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SEXUAL BEHAVIOUR, AGGRESSION, SOCIAL STATUS, AND HORMONES

A BIOPSYCHOSOCIAL APPROACH TO UNDERSTANDING THE INTERRELATIONSHIPS AMONG SEXUAL BEHAVIOUR, AGGRESSION, SOCIAL STATUS, AND HORMONES

By

SHAFIK SUNDERANI, B.A. (HONOURS)

A Thesis

Submitted to the School of Graduate Studies

in Partial Fulfillment of the Requirements

for the Degree

Doctorate of Philosophy

McMaster University

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DOCTORATE OF PHILOSOPHY (2011) (Psychology, Neuroscience & Behaviour) McMaster University Hamilton, Ontario

TITLE: A BIOPSYCHOSOCIAL APPROACH TO UNDERSTANDING THE INTTERRELATIONSHIPS AMONG SEXUAL BEHAVIOUR, AGGRESSION, SOCIAL STATUS, AND HORMONES.

- AUTHOR: Shafik Sunderani
- SUPERVISOR: Dr. Tracy Vaillancourt
- NUMBER OF PAGES: x, 108

Declaration of Academic Achievement

This dissertation consists of previously prepared material that is currently under review for publication in peer-reviewed scientific journals.

Data presented in each chapter were collected during the Spring of 2009, on McMaster University's campus.

The author of this dissertation is the primary author of each of these articles. As the primary author, contributions included: study and questionnaire design, theoretical formulations of each research project, literature review, collecting and analyzing data, and manuscript preparation.

For Chapter 2, the thesis supervisor is the second author. She offered input and expertise during each phase of the research formulation and manuscript preparation. Eric Duku, the third author, was a consultant on the analyses. The fourth author, Cameron Muir, performed the assays with the assistance of the author of the present thesis and served as a consultant on the hormonal data.

Chapter 3 has been accepted for publication in the journal *Brain and Cognition*. As with Chapter 2, the thesis supervisor is the second author. She offered input and expertise during each phase of the research formulation and manuscript preparation. Note that the thesis supervisor is the first author on the version accepted for scientific publication.

Chapter 4 has also been accepted for publication (provisional) in the journal *Archives of Sexual Behavior*. Steven Arnocky, the second author, aided in various stages of manuscript review including: assisting with analyzing data and manuscript preparation. The third author is the thesis supervisor who again offered input and expertise during each phase of the research formulation and manuscript preparation.

Abstract

Sex differences, hormones and intrasexual competition and their relation to social status and romantic partner attraction were examined, uniting two bodies of literature: statusstriving and romantic attraction. In Chapter 2 different forms of social status, (i.e., dominance, power, popularity, prestige) were examined as they relate to testosterone levels in men and women. Factor analysis revealed that dominance was a separate psychological construct from power, popularity and prestige. Furthermore, a positive association was shown between dominance and testosterone levels whereas lower testosterone levels were associated with the power, popularity and prestige composite. In Chapter 3 psychopathy and indirect aggression were examined in relation to cortisol levels, again in men and women. Results indicated that lower cortisol levels were associated with primary psychopathy and higher cortisol levels were associated with secondary psychopathy, in women only. Results also showed that primary psychopathy but not secondary psychopathy was positively correlated with indirect aggression. In Chapter 4, romantic attraction was examined from an evolutionary perspective to predict the characteristics of people who invade an existing romantic relationship as well as those characteristics that predict people who are targets for defection away from their primary romantic relationship. In men, successful mate poaching was best predicted by high selfesteem, cold affect, and criminal tendencies. These men also showed lower levels of testosterone and higher levels of cortisol. In women, physical attractiveness best predicted success in mate poaching. For both sexes, physical attractiveness also determined the frequency of being a target for a poach. Collectively, these studies provide evidence to support behavioural patterns that are consistent with evolutionary ideas relating to social status acquisition and romantic attraction.

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CHAPTER 1

GENERAL INTRODUCTION

Two classes of fundamental motivations all humans possess are expressed as 1) a "need to get along" and 2) a "need to get ahead" (see Hawley et al., 1999; 2003a,b; 2008). The drive to satisfy both of these needs concurrently is an ongoing struggle. This struggle provides the theoretical framework for contextualizing the material presented in this dissertation. On the one hand, the pursuit of 'getting ahead' has the potential to lead to hostility between individuals— each striving to meet their own goals in a world of finite resources (e.g., food, status, and mates). On the other hand, seeking approval of others and displaying prosocial qualities (e.g., behaviours characteristic of 'getting along') is a viable strategy for fulfilling our need for acceptance and belonging albeit at a cost of stifling our best efforts to procure resources for ourselves. The behavioural patterns often used to 'get ahead' are associated with traits such as dominance, indirect aggression and mate poaching; research topics of primary foci within this dissertation.

The purpose of the present studies is to unravel the interrelations among various aspects of the aforementioned selected features (i.e., social status, psychopathy, indirect aggression, mate poaching). In establishing a unifying theme within the present dissertation I utilize an evolutionary psychological framework with specific reference to jockeying for status and mates to serve as a foundation. Bugental (2000) suggested that all interpersonal relations can be broken into five major domains based on evolutionary pressures: filial attachment, forming social coalitions, reciprocity, hierarchical power, and mating. Bugental further explains that mating is regarded as the cornerstone of

interpersonal dynamics and governs the majority of social behaviour. This notion is supported by Vaillancourt (2005), who suggested both direct and indirect forms of aggressive behaviour as well as social dominance function to provide the individual maximal choice when selecting for a mating partner. For example, Person X can dominate or aggress against Person Y in order to lower his/her rival's 'mate value' in the mating market. Research has shown that both males and females compete within their own sex through either making themselves more appealing (e.g., improve physical appearance) or derogating the competition (e.g., spread rumours about the rival) to attract partners of the opposite sex (e.g., Buss, 1988a,b.; Buss & Dedden, 1990). There is no universal way of conceptualizing social status (e.g., Parkhurst & Hopmeyer, 1998). Social status within a group is associated with a variety of behavioural and nonbehavioural characteristics such as toughness (Pickert & Wall, 1981), coolness (Rodkin, Farmer, Pearl & Van Acker, 2000), bigger physical size, pubertal maturation, athleticism (Savin-Williams, 1979), resource-monopolization (Hawley, 1999), conversational influence and erect posture (Mazur, 1985), stylish dress, physical attractiveness, relatively higher socio-economic status, better academic performance, and exceptional interpersonal skills (Vaillancourt & Hymel, 2006).

Rodkin et al. (2000) found both prosocial and antisocial behavioural patterns can be used to attain social status. Other researchers have argued the most effective strategy to gain high peer regard and social status in a group is the employment of both antisocial and prosocial characteristics concurrently— a term referred to as "bi-strategic control" (see Hawley, 2003; Hawley & Vaughn, 2003). Social status is a well-documented global

assessment of multiple instances of behavioural interaction among infra-human species that are characterized by group living, as typically measured by researchers through observing social dominance encounters (e.g., de Waal, 1982; also see Hawley, 1999, for a review). For example, among non-human primates, those in a dominant position incur greater access to finite resources (e.g. Darwin, 1871; de Waal, 1982; Goodall, 1971, 1986). Specifically in non-human primates, elevated social rank has been associated with an increase in the number of copulations for both males and females (e.g., Cowlishaw & Dunbar, 1991; Dewsbury, 1982; Fedigan, 1983) and an increase in the number of offspring (e.g., Gust & Gordon, 1991; Klinkova et al., 2005; Wilson, 1981).

Among human males, those in positions of power ranging from kings to emperors to tribe leaders have been shown to procure and maintain large harems of females thereby siring hundreds of offspring with their wives, mistresses, and concubines; a trans-historic finding (see Betzig, 1986 for a comprehensive review). This differential distribution of reproductive success among men in preindustrial societies reflected the popular ethos 'to the winner go the spoils'. In modern times, men belonging to the upper-middle class with good financial prospects have been shown to have more sexual partners (Perusse, 1993). Within adolescent peer culture, high school football stars enjoy greater levels of social status compared to their not-so-athletically gifted counterparts (e.g., Melnick, Sabo & Vanfossen, 1992) and as a result, are highly sought after by their female schoolmates (e.g., Milner, 2004). The advantages gained by high status men are not limited to the quantity of women procured but also include the quality of women that can be obtained by these men. Studies show high status men are able to attract better looking (Elder,

1969; Taylor & Glenn, 1976; Udry & Eckland, 1984) and younger, more fertile women (Grammer, 1992) than low status men. Moreover, dominant looking men (i.e., rectangular-shaped face, well-defined jaw line, deep-set eyes, strong cheekbones, pronounced chin) report having sex at an earlier age compared to men lacking these dominant facial features (e.g., Mazur, Halpern, & Udry, 1994). In contrast, young college men who score low on a dominance personality measure have been shown to be more likely to report being virgins (Keller, Elliot & Gunberg, 1982).

