis, Del Giudice, & Shirtcliff, 2016). In the evolutionary sense, these traits would be adaptive so long as they promote survival and reproduction and in as much as deception might facilitate such ends (Jonason et al., 2009), variability in the Dark Triad traits might represent adaptive individual differences. A common misconception is that if something is evolved or adapted it is fixed. This is an unfortunate misunderstanding of evolutionary models of personality. Instead, we would argue that traits like the Dark Triad are facultative or condition-dependent adaptations that bias the way individuals respond to and process information from their environments. For example, for most people, being asked to lie on film will induce a stress response (O’Leary, Loney, & Eckel, 2007; ten Brinke, Lee, & Carney, 2015). However, if one is already predisposed towards lying and that predisposition is

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adaptive, setting the person up for success at that very thing, we might expect an active coping response (Salvador, 2012) reflected in heightened testosterone (Dabbs, Jurkovic, & Frady, 1991; Pompa et al., 2007; ten Brinke et al., 2015) and diminished stress after one lies (i.e., lower levels of cortisol). That is, in combination, these two hormonal responses should be instrumental, hormonal responses to evaluative social stressors resulting from feelings of more control (Dickerson & Kemeny, 2004), less fear (Hermans et al., 2007; Hermans, Putnam, Baas, Koppeschaar, & van Honk, 2006; Hermans, Ramsey, & van Honk, 2008) and higher tolerance for risk (Apicella, Dreber, & Mollerstrom, 2014; Coates & Herbert, 2008) that function behind the scenes to better enable those high on the Dark Triad traits to continue to exploit others.

While testosterone and cortisol have been linked to many aspects related to the Dark Triad traits (i.e. empathy, fear reactivity, and instrumental aggression; see Yildirim and Derksen (2012) for review of testosterone and psychopathy), research on these endogenous steroid hormones (see Salvador, 2012) and direct measures of the Dark Triad traits in non-clinical populations is inconsistent. This may be partially caused by sampling method (e.g., measurement of baseline/basal v. stress induced) or population sampled (e.g., non-clinical v. deviant). Some non-clinical studies have found a positive relationship between psychopathy and baseline testosterone/cortisol (Welker, Lozoya, Campbell, Neumann, & Carre, 2014), and a ratio of baseline testosterone to cortisol reactivity (Denson, Mehta, & Ho Tan, 2013; Glenn, Raine, Schug, Gao, & Granger, 2011), where others have shown no zero-order correlations between psychopathy and baseline levels of either hormone (O'Leary et al., 2007; Pfattheicher, 2016; Sunderani et al., 2013). When exposed to social evaluative stressors (e.g., giving a speech or social rejection), men who were low in psychopathic traits tend to show a normal stress response (i.e., increases in cortisol) whereas those who were higher in psychopathic traits lacked this response (O'Leary et al., 2007; O'Leary, Taylor, & Eckel, 2010). Positive relationships between narcissism and baseline cortisol and testosterone were reported in at least two studies (Pfattheicher, 2016; Reinhard, Konrath, Lopez, & Cameron, 2012), although in other studies no correlations with baseline cortisol (Edelstein, Yim, & Quas, 2010; Wardecker, Chopik, LaBelle, & Edelstein, 2016) or testosterone (Lobbstael, Baumeister, Fiebig, & Eckel, 2014) are found. The picture with hormone reactivity is a bit different. Men who scored high on narcissism showed increased cortisol reactivity after a social evaluative stressor (i.e., giving a speech; Edelstein et al., 2010), however the stress response to this evaluation was paralleled by an increase in negative affect for men high in narcissism (which may reflect a lack of an active coping response; Salvador, 2012). Grandiose narcissism was positively related to testosterone reactivity after a behavioral aggression task (Lobbstael et al., 2014). Little research exists on Machiavellianism and hormonal response and what does, shows no evidence of relationships between basal cortisol/testosterone and this trait (Pfattheicher, 2016).

In the present study, we further examine the relationship between all three of the Dark Triad traits and steroid hormones with a social stressor (i.e., lying on video) from an evolutionary paradigm to test the cheater hypothesis. From this perspective, we predicted: (a) positive relationships between the Dark Triad traits and enjoyment of the task, (b) men higher in the Dark Triad traits would show decreases (or no changes) in cortisol and (c) increases in testosterone post-task.