Ranking high in the social hierarchy for female primates is associated with earlier sexual maturity (e.g., Pusey, Williams & Goodall, 1997), an increased number of copulations (e.g., Drickamer, 1974), and a greater offspring survival rate (e.g., Dunbar, 1980). Ellis's (1995) meta-analysis of 32 studies has shown there to be sizeable reproductive benefits to be gained by high-ranking females. In human females, positive associations have been shown amongst teenage girls, who are regarded as 'popular' by their peers, are more likely to engage in sexual activity and initiate sexual relations at an earlier age (e.g., Kirby, 2002; La Greca, Prinstein, & Fetter, 2001; Prinstein, Meade, & Cohen, 2003). Merten (1997) showed that adolescent females who were nominated by others in their high school as 'popular' (i.e., one form of social status) had more active dating lives. In adult females, it has been suggested that females at the top of the social hierarchy would have a better choice in selecting a romantic/mating partner (e.g., Vaillancourt, 2005). For females, success is not necessarily determined by the sheer quantity of mating partners but also by the quality of the partners they are able to retain.

A primary feature of this dissertation is to underscore the importance of this mating domain in relation to obtaining social status and the sequalae of interpersonal conflict. A related concept to this emanates from Buss and Duntley's (2008) work on exploitation and the myriad of *exploitive resource acquisition strategies*. The adoption of these exploitation strategies is pertinent to 'getting ahead' through tactics of dominating others.

A second feature of this dissertation is the emphasis on a multi-measure approach to understanding complex human phenomena. In all three of the studies, biological data (i.e., testosterone and cortisol) were measured repeatedly. These hormonal data were used in conjunction with self-report data to provide greater support for its results. In addition, each of the results is explained using a broad range of theories encompassed within an evolutionary framework. The use of a multi-measure approach reflects a broader movement in the field towards integration of various sub-disciplines within psychology. Specifically, this dissertation highlights the intersection among evolutionary psychology, social psychology and developmental psychology.

Outline of Empirical Chapters

Darwin (1871) proposed that modern-day humans are a product of two simultaneous processes, namely natural selection pressures and sexual selection pressures. The processes involved in natural selection which propel the organism into action for survival can also aid in sexual selection. For example, in both infra-human and human animals, being higher on levels of trait dominance allow for increased access to food (which satisfies survival needs) and increased access to mates (which satisfy sexual and reproductive needs). Individual differences in personality, physiology, and dispositional traits can be used to secure both a certain quantity and quality of mates.

Summary of Thesis Contributions

The first part of this dissertation advances our understanding of the of the social status and testosterone link. Previous works have neglected the study of females, in part, because historically females have not been considered aggressive or dominant and because of the highly variable nature of their testosterone levels. The studies contained in the present thesis use multiple samples of testosterone as a more reliable measure of a hormone sensitive to fluctuations. The most significant contribution of Chapter 2 is its careful delineation of different forms of social status. This chapter provides evidence to support that indeed there are different types of social status which contain differing physiological correlates and therefore provides support for the separate examination of different forms of social status.

Chapter 3 of this dissertation addresses the relationship between psychopathy and indirect aggression. The increased use of indirect aggression is a behavioural manifestation of an underlying personality construct psychopathy. The unique constellation of traits that comprise psychopathy can be broken down into two subtypes: primary and secondary. Cortisol, a marker of physiological activity, can be used as a biological index to predict the use of indirect aggression (or lack thereof) and may possibly be a sex-specific marker to differentiate between primary and secondary forms of psychopathy.

Chapter 4 of this dissertation advances our understanding of mate poaching (a relatively new topic of study in academia) described as 'the behaviour of romantically attracting someone away from a current relationship' (Schmitt & Buss, 2001, pp. 894-895). To date, no researcher has investigated a wide assortment of predictors into a regression equation in order to determine the characteristics of a 'mate poacher' and the characteristics of someone being targeted for poaching. Dispositional, physical, physiological, and psychological variables were all used to estimate the qualities that characterize the likelihood someone would successfully steal away someone else's romantic partner and/or be a target.

CHAPTER 2

Sunderani, S., Vaillancourt, T., Duku, E., & Muir, C.

Repeated measures of testosterone and social status in men and women

Abstract

Most studies on testosterone and social status have examined context-specific, state testosterone, by measuring changes in hormonal level as a result of an upward shift in job prestige or success in an athletic feat in males. Few have examined repeated measures of testosterone and its association to social status in males and females in the same study. We examined the association between different types of social status and trait testosterone levels (8 measures) amongst 154 university students. Principal components factor analysis revealed a two-factor structure solution with popularity, prestige, and power loading on the same factor and dominance loading on a separate factor. Dominance was *positively* associated with testosterone level for both sexes. Contrary to initial predictions, the composite of prestige, power and popularity was *negatively* associated with testosterone for both males and females. These findings suggest that social status is a variegated construct such that dominance is distinguishable from prestige, power and popularity. Results are discussed using an evolutionary theoretical framework.

Across primates, including humans, interpersonal relations are governed by one's social status (Keltner, Gruenfeld, & Anderson, 2003). Generally, social status refers to an individual's hierarchical position in a given group or society (Frank, 1985). Social status encompasses different but related sub-constructs including but not limited to dominance, prestige, power, and popularity. *Dominance* refers to the use of force or threatened force to achieve authority over others and is the metric by which animal researchers gauge social status (Rowell, 1974). *Prestige* refers to status or reputation that is bestowed upon an individual by others because of skill, talent, and/or a desirable characteristic the individual has earned through their own merit (Henrich & Gil-White, 2001). *Power* is similar to dominance but is used primarily in human studies to refer to the influence one individual has over another (Vaillancourt & Hymel, 2006). Finally, popularity refers to the extent an individual is well-known and visible to others in the peer group (Vaillancourt & Hymel, 2006). Popular individuals are not necessarily well-liked, but they do exert much influence over others in their social and peer group.

Studies examining testosterone in relation to social status have focused primarily on dominance in non-human animals, sporting success, and job prestige. The latter two have been used interchangeably with dominance in many studies (reviewed below). With respect to testosterone and "social status", studies of non-human male primates have shown strong links between higher levels of testosterone and dominance (e.g., Bernstein, Gordon & Rose, 1983). Although these links have been positively associated, the causal direction remains undetermined (Dabbs & Dabbs, 2000; Mazur & Booth, 1998).In humans, the link between testosterone and dominance is less pronounced and less

consistent. Studies have shown that male winners of sporting matches including tennis (Booth, Shelly, Mazur, Tharp & Kittok, 1989), wrestling (Elias, 1981), judo (Suay et al., 1999), and hockey (Carre, Muir, Belanger, & Putnam 2006) had higher levels of testosterone following the victory in comparison to losers. In some cases, these elevated levels of testosterone were sustained in subsequent matches (Mazur & Lamb, 1980). For female athletes, testosterone levels have not been shown to differ between winners and losers in a sample of rugby players (Bateup, Booth, Shirtcliff, & Granger, 2002). Similarly, Mazur, Susman and Edelbrock (1997) found no differences in testosterone levels as a response to winning in a best of five video game ping-pong competition in a sample of females. In another study, Kivlighan, Granger and Booth (2005) investigated females involved in a rowing ergometer competition and found a complex pattern of results emerging based on the level of competence and the phase of the event. Only a handful of studies have examined the link between testosterone and winning in sports competition among females, thus conclusions regarding this association should be applied judiciously.

Increases in testosterone levels are not limited to triumph in sporting competitions. Similar patterns have been observed in other contexts with regards to ascendance in social status. For instance, male medical students showed increases in testosterone level immediately following graduation suggesting shifts in social status can have an impact on hormonal functioning (Mazur & Lamb, 1980). Trial lawyers had higher levels of testosterone than nontrial lawyers, suggesting situations that are adversarial in nature with clearly defined winners and losers lead to elevations in

testosterone (Dabbs, 1998). Kreuz, Rose and Jennings (1972) studied a sample of male military officers in training and found lower levels of testosterone during the initial training period which later returned to baseline levels upon completion of the military officer training program. For females, Gladue (1991) found a negative relation between job prestige and testosterone level. However, Purifoy and Koopmans (1979) found a positive association between job prestige and testosterone level in females. To our knowledge, no study has been published in which other forms of social status apart from dominance, job prestige, and sporting success in females has been investigated.

The majority of studies reviewed above primarily assess testosterone levels that are context-specific, *state* testosterone, by measuring changes in hormonal level as a result of an upward shift in their job prestige or success in an athletic feat. Research using repeated measures of testosterone (testosterone profile over time) and its association to social status in males have shown similar results to those examining *state* testosterone. Using multiple samples of testosterone, Christiansen and Knussman (1987) evaluated its link to trait dominance in a group of young adults and found a positive association. Johnson, Burk, and Kirkpatrick (2007) found that in adult males, higher testosterone levels (measured with one sample) predicted dominance but not prestige.

The few studies that have investigated female participants have shown a variety of inconsistencies. Inoff-Germain and colleagues (1988) observed patterns of dominance among female adolescents by watching how they interacted with family members and found that females with higher testosterone levels engaged in more dominating-like behaviour. In another study, using incarcerated females, Dabbs and Hargrove (1997)

found that aggressive dominance within the prison facility was associated with higher levels of testosterone. In contrast, Cashdan (1995) examined female dominance behaviour in small groups, asking participants to interact with each other in a laboratory setting which was surveillanced by a research team via video camera and then subsequently analyzed for non-verbal dominance behaviour (i.e., open arms, open legs, lean back, smiling). Findings showed an inconsistent picture such that androgen levels were unrelated to non-verbal dominance cues with the exception of less smiling. Rejeski, Parker, Gagne and Koritnik (1990) examined females interacting in small groups and had the experimenter contest some of the participants' arguments to determine if the participant had a dominant interpersonal style and would contest with the experimenters' challenges. There were no differences in testosterone level between dominant and nondominant females. Taken together, these findings suggest a positive relation between social status and testosterone in human males. Less conclusive is whether female testosterone levels mirror the same pattern found with males in relation to social status.