1. Method

1.1. Participants

Participants were 25 male, western Canadian undergraduate college students ($M_{\text{age}} = 23.16$, $SD_{\text{age}} = 6.31$, $\text{Range} = 18\text{--}43$). The participants were 40% Asian, 24% Caucasian, 20% other (majority of Middle

Eastern descent), 4% South Asian, 4% African, 4% Hispanic, and 4% First Nations. Participants received partial (2%) course credit and were also entered into a draw for a CAN\$50 gift card. All procedures were approved by the College Institutional Research Ethics Board.

1.2. Measures

Narcissism was measured using the 40-item Narcissistic Personality Inventory (Raskin & Hall, 1979), which asks participants to choose between two statements such as, "I can usually talk my way out of anything" or "I try to accept the consequences of my behavior". The number of narcissistic endorsed options is summed to create an index of narcissism, resulting in a scale ranging from 0 to 40 (Cronbach's $\alpha = 0.87$).

The 20-item Mach IV (Christie & Geis, 1970), was used to measure Machiavellianism on a Likert-type scale (1 = *Strongly Disagree*; 5 = *Strongly Agree*) and includes questions such as, "The best way to handle people is to tell them what they want to hear". Items were averaged to create a single index of Machiavellianism ($\alpha = 0.64$).

Subclinical psychopathy was measured with the SRP III (Paulhus, Neumann, & Hare, 2009), which includes 64 items measured on a Likert-type scale (1 = *Strongly Disagree*; 5 = *Strongly Agree*) and includes questions such as, "I would get a kick out of scamming someone". Items were averaged to create a single index of psychopathy ($\alpha = 0.85$).

Enjoyment of the task was measured by asking participants how stressful they found playing the two truths and a lie game in comparison to activities they do on an everyday basis ($-3 = \textit{very stressful}$; $0 = \textit{neutral}$; $+3 = \textit{enjoyable}$).

Participants were asked to abstain from exercising, drinking caffeinated drinks, and/or eating for at least 1 h prior to the study. All sessions were scheduled between 10:00 am and 3:00 pm. Saliva was collected by passive drool into a cup and transferred into polystyrene test tubes. Samples were immediately frozen and held at -20°C until they were assayed. Samples were assayed in duplicate using competitive enzyme immunoassays for cortisol and testosterone in Dr. Neil Watson's lab (Salimetrics LLC, State College, PA) by a technician blind to the hypotheses. Cortisol was assayed from saliva at pre-test, immediately post-lie and 20 min following the lie task, whereas testosterone was assayed at pre-test and 20 min post-lie task. The average intra-assay coefficient of variation was 4.43% for cortisol and 3.52% for testosterone, and inter-assay coefficients for low and high testosterone were 1.16% and 15.01% for testosterone and 5.83% and 4.46% for cortisol. Cortisol was positively skewed, therefore, we used log10-transformed cortisol for all analyses, like prior studies (Welker et al., 2014; Zilioli & Watson, 2012).

1.3. Design and procedure

We investigated whether lying, while being videotaped, differentially affected testosterone and cortisol levels in individuals varying in the Dark Triad traits. Participants arrived at the lab one at a time and after giving informed consent, they completed a few demographic and individual difference measures while they provided a baseline sample of 2–3 ml of saliva by passive drool. The participants were then asked to play the game, two truths and a lie. They were asked to think of three "I" statements (i.e., statements beginning with the pronoun "I"), two of which were truthful and one of which was a lie. Participants were given an example of a truthful statement like, "I played basketball in high school and in the last game of the season, with 15 min left to play, the coach sent me in and I scored the winning goal" but asked to generate their own, short true and lie statements. Participants were advised they would be video-recorded and evaluated on how well they lied. They were told that it was important to be an "effective liar" so the person

viewing the recorded statements would not be able to tell which was a lie. Participants were given 2 to 5 min to record their two truths and a lie and reminded at least three times of how important it was to be an “effective liar” and that they would be evaluated on how well they did. Video recordings of the statements were filmed at six feet away, with a Canon® HDM 400 video camera while participants were seated in front of a draped wall. Immediately after recording, participants provided a second sample of 2–3 ml of saliva and rated their enjoyment of the task. Further questionnaires on personality traits were then administered and after 20 min a final 2–3 ml of saliva was obtained. Participants were then debriefed and thanked for their time.