One limitation of these studies is that most have failed to take into account the fact that testosterone is a dynamic hormone that shows a clear circadian rhythm (Dabbs, 1990), which is known to be sensitive to context. Moreover, many of the studies reviewed herein did not take multiple measures of testosterone from their participants to ensure a precipitating life event is not unduly influencing their hormonal levels. In this study we examined the social status-testosterone link in human males and females using multiple samples of morning and evening salivary testosterone.

Another limitation of these studies is that the link between social status and testosterone in females is almost invariably ignored. Gaining an understanding of the influence of social status and testosterone in females is important because their social groups are also organized hierarchically and resemble male social hierarchies (Vaillancourt & Hymel, 2006). Consequently, it is unknown as to whether or not androgen levels in females operate in a similar fashion and exert the same influence as they do in males.

Other limitations of studies is that they have not adequately controlled for various known confounds such as: cigarette smoking, use of oral contraceptives, dating relationship status, the use of psychotropic and/or steroid medications, time of day, and waking and sleeping time (Alexander, Sherwin, Bancroft, & Davidson, 1990; Burnham, Chapman, Gray, McIntyre, Lipson, & Ellison, 2003; Dabbs, 1990; Graham, Bancroft, Doll, & Tanner, 2007). In this study, we examined these variables in relation to testosterone.

Finally, we examine different forms of social status not investigated in previous research. The importance of examining different forms of social status is that it is not a unitary construct insofar as social status has varied indexes, as described above. An individual may be regarded as high status due to their own merits to attain a higher social position while a different individual may accrue an elevated rank within their social hierarchy through more coercive means. The benefit of using varied indexes of social status is that humans have the most unstable, dynamic, and fluid social structures in comparison to other species (Josephs, Sellers, Newman & Mehta, 2006).

The aim of the present study was to reinvestigate the social status-testosterone link in an attempt to reconcile the disparities found in the literature. Toward this aim, we examined the association between social status and testosterone in a sample of males *and* females using repeated measures of salivary testosterone and controlling for a wide range of recognized confounds that are known to influence testosterone level. Furthermore, we investigated different forms of social status unlike previous studies which almost exclusively focus on dominance typically defined as sporting success or job prestige. Social status is a variegated construct that demands closer attention to be paid to its different forms in order to ascertain a more comprehensive understanding of its relation to testosterone.

Based on the literature reviewed herein, we hypothesized that there would be a positive link between all four types of social status and trait testosterone for both males and females and that this association would be stronger for males than for females.

Method

Participants

Participants were recruited via posters that were displayed in the housing complexes of their university. They were offered \$26 in exchange for the provision of 8 saliva samples and the completion of a questionnaire package. Our sample consisted of heterosexual undergraduate students; 91 females (mean age=18.53, *SD*=0.69) and 63 males (mean age=18.76, *SD*=1.0) enrolled in a mid-sized, multi-ethnic university in Ontario, Canada. Only participants living in co-ed residences were used because hormonal levels can change as a function of living arrangements (Gray, Kahlenberg,

Barrett, Lipson & Ellison, 2002). In order to minimize potential confounds, the following variables were examined: cigarette use, use of psychotropic or steroid medication, oral contraceptive use, and waking and sleeping time.

Procedural Overview

Participants were instructed to complete the questionnaire package and provide the saliva samples in their own dormitory room. They were also provided with both detailed oral and written instructions of the proper storage of the saliva samples. They were instructed to keep the samples frozen in their personal freezer until the end of the 4 consecutive day testing period at which point the researchers collected all completed questionnaire packages and saliva samples.

Self-Report Measures

Dominance and Prestige. Participants filled out the 16-item Social Status Standing Scale (SSSS; Johnson et al., 2007), which distinguishes between two types of social status: dominance and prestige. The SSSS uses a 7-point Likert scale ranging from 1=strongly disagree to 7= strongly agree. The measures of dominance and prestige had internal consistencies of (α = 0.85 and α = 0.79), respectively.

Popularity (measure of visibility) and *power* (measure of influence) were also assessed using a measure initally developed as a peer nomination method (Vaillancourt & Hymel 2006). Consistent with results from Vaillancourt and Hymel (2006) two internally consistent indices of social status, emerged from the exploratory factor analysis. Popularity was comprised of the following 3 items: 'Others like me', 'I am popular', and 'I have a large social network' (α = 0.80) while power was comprised of the following 4

items: 'I have power over others', 'Others listen to and follow me', 'I am a leader', and 'I am looked up to' ($\alpha = 0.85$).

Testosterone

Following procedures by Vaillancourt, de Catanzaro, Duku, and Muir (2009), participants were provided with sugar-free gum and asked to chew it prior to providing each saliva sample. They were instructed to supply one saliva sample in the morning (20 minutes after waking) and to produce another sample in the late afternoon (at 16:00) across 4 days, adding up to a total of 8 saliva samples. Participants were asked to passively drool to the 1 ml mark in polyethylene tube-shaped vials. All saliva samples were stored at -20° C until they were assayed.

All saliva samples were centrifuged at 3000 xg for 15 minutes and supernatant were assayed. NUNC Maxisorb plates were used and testosterone antibodies (R156/7) and horseradish peroxidase conjugate were from C. Munro of the Clinical Endocrinology Laboratory, University of California, Davis. Steroid standards were from Steraloids, Inc. Newport, Rhode Island. Plates were coated with 50 µl of antibody stock diluted at 1:8500 in buffer (50 mmol/L bicarbonate buffer pH 9.6). Plates were sealed and stored for 12h at 4 °C. Plates were washed with 50 µl wash solution (0.15 mol/L NaCl solution containing 0.5 ml of Tween 20/L), then 50 µl per well phosphate buffer was added and plates incubated at room temperature for 2 hours. Two quality control saliva samples at 30% and 70% binding (high and low binding) were prepared. 50 µl testosterone horseradish peroxidase conjugate were added to each well, with 50 µl of standard, sample, or control. Plates then incubated for 1 h. Next, plates were washed with 50µl wash solution and

100µl of a substrate solution of citrate buffer, H2O2 and 2,2'-azino-bis [3-

ethylbenzthiazoline-6-sulfonic acid) was added. Plates were covered and incubated while shaking at room temperature for 60 min. The plates were then read with a filter at 405nm on a Titertek multiskan MCC/340 plate reader. Blank absorbances were obtained and a regression line was fit to the sensitive range of the standard curve (typically 40 – 60 % binding). Each sample was assayed in duplicate and averages were used. Interplate variation (CV) was 6.45% while intraplate variation was 6.51%.

Results

Descriptive Statistics

First, we examined whether known testosterone confounders such as age, smoking, wake time (the time they awoke on that particular day), oral contraceptive use, psychotropic and/or steroid medication and relationship status (dating or not) were associated with testosterone. The testosterone scores were log transformed using a base 10 to normalize the data and to reduce the high degree of variability found across the and within participants. Log transformed testosterone levels were all highly intercorrelated for both males and females allowing us to amalgamate the testosterone scores across day and time to produce a baseline level of testosterone for each participant. Only wake time and relationship status were found to be related negatively to log(testosterone) and were therefore examined as a covariate in subsequent analyses (see Table 1).

Next, we examined the means, standard deviation and bivariate correlations by sex for dominance, prestige, popularity, power, and log10(testosterone). As seen in Table 1, dominance was not linearly related to prestige and popularity for females. This was confirmed with a principal components factor analysis with Varimax rotation, which yielded a two factor solution for females in which prestige, power, and popularity loaded onto one factor and dominance loaded onto a separate factor. Considering these results, a social status composite was created which included prestige, power, and popularity (α =.78) and used in subsequent analyses. Dominance was also examined as a separate social status construct in subsequent analyses. No sex differences were found on measures of dominance or on the aggregate measure of social status.

Multilevel Regression Modeling

Multilevel regression models with orthogonal polynomial contrasts were used to capture and model the circadian rhythm observed in the data using MLwiN software (Rasbash et al., 2000). Multilevel modeling was used to avoid violating the assumption of independence (the testosterone data were nested at the level of the individual).

Using this analytic approach, we found that, taking into account the nested nature of the testosterone data, females had higher levels of testosterone than males at baseline $(b=.42 \ SE=.17, p<.05)$, and that wake time at baseline significantly affected baseline testosterone levels with later risers having lower testosterone level than early risers (*b*= -.08, *SE*=.03, *p*<.05). With respect to social status, dominance was positively related to baseline testosterone for females and males (*b*=.15 *SE*=.08, *p*<.05), and this association was not stronger for males than for females. Moreover, contrary to initial predictions, social status (prestige, power and popularity) was *negatively* associated with baseline testosterone levels for both males and females (*b*=-.22, *SE*=.07, *p*<.01).

Discussion

A best evidence approach was taken in which multiple measures of social status and multiple samples of testosterone were examined in males and females to extend previous works that have focused on the testosterone-social status link. Results were mixed insofar as dominance was positively related to baseline testosterone levels for both males and females; however, lower testosterone was negatively related with an aggregate measure of social status (prestige, power, popularity). The link between dominance in testosterone is not surprising as this result corroborates much of the prior research. In terms of females, these findings neither support nor challenge previous works because far too little is known about the relation between social status and testosterone in females. When this link has been studied, female participants have been drawn from samples such as rugby players (Bateup et al., 2002) or inmates (Dabbs & Hargrove, 1997), which does not reflect the female population at large. We recommend that closer attention be paid to females in 'day-to-day' contexts in hopes to better gauge their baseline trait testosterone levels.

Why would baseline testosterone levels for both sexes be differentially related to different types of social status? We suspect that our measures of social status whether it be dominance or the conglomeration of prestige, power, and popularity are tapping into different psychological mechanisms. It may be that dominance has a richer evolutionary history in that it is linked with aggressiveness and is commonplace among many species. Prestige, conversely, is more modern in its development insofar as it is unique to social animals such as humans and is often expressed through cultural symbols such as wealth

and attire (Henrich & Gil-White, 2001). Our findings are consistent with those of Johnson, Burk and Kirkpatrick (2007), who showed dominance was positively related to testosterone levels and prestige negatively related to testosterone levels in males. Although our findings replicate Johnson et al. results, it is important to highlight that they used only a single measure of testosterone and did not include females.

The females in our sample exhibited a similar hormonal pattern to that of males, in which testosterone was positively associated with dominance and inversely related to the prestige, popularity, power composite. One possibility to explain these findings is to understand that the 'dominance' system is more primitive whereas the 'prestige' system (and by extension power and popularity) is more abstruse and evolved as a mechanism to suppress aggressive urges rooted in the 'primitive dominance system' under conditions of threat (Henrich & Gil-White, 2001).

One peculiarity that arose in our findings was that females had a higher mean level of testosterone in comparison to males. At this point, we can only begin to speculate as to why this may have occurred. It is worth mentioning that the mean age of the male sample was only 18 years suggesting that some participants may have not completed puberty thereby reflecting a lowered baseline testosterone level. Testosterone can also vary considerably with regards to individual characteristics such as recent sexual activity, social status, relationship status, or other forms of interpersonal stressors relating to dayto-day social interactions. Perhaps, our males were exposed to some common environmental trigger that attenuated their circulating levels of testosterone such as living

in a co-ed residence. It has been shown that being in a romantic relationship is associated with lower testosterone levels in males (Burnham et al., 2003; Gray et al., 2002).

An alternative theory proposed to explain why male testosterone levels were lower than females is that a sizeable number of our sample was in their first-year and all of the students were living on university residences. Given that many of these participants were living away from home for the first time, it is plausible that they experienced 'deindividualization' akin to new officers in the military (Kreuz et al., 1972) or those in an incarceration program (Thompson, Dabbs, & Frady, 1990) that show suppressed levels of testosterone.

Limitations

The sample size in our study is consistent with previous works in this area; however, it can be improved upon by using a larger sample. This study was limited by its sample type such that only university students were recruited, thus drawing conclusions from this sample and generalizing to the population at large should be done judiciously.

Previous research using repeated measures of testosterone is scant in comparison to studies investigating 'state' testosterone in humans. The data on nonhuman animals are far richer by comparison than work done on humans and therefore future research could profit from building a stronger theoretical bases to explain these unexpected findings. Also, given testosterone is highly variable in nature and extremely sensitive to environmental context (Dabbs, 1990), future studies could benefit from replicating the findings presented here.

Another limitation of the present study was we did not control for female menstrual cycling; a factor known to influence testosterone levels. Specifically, testosterone peaks during the luteal phase of the menstrual cycle (Judd & Yen, 1973). It has been shown that in dormitory living conditions menstrual synchrony can occur (Quadagno, Shubeita, Deck, & Francouer, 1981). If indeed at the time of recruitment our female participants were in menstrual synchronization with each other and in their luteal phase this could, in part, explain why female baseline testosterone levels were higher than males.

Finally, the researchers did not witness the participants produce their saliva samples so an element of trust was inherent in the research study requirements.

Conclusion

Our results revealed testosterone level is positively associated with dominance but inversely associated with other forms of social status (i.e., power, prestige, and popularity). This latter finding was not predicted in our hypotheses, and we have offered several explanations above to account for this phenomenon.

	М	SD	1	~~~	3	4	5	6	7	8	9	10	11	12	13	14
1. Dating Status	N=31 (35)			.20	-,06	01	020	10	29*	.03	.01	21*	01	02	.05	09
2. Wake time	9.48 (9.07)	1.61 (1.69)	24		13	04	01	11	09	17	.01	.20	05	11	.14	09
3. Monday AM log(T)	6.68 (6.82)	1.08 (1.29)	.20	30*		.47**	.43**	.38**	.20	.36**	.28**	.18	16	03	04	09
4. Monday PM log(T)	6.21 (6.68)	1.50 (1.57)	.02	11	.36**		.63**	24**	.59**	.57**	.50**	.37**	.06	27*	.04	16
5. Tuesday AM log(T)	6.51 (6.85)	1.25 (1.38)	.02	24	.35**	.59**		.63**	.24*	.59**	.50**	.37**	01	.04	22*	22*
6. Tuesday PM log(T)	6.29 (6.82)	1.30 (1.60)	.07	19	.34**	.56**	.51**		.26*	.53**	.57**	.46**	.07	16	.00	04
7. Wednesday AM log(T)	6.75 (7.04)	1.33 (1.71)	.02	25*	.54**	.47**	.66**	.50**		.43**	.20	.18	0.00	18	06	08
8. Wednesday PM log(T)	6.31 (6.69)	1.45 (1.54)	.06	14	.52**	.54**	.56**	.29*	.59**		.54**	47**	.04	34**	14	14
9. Thursday AM log(T)	6.26 (6.58)	1.15 (1.54)	.09	45**	.38**	.39**	.61**	.46**	.42**	.44**		.43**	01	20	.08	03
10. Thursday PM log(T)	6.25 (6.64)	1.39 (1.81)	.06	23	.12	.43**	.59**	.52**	.46**	.22	.49**		01	.17	05	03
11. Dominance	4.6 (4.18)	0.92 (0.93)	.00	.07	.04	.04	.03	10	08	06	.02	.08		.13	04	.42**
12. Prestige	4.93 (5.22)	0.77 (0.64)	.17	.06	.22	11	22	11	0.06	13	01	26*	.48**		.47**	:57**
13. Popularity	5.18	1.21	01	.21	05	17	34**	09	10	24	15	20	.45**	.67**		.43**
14. Power	(5.49) 4.72 (4.85)	(0.84) 1.10 (1.05)	.03	.03	.01	15	36**	09	12	29*	14	16	.54**	.66**	.65**	

Table 1. Means, standard deviations, and correlations for males and females

log(T) = log(testosterone); Males=0, Female =1; Female data are presented above the diagonal and means and standard deviations are shown in brackets. Currently in a dating relationship 1=yes 0=no; *correlation is significant at the 0.05 level (2-tailed); ** correlation is significant at the 0.01 level (2-tailed).
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Chapter 3

Psychopathy and indirect aggression: The roles of cortisol, sex, and type of psychopathy

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Abstract

Salivary cortisol was examined in relation to indirect aggression and primary psychopathy (i.e., cold affect and interpersonal manipulation) and secondary psychopathy (i.e., criminal tendencies and erratic lifestyle) in a sample of 154 undergraduate students. Results revealed that although psychopathy and indirect aggression were strongly correlated, when statistically controlling for each of type of psychopathy, only primary psychopathy was related to indirect aggression. In women but not in men, lower cortisol was associated with higher levels of primary psychopathy and higher cortisol was associated with higher levels of secondary psychopathy. Cortisol was not related to indirect aggression. Results are discussed from both an evolutionary and developmental perspective.

Indirect aggression, also termed relational and social aggression (see Archer & Coyne, 2005), refers to causing harm to someone in a covert fashion often through subtle non-verbal behaviour and/or manipulation of social situations (Archer, 2001; Bjorkvist, Lagerspetz & Kaukiainen, 1992; Crick & Grotpeter, 1995; Galen & Underwood, 1997). Indirect aggression is a widespread phenomenon used equally by adult men and women (Archer, 2004) that is both psychologically and emotionally damaging to victims (e.g., Bjorkvist, 1994; Werner & Crick, 1999). Vaillancourt (2005) argued that indirect aggression is an adaptive behavioural strategy to access finite resources such as mates and social status (also see Campbell, 1995; Hawley, 2002). Reaping the benefits in social groups requires a certain level of interpersonal competency. Not surprisingly, researchers have linked more frequent indirect aggression use to enhanced social intelligence (Kaukiainen et al., 1999), leadership skills (e.g., Vaillancourt, Hymel & McDougall, 2003), and greater popularity and power among peers (e.g., Vaillancourt & Hymel, 2006). These Machiavellian-type correlates are consistent with the clinical and subclinical personality types of psychopathy (McHoskey, Worzel, & Szyarto, 1998) which has recently been linked to the use of indirect aggression (Coyne & Thomas, 2008; Czar, Dahlen, Bullock, & Nicolson, 2011; Kerig & Stellwagon, 2010; Marsee, Silverthorn, & Frick, 2005; Miller & Lynam, 2003; Schmeelk, Sylvers, & Lilienfeld, 2008; Warren & Clarbour, 2009).