2. Results

We analyzed whether participants felt stressed by the video-taped lying task using a single sample *t*-test (testing against a population value of zero). Participants, on average, rated the lying task as slightly more enjoyable in comparison to everyday activities ($M = 0.72, SD = 1.70$), $t(24) = 2.12, p = 0.04$, Cohen’s $d = 0.42$. Correlational analyses revealed that narcissism ($r(23) = 0.57, p = 0.003$, two-tailed) was positively correlated with enjoyment of the task, however, psychopathy ($r(23) = 0.23, p = 0.27$, two-tailed), and Machiavellianism ($r(23) = -0.13, p = 0.55$, two-tailed), were not, although the latter two associations were in a similar direction.

The time of day that samples were collected was not significantly related to any of the hormone measures, but because there is diurnal variation in testosterone and cortisol we included it as a covariate in our analyses. We present the partial correlations between the Dark Triad traits and pre/post lie hormone levels, controlling for time of day in Table 1. Individuals with higher levels of Machiavellianism had higher baseline testosterone (T) levels, whereas post-lie testosterone was positively related to psychopathy and Machiavellianism. Pre-test cortisol (C) was positively related to psychopathy and Machiavellianism, and to a lesser extent narcissism. All the Dark Triad traits were positively related to cortisol 20 min post-test.

To investigate whether individual differences in the Dark Triad traits moderated changes in hormone levels pre- and post-task, we conducted 2×2 mixed-model ANCOVAs, first with cortisol (log-transformed and centered) as the dependent variable, Pre/Post-test (pre-test and time 2 - immediately after the task) as the repeated factor, and each of the Dark Triad traits (centered, median-split), separately, as the between-subjects factor, with time of sample collection as a covariate. There was no main effect of Machiavellianism, Pre/Post-test or time of sample collection on cortisol levels, but there was an, $F(1, 22) = 5.82, p = 0.03, partial \eta^2 = 0.21$. Cortisol decreased in men high in Machiavellianism, but increased in men low in Machiavellianism (Fig. 1). We found the same pattern for narcissism but the interaction failed to reach significance in our sample, $F(1, 22) = 0.57 p = 0.46, partial \eta^2 = 0.03$. The effect of psychopathy on change in cortisol was different. There was a main effect for psychopathy, $F(1, 22) = 5.67, p = 0.03, partial \eta^2 = 0.21$, but the interaction was not significant

Table 1
Partial correlations between Dark Triad Traits, pre- and post-testosterone/cortisol, controlling for time of day.

	Pre-test T	Post Lie T	Pre-test C	Post lie C Time 2	Post lie C Time 3
Psychopathy	0.12	0.52**	0.43*	0.49*	0.64***
Machiavellianism	0.54**	0.59**	0.42*	0.22	0.38
Narcissism	-0.21	0.21	0.32	0.39	0.44*

T = Testosterone, C = log10 transformed cortisol.

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$, two-tailed.

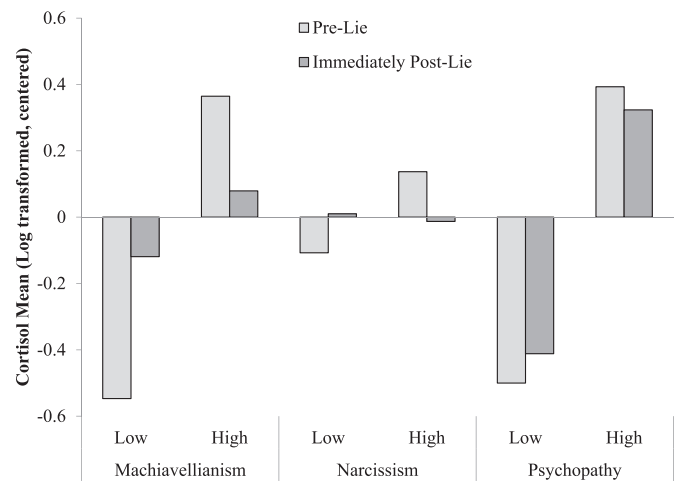


Fig. 1. Moderating effect of individual differences in Dark Triad traits on cortisol pre- and post-lie, controlling for time of day.