Psychopathy is a multi-faceted personality construct that incorporates a wide array of unique behaviour, affective states, interpersonal styles and attitudes (e.g., Cleckley 1941; Hare, 1980). This constellation of behaviour and attitudes can be sub-

categorized into behavioural, affective, and interpersonal components. These include, but are not limited to, stable displays of behavioural misconduct, risk-taking, manipulativeness, and emotional coldness that profile a certain type of character within the population at large. In high functioning, non-clinical samples (e.g., university students, business leaders), psychopathy is expressed in a more subtle way that includes indirect forms of aggression such as social manipulation (Schmeelk et al., 2008).

Psychopathy is subdivided into two distinct facets: primary and secondary (Blackburn, 1975; Cleckley, 1941; Hare, 1991; Karpman, 1941; Lishner, Swim, Hong, & Vitacco, 2011; Lykken, 1995; Mealey, 1995). Primary psychopathy is suggested to be an inherent interpersonal-affective facet marked by an absence of fear, lowered levels of empathy, and lowered levels of anxiety. Secondary psychopathy is suggested to be a lifestyle-antisocial facet that includes impulsivity, higher levels of anxiety, and greater empathy due to extrinsic factors such as situational and/or affective turmoil. In addition to these cognitive and behavioural markers, primary and secondary psychopathy can be differentiated on the basis of physiology. For example, primary psychopaths are characterized as having lowered physiological reactivity in comparison to their secondary psychopathic counterparts (see Mealey, 1995, for a review). Cortisol, a hormone associated with stress, is a marker of physiological reactivity and functioning of the hypothalamic-pituitary-adrenal (HPA) axis (e.g., Brown et al., 1996; Henry, 1992). Hyper-secretion of cortisol has been correlated with negative affect such as anxiety and depression (e.g., King et al., 2006), whereas hypo-secretion of cortisol has been correlated with aggressive displays and other forms of misconduct (e.g., Raine, 1993;

Van Goozen, Fairchild, Snoek, & Harold, 2007) that reflect psychopathic personality traits.

Given the heterogeneity amongst people exhibiting psychopathic personality traits, we hypothesized that cortisol secretion should serve as a physiological marker that aids in distinguishing individuals who show low fear and low anxiety (primary psychopaths) in comparison to those with higher fear and higher anxiety (secondary psychopaths). Popma et al., (2007) provided evidence to support lowered reactivity in the HPA axis in a sample of adolescent boys who displayed antisocial behaviour. This inverse relationship between cortisol levels and psychopathic personality traits has also been found in adult samples of males charged with serious violent crimes (Holi, Auvinen-Lintunen, Lindberg, Tanni, & Virkkunen, 2006). In a study comparing two groups of male inmates (i.e., psychopathic and non-psychopathic) to a control group (i.e., noninmates), Cima, Smeets, and Jelicic (2008) reported that among inmates, psychopaths had the lowest diurnal concentration of cortisol whereas non-psychopaths had the highest. The controls' cortisol levels fell in between those of the two groups of inmates. In their study conducted on a non-referred sample of adolescents, Loney, Butler, Lima, Counts, and Eckel (2006) found that low emotional activity, as measured by baseline cortisol levels, was associated with callous-unemotional traits, suggesting lowered cortisol levels may be a biological marker for primary psychopathy in males. In a follow-up study by O'Leary, Loney, and Eckel (2007), cortisol levels from male and female undergraduate students were measured before and after a stress test. The results showed that male (not female) participants scoring higher on the primary psychopathy questionnaire had

lowered stress reactivity, as indexed by pre- and post-test cortisol measures, in comparison to males with low scores on the psychopathy questionnaire, suggesting that low cortisol production may be a male-specific marker for primary psychopathic personality (see also Loney et al., 2006).

As mentioned at the outset, it seems that both psychopathic personality traits and indirect aggression share certain commonalities that allow the individual to effectively navigate through their social world and secure positions of power through the use of 'cutthroat' behavioural strategies (e.g., derogating a rival behind their back to the employer for a job promotion). Psychopathy and the use of indirect aggression involve an element of refined social skills. Some have argued that the psychopathic personality is functional to getting ahead thereby allowing the individual to ascend the social ladder at a far more rapid rate (e.g., Babiak & Hare, 2007; Hare, 1999; Oakley, 2008). This ascension is evidenced by the over representation of people (typically men) with psychopathic personality traits in upper echelons of the occupational work force such as high profile criminal lawyers, CEOs of larger corporations, and nefarious political figures (see Babiak & Hare, 2007; Hare, 1999; Oakley, 2008). Indirect aggression has also been linked to higher social status (Vaillancourt & Hymel 2006; Vaillancourt et al., 2003) and lowered levels of empathy (Kaukianen et al., 1999), a trait that is also linked to primary psychopathy.

The parallels between indirect aggression and psychopathy suggest that there might be a degree of overlap between these two constructs in the mechanisms involved in eliciting this aggressive behaviour. One mechanism that may help explain the relationship

between indirect aggression and psychopathy is physiological reactivity as indexed by the level of cortisol secretion. In this study, we examined the associations between indirect aggression, psychopathy, and cortisol levels in a sample of university students. Consistent with other published studies (e.g., Czar et al., 2011; Kerig & Stellwagon, 2010; Marsee et al., 2005; Miller & Lynam, 2003; Schmeelk, et al., 2008; Warren & Clarbour, 2009), we hypothesized that a positive relation between indirect aggression and psychopathy (total score) would be found. Furthermore, because acts of indirect aggression are generally premeditated, strategic, and require mastery of necessary social skills to achieve one's goals within a group, we expected that consistent with Coyne and Thomas (2008), interpersonal manipulation and callous affect (primary psychopathy) would be more strongly correlated to indirect aggression than criminal tendencies and erratic lifestyle (secondary psychopathy). We also predicted that when controlling for each type of psychopathy, only primary psychopathy would be related to indirect aggression.

In terms of links with cortisol, we expected that high levels of primary psychopathy would be related to lower levels of cortisol whereas high levels of secondary psychopathy would be related to higher levels of cortisol. These relations were expected to be moderated by sex. Specifically, we hypothesized that the associations would be stronger in men than in women (consistent with Loney et al., 2006; O'Leary et al., 2007). We also expected that indirect aggression would be related to lower levels of cortisol, given the expected association between indirect aggression and primary psychopathy.

Method

Participants

Our sample consisted of 91 females (M age = 18.53, SD = 0.69) and 63 males (M age = 18.76, SD = 1.0). Participants were heterosexual undergraduate students, enrolled in a mid-sized, urban, multi-ethnic university in Southern Ontario, Canada. Participants were recruited via posters that were displayed in common areas of the university's housing complexes. They were offered \$26 in total for providing eight saliva samples and completion of the questionnaire package. In order to reduce potential confounds, we asked participants about the following and examined these variables in subsequent analyses: (1) cigarette use, (2) use of psychotropic or steroid medication, (3) oral contraceptive use, and (4) waking and sleeping time.

Procedural Overview

Participants were instructed to complete the questionnaire package and provide the saliva samples in their own dormitory room. They were also provided with both detailed oral and written instructions for the proper storage of the salivary samples. They were instructed to keep the samples frozen in their personal freezer until the end of the 4day testing period at which point the researchers collected the completed questionnaire packages and salivary samples. Participants were asked to complete several self-report questionnaires pertaining to their use of indirect aggression and the level to which they agreed with statements assessing psychopathy.

Self-Report Measures

Indirect aggression. Participants were asked to fill out the 35-item Indirect Aggression Scale Aggressor Version (IAS-A; Forrest, Eatough, & Shevlin, 2005). Example items from this measure include: "How often have you done the following to your peers "criticized them in public", "turned other people against them", "spread rumours about them" and "used emotional blackmail on them". The IAS-A uses a 5-point Likert scale ranging from 0 = never to 4 = very often. An indirect aggression composite score was created by averaging the 35 items with higher scores reflecting greater use of indirect aggression ($\alpha = 0.95$).

Psychopathy. Participants filled out the 64-item Self Report Psychopathy scale (SRP-III; Paulhus, Hemphill, & Hare, 2009), which uses a four factor structure to capture the heterogeneity found within the personality construct of psychopathy: interpersonal manipulation, callous affect, criminal tendencies, and erratic lifestyle. The measure was developed for a non-criminal, non-forensic sample. The SRP-III uses a 5-point Likert Scale ranging from 1 = strongly disagree to 5 = strongly agree where high scores represent higher levels of psychopathy ($\alpha = 0.93$).

Primary psychopathy was assessed by combining the Interpersonal Manupulation sub-scale and the Cold Affect sub-scale (r = 0.70). Interpersonal manipulation refers to the use of scheming, manipulating, and deceitfulness. This subscale consisted of 16 items which were averaged to created a composite score ($\alpha =$ 0.84) with higher scores reflecting greater manipulative behaviour. Sample items from the interpersonal manipulation subscale include "I would get a kick out of 'scamming'

someone", and "I purposely flatter people to get them on my side". *Cold affect* refers to the disregard of other people and lack of emotional care and concern. This sub-scale consisted of 16 items which were averaged to created a composite score ($\alpha = 0.83$) with higher scores reflecting greater cold affect. Sample items from the callous affect subscale include "people sometimes say I'm coldhearted" and "people cry way too much at funerals".

Secondary Psychopathy was assessed by combining the Criminal Tendencies subscale and the Erratic Lifestyle sub-scale (r = 0.55). Criminal tendencies refer to behaviour that are mainly antisocial in nature and are deemed illegal. This subscale consisted of 16 items which were averaged to created a composite score ($\alpha = 0.80$) with higher scores reflecting greater criminal behaviour. Sample items from the criminal tendency subscale include "I have broken into a building or vehicle in order to steal something or vandalize" and "every now and then I carry a weapon (knife or gun) for protection". Erratic lifestyle refers to behaviour that is reckless, impulsive and involve an element of high risk. This sub-scale consisted of 16 items which were averaged to created a composite score ($\alpha = 0.83$) with higher scores reflecting greater recklessness. Sample items from the erratic lifestyle subscale include "I'd be good at a dangerous job because I make fast decisions" and "I enjoy doing wild things".

Saliva Collection

Following procedures by Vaillancourt et al (2008, 2009), participants were provided with, *Wrigley's Extra Peppermint*TM sugar-free gum and asked to chew it prior to providing each saliva sample. They were instructed to supply one saliva sample in the

morning (20 minutes after waking) and to produce another sample in the late afternoon (at 16:00) across 4 days. Thus, participants provided a total of eight salivary samples. Participants were asked to spit up to the 1 ml mark in polyethylene tube-shaped vials manufactured by Nalgene Co. All salivary samples were stored at -20° C until they were ready to be assayed. For a detailed description of assaying procedures, see Vaillancourt et al. (2008, 2009, in press).

Because our interest was not in daily patterns of cortisol or in a particular point in the diurnal pattern, we create a single cortisol composite that reflected an index of general activation of the HPA axis across 4 days. To confirm the statistical appropriateness of this index, a principal component analysis was conducted. Results indicated a one factor solution for cortisol that accounted for 47% of the variance. Accordingly, the 8 saliva samples (ng/ml) were averaged across participants to create a single composite with higher scores indicating higher overall cortisol production across 4 days ($\alpha = 0.80$). This composite was log transformed using a base 10 to normalize the data and to reduce the high degree of variability.

Results

First we examined whether known cortisol confounders such as age, smoking, wake time, oral contraceptive use, psychotropic and/or steroid medication were associated with cortisol. None of these potential confounds were associated with cortisol and they also did not relate to indirect aggression or psychopathy and therefore were not included in subsequent analyses (exception of wake time). Although wake-time did not statistically relate to our variables of interest, it was nevertheless included as a control

variable when we examined cortisol given the large wake-time variability among our participants (from 6:30 to 13:00).

Next, we examined the zero-order correlations (two-tailed) between our variables of interest, namely cortisol, indirect aggression, total psychopathy, and primary (interpersonal manipulation and cold affect) and secondary (erratic lifestyle and criminal tendencies) psychopathy. Following recommendations by McHoskey et al. (1998) concerning the necessity to isolate their unique sources of variance when examining primary and secondary psychopathy, we also examined the partial correlations between indirect aggression and primary and secondary psychopathy by controlling for primary when examining secondary (and vice versa).

As seen in Table 1, men were higher on total psychopathy (F(1, 144)=54.25, p < 0.001) and on primary and secondary psychopathy than women (Wilks' $\lambda = 0.025, F(1, 144) = 29.46, p < 0.0001$). No other sex differences were found.

Consistent with our initial hypothesis, indirect aggression was positively correlated with total psychopathy (r = 0.56, p < 0.001), and held a stronger relation to primary psychopathy (r = 0.60, p < 0.001) than to secondary psychopathy (r = 0.43, p<.001; z = 1.99, p < 0.05). Moreover, when controlling for the opposing psychopathy measure, we found that only primary psychopathy was uniquely correlated with indirect aggression (r = 0.45, p<.001 vs. r = 0.06, p=.45 for secondary controlling for primary; z =3.53, p < 0.001).

The zero-order correlations of indirect aggression, total psychopathy, primary psychopathy and secondary psychopathy showed similar correlations for men and women

(see Table 1). Likewise, there were no statistically significant differences between males and females in terms of the partial correlations by primary and secondary psychopathy with indirect aggression (using Fisher's r to z transformations).

Contrary to our initial prediction, cortisol was not found to be related to indirect aggression or psychopathy (total, primary, or secondary). However, when we examined partial correlations (controlling for each type of psychopathy respectively and wake-time), we found that cortisol was *negatively* associated with primary psychopathy for women (r = -0.31, p < 0.005) but not for men (r = -0.02, p = 0.87; z = -1.62, p < 0.11), and *positively* correlated with secondary psychopathy again for women (r = 0.30, p < 0.007) but not for men (r = 0.02, p = 0.80; z = -.38, p = .35).

Discussion

Several studies have linked psychopathy to indirect aggression (Coyne & Thomas, 2008; Czar, et al., 2011; Kerig & Stellwagon, 2010; Marsee et al., 2005; Miller & Lynam, 2003; Schmeelk, et al., 2008; Warren & Clarbour, 2009). The present study extended these findings by also examining the roles of sex and cortisol in a sample of Canadian university students.

Recently, Coyne and Thomas (2008) found that primary psychopathy was better predicted by indirect aggression and secondary psychopathy was better predicted by direct aggression when statistically controlling for the each type of psychopathy. Warren and Clarbour (2009) also found a stronger relation between indirect aggression and cold heartedness (primary psychopathy) than between indirect aggression and impulsive antisociality (secondary psychopathy). However, in Warren and Clarbour's study, partial

correlations were not used; rather the magnitude of the associations was examined. According to McHoskey et al. (1998), "to understand primary psychopathy, it is necessary to statistically control for secondary psychopathy and vice versa" (p.195). Results of the present study replicated the strong association between indirect aggression and psychopathy. Importantly, however, we also showed that when partitioning the psychopathy variance into primary and secondary, only primary psychopathy was related to indirect aggression (partial r = 0.45 for men and r = 0.56 for women). Why might this be the case?

Buss and Duntley (2008) have proposed that humans are equipped with differing propensities to exploit others in the immediate social environment. We suspect that indirect aggression may be a variant of a broader exploitation system humans have a capacity for, which may be why indirect aggression was associated with primary psychopathy and not secondary psychopathy. It could also be that indirect aggression is simply a behavioural manifestation comprising of the overarching psychopathic personality. Psychopaths are known to be enticed by immediate rewards (see Mealey, 1995, for a review). Similarly, the increased use of indirect aggression has been linked to a variety of social benefits such as the attainment of peer status and earlier and more frequent dating/sexual opportunities (e.g., Vaillancourt, 2005; Vaillancourt & Hymel, 2006; White, Gallup & Gallup, 2010). It is conceivable that those higher in psychopathy are more likely to utilize indirect aggression as a strategy to obtain highly rewarding items such as money, status, and sex. The results of the present study lend support to these hypotheses and highlight the need to further understand the difference and similarities between indirect aggression and psychopathy.

Results of this study also showed that as predicted, lower cortisol was associated with higher levels of primary psychopathy and higher cortisol was associated with higher levels of secondary psychopathy. However this held true only for women. Past studies of non-criminal populations have linked primary psychopathy to lower basal and reactive cortisol in men and not women (Loney et al., 2006; O'Leary et al., 2007). Although the directionality of these findings is in line with our initial hypothesis, they do require replication given that the associations were found in women and not in men. Because only a few studies have to date examined psychopathic traits and cortisol in non-criminal populations of males and females, it is not possible to draw firm conclusions regarding whether low cortisol is a sex-specific marker for primary psychopathic traits.

Contrary to initial predictions, indirect aggression held no relation to cortisol despite being strongly correlated with primary psychopathy. There are very few studies that have examined indirect (relational) aggression and cortisol and, therefore, it is difficult to place this null finding in context. Dettling, Gunnar and Donzella (1999) found that relational aggression was associated with a rise in cortisol over the day for preschool children attending childcare. Susman and colleagues (2007) reported no association between relational aggression and cortisol in children aged 8 to 13 years. Murray-Close, Han, Cicchetti, Crick, and Rogosch (2008) found that relational aggression was associated with a rise aggression was associated with low cortisol following morning arrival at a summer day camp and blunted diurnal change in cortisol which was moderated by maltreatment status (more

dysregulation in maltreated children). To our knowledge, there are no published studies examining indirect aggression and cortisol in adult males and females and therefore more research is needed in this area.

Limitations

One limiting factor of the present study is the reliance on an undergraduate university sample. The university population tends to be more mild-mannered, and have better future financial prospects as compared to populations drawn from other segments of society (e.g., Babbie, 2008). It is reasonable to suspect that the very qualities necessary to secure a position in a university are opposed to possessing *some* of the features that characterize psychopathy and therefore this sample is prone to a unique psychologicalpersonality organization that may not be generalized to other populations (Ross & Rausch, 2001). Nevertheless, it is important to consider that psychopathy is not restricted to the criminal population. Increased scholarly attention has been directed toward studying white-collar psychopaths (e.g., Babiak & Hare, 2007; Hare, 1999). Hare (1999) suggested the necessity to distinguish among non-criminal psychopaths and criminal psychopaths (e.g., serial killers) as well as sociopaths (e.g., individuals' antagonist towards societal rules and laws). Non-criminal psychopaths are able to control their impulses and are adept at navigating their way through interpersonal relations and are apt to climb to elevated positions in the workforce thereby procuring the benefits of wealth and prestige. In addition, they are able to distinguish between right and wrong but just do not care. Interestingly, in a recent study of successful (uncaught) and unsuccessful (caught) psychopaths Gao, Raine, and Schug (in press) found electrophysiological

processing differences that suggest neurocognitive distinctions between the two groups of psychopathic men. These studies and the present study suggest a need to consider subtypes of psychopathy (primary vs. secondary; successful vs. unsuccessful) and move beyond the typical consideration of psychosocial and personality factors to include measures of psychophysiology.