although it was in the predicted direction, $F(1, 22) = 0.45 p = 0.51, partial \eta^2 = 0.02$. Men high in psychopathy had higher levels of cortisol than those low in psychopathy both pre- and post-lie (Fig. 1).¹

We conducted the same mixed-model ANCOVAs with testosterone as the dependent variable. Pre/Post, in this case, represented the pre-test and post-test 20 min after the task and the Dark Triad traits were analyzed, in separate tests, as the between-subjects factor with time of saliva collection as a covariate. There was a main effect of Machiavellianism on testosterone, $F(1, 22) = 6.68 p = 0.02, partial \eta^2 = 0.23$, no main effect of Pre/Post-test, $F(1, 22) = 0.03 p = 0.87, partial \eta^2 = 0.00$, or time of day, $F(1, 22) = 0.01 p = 0.92, partial \eta^2 = 0.00$, and no interaction, $F(1, 22) = 0.00 p = 0.99, partial \eta^2 = 0.00$. Men high in Machiavellianism had higher testosterone than those low in the trait at both time points (Fig. 2). There were no main effects of narcissism, $F(1, 22) = 0.001 p = 0.97, partial \eta^2 = 0.00$, or Pre/Post-test on testosterone, $F(1, 22) = 0.07 p = 0.79, partial \eta^2 = 0.00$, but there was an interaction, $F(1, 22) = 5.95 p = 0.02, partial \eta^2 = 0.21$. Men high in narcissism showed an increase in testosterone 20 min after the truth/lie task. The reverse was true for men low in narcissism. There was also no main effect of psychopathy, $F(1, 22) = 0.77 p = 0.40, partial \eta^2 = 0.03$, or pre/post-test on testosterone, $F(1, 22) = 0.18 p = 0.68, partial \eta^2 = 0.01$, but this was qualified by an between the two, $F(1, 22) = 4.83, p = 0.04, partial \eta^2 = 0.18$. At pre-test there were no differences between men high or low in psychopathy, but testosterone increased 20 min after the lie in men high in psychopathy, and decreased in those low in psychopathy.

3. Discussion

To our knowledge, this is the first study to investigate the relationship between all three of the Dark Triad traits and hormonal responses to a social evaluative task, such as trying to convincingly lie. As predicted, men high in the Dark Triad traits showed some decrease in cortisol after the lie task. The decrease in cortisol was significant only for Machiavellianism, but all traits followed a similar pattern. Also, as predicted, increases in testosterone post-task were observed for those high in psychopathy and narcissism (even 20 min after the task), although those high in Machiavellianism showed no change in testosterone. This is consistent with previous work on testosterone reactivity to social stressors (Lobbestael et al., 2014). Levels of testosterone are related to decreased risk sensitivity (Terburg, Morgan, & van Honk, 2009) and fear (Hermans et al., 2006; Hermans et al., 2007; Hermans

¹ Although not included in the present analysis, cortisol levels tended to return to pre-test levels 20 min after the lie task (time 3).

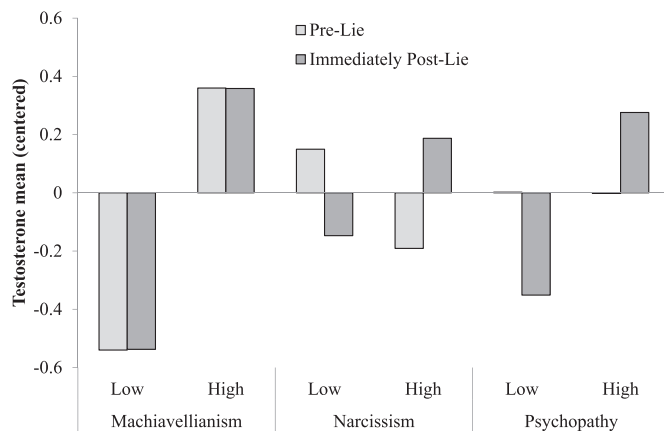


Fig. 2. The effect of individual differences in Dark Triad traits on testosterone pre-and post-lie, controlling for time of day.

et al., 2008) which most people are likely to face when asked to lie on film. Men higher in Machiavellianism in this sample, however, had higher pre-test testosterone levels than those high in narcissism or psychopathy so there may have been a ceiling effect. Men who were lower on the Dark Triad traits showed the opposite patterns (increase in C and decrease in T) with the exception of men low in Machiavellianism who showed little change in testosterone from pre-test to post-lie. To us, this provides additional evidence for the cheater hypothesis in relation to the Dark Triad traits.