Another limitation to the present study is we did not control for the menstrual cycle in our female participants when assessing their cortisol levels. Cortisol is elevated when circulating estrogen levels are high (Gardner & Shoback, 2007). We also relied exclusively on measuring basal salivary cortisol levels, which is an index of overall *activity* of the HPA axis. It is, therefore, unclear how psychopathy and indirect aggression relate to cortisol reactivity obtained by introducing an acute stressor or how it relates to different aspects of the diurnal pattern (e.g., awakening response or the slope across the day).We could not verify if participants did indeed comply with the instructions to produce their samples 20 minutes post-waking and again at 16:00.

Finally, although indirect aggression has been consistently linked with physical aggression (e.g., Cote, Vaillancourt, Barker, Nagin & Tremblay, 2007), we did not control for this correlation in the present study. Recently, Czar et al. (2011) found that both primary and secondary psychopathy explained additional variance in relational aggression beyond that explained by physical aggression. Marsee et al. (2005), in a sample of 5th to 9th graders, and Kerig and Stellwagon (2010) in a sample of 6th to 8th graders, found that both overt/physical aggression and relational aggression was associated with psychopathic traits. Warren and Clarbour (2009) also reported a

relationship between psychopathy and physical aggression in adults and Coyne and Thomas (2008) showed that primary psychopathy was better predicted by indirect aggression and secondary psychopathy by direct aggression. Although we acknowledge the importance of considering overt/physical aggression given its relation to both indirect aggression and psychopathy, we did not in this study because the criminal tendencies sub-scale of the SRP-III includes items that assess physical aggression along with the use of antisocial behaviour in general. Nevertheless, researchers wishing to replicate and extend our findings ought to consider formally including a measure of physical aggression. However in doing so, we suggest that perhaps a more fruitful area of inquiry would be to examine the role of cortisol in the relationship between psychopathy and reactive versus proactive aggression. Reactive aggression is characterized as affectively unstable and impulsive and therefore likely linked to higher cortisol and secondary psychopathy with weak relations to indirect aggression. Conversely, proactive aggression is characterized by more stable affect and as being goal-directed and therefore likely linked to lower cortisol and primary psychopathy with strong relations to indirect aggression.

Conclusion

In this study, a positive association among indirect aggression, total psychopathy, primary psychopathy and secondary psychopathy was found with stronger links existing between primary psychopathy and indirect aggression than secondary psychopathy. We also found that for females, lower cortisol levels were related to higher primary psychopathy and higher cortisol levels were related to higher secondary psychopathy.

Given the correlational nature of this study, it is not possible to say if low or high cortisol is a predictor or a consequence of psychopathic behaviour. Future longitudinal studies are needed to establish the directionality of these findings.

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			Zero-order		Partial by Primary or Secondary Psychopathy	
	M	SD	Cortisol	IA	Primary	Secondary
Cortisol Y	.45 (.48)	.35 (.30)			02 (31*)	.02 (.30*)
Indirect Agression	1.06 (.90)	.56 (.52)	08 (.11)		.45** (.56**)	.12 (.07)
Psychopathy	2.70 (2.20)	.42 (.37)	.01 (03)	.56** (.60**)		
Primary Psychopathy	2.94 (2.50)	.54 (.52)	.01 (18)	.58** (.67**)		
Secondary Psychopathy	2.85 (2.16)	.47 (.44)	.02 (.13)	.43** (.40**)		

Table 2. Means, standard deviations, zero-order correlations, and partial correlations.

Note. γ Wake-time was statistically controlled for with all correlations involving cortisol; *p<.01, **p<.001; Females in bracket.

Chapter 4

Sunderani, S., Arnocky, A., & Vaillancourt, T.

Individual differences in mate poaching: An examination of hormonal, dispositional, and

behavioral mate-value traits

Abstract

The personality and hormonal correlates of mate poaching (attempting to steal another person's partner away) and of the target of the seducer (the mate poached) were examined in a sample 154 undergraduate university students (91 females; 63 males). Thirteen variables were modeled into two regression equations to predict and profile mate poachers and the mate poached. Findings revealed that (1) male mate poachers were better looking and had higher cortisol levels, lower levels of testosterone, and reported being higher on cold affect, self-esteem, and criminal tendencies and (2) female mate poachers and targets of mate poachers reported being more physically attractive, as did male targets of mate poachers. Sex differences in the context of mate poaching attraction as well as the characteristics of those who are successful in their attempts to lure away another person's romantic partner were discussed.

Introduction

One realm of human mating that has received little attention is the behavior of mate poaching. Mate poaching is a widespread phenomenon (Schmitt & Buss, 2001) that is found across a variety of species (Dawkins & Krebs, 1978; de Waal, 1986; Trivers, 1985) and across various cultural groups (Schmitt et al., 2004). Mate poaching directly involves two people¹. A mate "poacher" is an individual who knowingly attempts to disrupt or terminate an existing romantic dyad with the intent of mating with one of the already-paired partners (Buss & Schmitt, 2001; Davies, Shackelford, & Hass, 2007). The mate "poached" refers to the person stolen away from their existing relationship (Schmitt & Buss, 2001).

Mate poaching can increase an individual's mating success by providing access to a mate who would not otherwise be available. Although there are clear benefits associated with mate poaching (e.g., casual sex or formation of a long-term union), such behavior is risky (Davies, Shackelford, & Glen Hass, 2010; Schmitt & Buss, 2001). Poaching is a form of intrasexual competition. Thus, a poaching attempt can bring about various forms of retaliation from the individual whose mate was stolen from (i.e., the "poachee"), as well as sanction from the social group. Poaching attempts can also test the strength of a romantic dyad and lead to a wide variety of interpersonal conflict between romantic partners, including feelings of jealousy (e.g., Buss, Larsen, Westen, &

¹ We recognize there is a third-party (the 'poachee') involved directly or indirectly in the mate poaching attraction process. Specifically, the 'poachee' is defined as the individual whose mate is lured away from them (Schmitt & Buss, 2001). Details pertaining to the 'poachee' are beyond the scope of the present study. We recommend future studies investigate the nature of the 'poachee' in relation to the 'poacher'-'poached' dynamic.

Semmelroth, 1992), emotional pain, anguish, sadness, anxiety (Buunk & van Driel, 1989), infidelity (e.g., Buss & Shackelford, 1997), relationship dissolution (e.g., Gottman, 1994), intimate partner violence (e.g., Buss, 1988; Buss & Shackelford, 1997), and even homicide (Buss, 2005; Daly & Wilson, 1988). Researchers have sought to investigate the complex interplay among individuals involved in the mate poaching process. Currently, the individual differences that render some people more or less likely to succeed in the act of mate poaching are insufficiently understood. The present study attempted to answer the following two questions: (1) What individual factors characterize a successful mate poacher? (2) What individual factors characterize the target of desire to be poached away?

Schmitt and Buss (2001) seminal work on individual differences in mate poaching showed that those who have attempted to poach someone from their existing romantic relationship tended to be lower on agreeableness, higher on extraversion, and, to a lesser extent, lower on conscientiousness. Successful mate-poaching was associated with greater physical attractiveness (especially in females) and having a proclivity towards promiscuity (unrestrained sexual disposition) in males. Other studies examining personality factors of male mate "poachers" showed an association with psychopathy (Williams, Spidel, & Paulhus, 2005), Machiavellianism, and narcissism (Jonason, Li, & Buss, 2010). Higher scores on psychopathy, Machiavellianism, and narcissism were also associated with being "poached" away (those who defected more often from their existing romantic dyad).
Targets of mate poaching (i.e., those who received frequent attempts to lure them from their existing romantic relationship) were characterized as being extraverted, open to experience, physically attractive, and uninhibited with regards to sex (Schmitt & Buss, 2001). Psychological traits of those who have been successfully poached away from their existing romantic relationship include low agreeableness, an uninhibited sexuality, and lower levels of commitment to the romantic relationship (see also Schmitt et al., 2004).

The overarching assumption in human mating research is that individuals who possess certain traits or qualities (e.g., good looks) will be more or less successful at mating (e.g., Buss & Barnes, 1986; Buss & Schmitt, 1993; Langlois et al., 2000). These traits are often termed "mate-value characteristics." Although many researchers have shown that these traits are indeed desired by the opposite sex, few have examined whether individuals who possess these qualities or traits are actually more successful in the endeavour of mating. Rhodes, Simmons, and Peters (2005) investigated whether physically attractive males and females (as measured by aggregate ratings of both facial and body attractiveness) actually had more sexual partners. Results revealed males with more masculine faces and bodies had more short-term and lifetime sexual partners whereas females with more feminine faces had more long-term relationships and became sexually active at an earlier age.