Beyond these central findings, we found some auxiliary results worth mentioning. First, we replicated prior work suggesting that psychopathy (Welker et al., 2014) and Machiavellianism (contrary to Pfattheicher, 2016) are positively correlated with pre-test cortisol in a non-clinical sample of men. The positive relationship between psychopathy and cortisol does conflict with previous reports of null (O'Leary et al., 2007) or negative relationships (Holi, Auvinen-Lintunen, Lindberg, Tani, & Virkkunen, 2006), although negative relationships have often been found for samples of deviant, or violent offenders. Second, men higher in narcissism reported enjoying the task, which might explain why our results contradict evidence of an increase in cortisol (along with negative affect) in men high in narcissism when being evaluated giving a speech (Edelstein et al., 2010). Third, men high in Machiavellianism had higher levels of pre-test testosterone than those either high in psychopathy or narcissism (contrary to Pfattheicher, 2016), which may relate to the centrality both testosterone (Archer, 2006) and Machiavellianism play in understanding individual differences in one's need for power (Kajonius, Persson, & Jonason, 2015).

3.1. Limitations and conclusions

Despite the contextual novelty of our study and use of hormonal assays of personality correlates, our study has a few limitations. First, despite the ethnic diversity of our sample, it could still be described as W.E.I.R.D. (i.e., Western, Educated, Industrialized, Rich, and Democratic) in nature. However, given the universality of testosterone and cortisol functionality in people and nonhuman primates (Alvergne, Faurie, & Raymond, 2009; Amir, Ellison, Hill, & Bribiescas, 2015), we do not see this as a major concern. Second, we had a small sample of men that we tested in a within-subjects fashion. This precludes between-sex comparisons and limits the generalizability of our tests. Power protects against false negative results and a focus on effect sizes, in addition to the significant findings presented, provides evidence of our primary hypothesis regarding the adaptive, cheater nature of the Dark Triad traits (Jonason & Webster, 2012; Mealey, 1995). Future work should attempt to replicate and understand the effects reported here in both sexes. We focused on men only because previous research

has found relationships between individual Dark Triad traits and hormonal responses to social stressors to be stronger, or only present, in men (Edelstein et al., 2010; Pfattheicher, 2016; Reinhard et al., 2012) and, the traits serve a stronger adaptive function in men than in women given the high costs women would have incurred over ancestral time for engaging in antisocial and aggressive social/sexual strategies (Jonason et al., 2009). Third, we have not focused on facet-level effects in the Dark Triad traits in the present study as we feel that it is often done in a rather atheoretical, fishing fashion². Finally, our focus was on the task of trying to convincingly lie while being recorded, however, the act of being asked to speak on video could also be considered a general social stressor. Although we do not believe this to be an issue, future research on the Dark Triad traits, hormones, and social stressors could consider comparing typical experimental social stressors to more context dependent ones like lying or competing for a date.

Are the Dark Triad traits a pathology? We would contend that the systematic organization of hormonal elements, individual differences, and responses to situational stressors related to social exploitation suggests otherwise. We argue that the Dark Triad traits are pseudo-pathologies (Crawford & Anderson, 1989) fashioned by natural selection to facilitate the active exploitation of conspecifics for “selfish” ends. There have likely been recurrent ancestral conditions that necessitated the prioritization of one's self over others through behaviors like deception. During these times, those individuals who were best equipped via both psychological and hormonal factors would have fared better relative to others. This type of, hormonally supported, cheater strategy, may have increased the reproductive success of individuals high in the Dark Triad as they may have been able to “take advantage” of individuals in their social group while not “stressing” about the costs of doing so.

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² The reader interested in facet-level result is encouraged to contact the first author.

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