Studies on mate value characteristics tend to focus on only a limited number of factors, such as physical attractiveness. However, it has been shown that many individual characteristics play a role in determining an individual's overall value as a mate. When considering which qualities play a role in the various aspects of mate poaching, it is

important to highlight two classes of characteristics. One is "mate value" characteristics, which increase an individual's attractiveness to the opposite-sex and therefore increases his/her chances of being selected as a target for a mate poacher (e.g., being physically attractive). These same mate value characteristics, as a result of their desirability to the opposite-sex, make an individual more likely to attract and successfully lure away a target from their existing romantic partnership. The second class of characteristics are traits that, although not necessarily desirable to the opposite sex, increase the likelihood that an individual will initiate more frequent attempts to infiltrate an existing romantic relationship (e.g., psychopathy, aggressiveness, sex drive). Physical prowess and behavioural dominance, for example, may reduce the risk of physical harm incurred by a prospective mate poacher from their target's primary partner. This may have been especially true in ancestral environments where a poacher could not rely on police force for example for protection from an irate male who discovers the poacher interloping with his mate.

To our knowledge, no study to date has comprehensively investigated the individual differences of the mate poacher and the mate poached, while taking into account characteristics that are physical (e.g., height and weight), psychological (e.g., indirect aggression and cold affect), and physiological (e.g., testosterone and cortisol) in nature. Much of the previous research has examined the traits and qualities that characterize the individual defecting from their existing relationship to engage in a short-term sexual liaison or a more committed, long-term affair with the mate poacher (for a

review, see Thompson, 1983), whereas only a few studies have investigated the traits and qualities of the mate poacher (e.g., Schmitt & Buss, 2001; Schmitt et al., 2004). In our model, we used qualities and traits that have been shown to be important in the mate attraction process. These processes have differential effects as a function of sex, therefore, we investigated these variables in men and women separately. The qualities and traits used in the present study can be broken down into two broad classes: competition related variables and attraction related variables. Competition related variables enhance the success of the potential mate poacher by usurping the opponent for the target. These include: sex drive, submissiveness, criminal tendencies, erratic lifestyle, cold affect, interpersonal manipulation, and indirect aggression. These traits may provide their possessor with an impetus to seek out mates, or with the skills necessary to effectively steal another's partner. Indeed, traits associated with psychopathy have also been shown to be more pronounced in males in comparison to females. Ostensibly, the characteristics of psychopathy mobilize the individual to seek mates with minimal guilt (Jonason, et al., 2010; Schmitt & Buss, 2001, Williams, et al., 2005). For instance, expressing cold affect (i.e., little care or compassion for others) may help to quell any moral objections to poaching or any feelings of empathy for the intrasexual rival whose mate one is attempting to poach. Testosterone and cortisol levels may also enhance a prospective mate poacher's ability to compete. These physiological characteristics are not stable traits because they rise and fall throughout the day and are very sensitive to environmental context. Nevertheless, these hormones may be related to motivating an individual to engage in mate-seeking behaviour.

The other broad class of traits are attractiveness related variables that are selected for by the opposite-sex, which parallel the same traits involved in general romantic attraction. Because mate poaching is a subtype of general mate attraction (Buss & Schmitt, 2001), we presumed that some of the qualities, traits, and dispositions involved in mate poaching should be akin to those involved in general romantic attraction. In the present study we examine height, weight, self-esteem and self-perceived physical attractiveness. It is important to note that while these variables are in no way comprehensive to the identification of mate attraction, they are among the most important and commonly examined ones in the literature. For instance, it has been shown that weight (e.g., Singh & Young, 1995), and physical attractiveness (Buss & Schmitt, 1993; Langlois et al., 2000) are important predictors of one's ability to attract a mate, and this may be especially true for females. In a similar vein, height (e.g., Pawlowski, Dunbar, & Lipowicz, 2000), sex drive (Baumeister, Catanese, & Vohs, 2001), and high testosterone (e.g., Dabbs, 2000) have been related to males' ability to obtain mating opportunities.

We further predicted that high self-esteem as a sociometric indicator of one's own mate value (Brase & Guy, 2004) would be related positively to each of the poaching domains. People with high self-esteem have been shown to be better at making new friends and better at communicating information about themselves (Baumeister, 1993), both of which are skills that might make oneself more noticeable or desirable to a poacher or to a target of a poach. Consistent with the results of previous work (e.g., Schmitt & Buss, 2001), we also predicted the targets of mate poachers would have been higher on physical attractiveness.

Other studies have investigated facial and behavioural dominance in males and its role in attracting females (e.g., Bogaert & Fisher, 1995; Mazur, Halpern, & Udry, 1994; Sadalla, Kenrick, & Vershure, 1987). For instance, lower dominance has been associated with a greater likelihood of being a virgin among a college sample (Keller, Elliot, & Gunberg, 1982). Yet, no studies have specifically directed their efforts to examine whether submissiveness is associated with an increased likelihood to engage in mate poaching attraction as either the poacher and/or the target of a poach. Related to both dominance and sexual behaviour is the hormone testosterone (Mazur, 2005). Accordingly, we were interested in the relationship between testosterone and poaching behavior. Among males both prenatal and circulating testosterone levels (as indicators of male dominance) are associated with having more lifetime sex partners (Honekopp, Voracek, & Manning, 2006; Pollet, der Meil, Cobey, & Buunk, 2011). Moreover, in females, testosterone correlates with intercourse frequency (during ovulation) as well as sexual gratification scores (Persky, Lief, Strauss, Miller, & O'Brien, 1977).

Finally, cortisol secretion has been associated with romantic attraction in both males and females. However, comparisons between the two sexes have not been made (e.g., Lopez, Hay, & Conklin, 2009; Loving, Crockett, & Paxson, 2009; Roney, Lukaszewski, & Simmons, 2007; Roney, Mahler, & Maestripieri, 2003). Although the aforementioned attractiveness variables have been previously identified as important predictors of human mating, it is important to note that their relationships to human sexuality may be more complex than was once believed. Height, for example, has a complex relationship to sex as a mate preference, with some research suggesting it is the

angle between eyes of partners that is most important, some finding height is desirable in men and women, and other research showing curvilinear relationships in women (Buunk et al., 2009). Weight is also more complex, with BMI and Waist-to-Hip Ratio being the stronger determiners of sex-specific attraction in most studies (e.g., Henss, 1995; Singh, 1994, 2002; Singh & Young, 1995).

It is also crucial to note that these two broad classes of traits-- attractiveness related variables and competition related variables are not mutually exclusive. For example, the personality trait of sex drive may propel an individual to seek out a mate via poaching as well as be deemed desirable by a member of the opposite-sex, as it may be a cue to better sexual performance.

The present study is limited to testing successful poaching dynamics. There may be a fundamental difference between those who attempt to poach and those who do not. Poaching behavior can vary considerably (direct courting to more subtle manipulations). Moreover, one can be "shut-down" and thus be unsuccessful in their attempts making it costly and a non-beneficial strategy.

To summarize, in the present study, we predicted (1), high self-esteem, and high physical attractiveness would predict successful mate poaching in both sexes. Following from the literature reviewed herein, we also predicted that (2) height, cold affect, interpersonal manipulation, criminal tendency, erratic lifestyle, and high testosterone would predict mate poaching by males only. (3) For females, we predicted that lower weight and greater indirect aggression would predict successful mate poaching. We made no sex-specific hypotheses as to whether sex drive, submissiveness and cortisol level

would predict mate poaching behaviour because of the inconsistent results obtained regarding sex differences in general romantic attraction. (4) We predicted that being a target of a poach would be predicted by greater height for males, lower weight for females, and greater physical attractiveness for both sexes. Furthermore, we made no-sex specific predictions for being a target of a poach with regards to all the other variables mentioned.

Method

Participants

Our sample consisted of female (n = 91, M age = 18.53 years, SD = 0.69) and male (n = 63, M age = 18.76 years, SD = 1.0) undergraduate students enrolled in a midsized, multi-ethnic university in southern Ontario. Participants were recruited via posters that were displayed in common areas of university housing complexes. They were offered \$26 in total for providing 8 saliva samples and completing and returning the questionnaire package. As the present study applied to heterosexual relationships, sexual orientation was measured by asking participants to identify as "heterosexual" "bisexual" "gay" "lesbian" "transgendered" "other". Data from non-heterosexual students were excluded from the analyses (n=6). We asked participants about the following factors which might influence our hormonal analyses: (1) cigarette use, (2) use of psychotropic or steroid medication, (3) oral contraceptive use, and (4) waking and sleeping time using a "yes" / "no" dichotomous response scale. These variables were included in the analyses in order to reduce potential confounds with respect to the testosterone and cortisol data.

Procedure

Participants were instructed to complete the questionnaire package and provide the saliva samples in their own home (e.g. dormitory room). They were also provided with detailed oral and written instructions of the proper storage of the saliva samples. They were instructed to keep the samples frozen in their personal freezer until the end of the 4-day testing period at which point the researchers collected all completed questionnaire packages and saliva samples. Participants were asked to complete several self-report questionnaires pertaining to a wide range of variables thought to play a role in successful and unsuccessful mate poaching attraction.

Measures

Mate poaching.

Two outcome variables were used as the dependent measures of mate poaching behaviors. The following items were used: "How often have you successfully poached someone away from a past partner?", "How often have you experienced someone try to poach you away successfully from an existing relationship you have had?" and "How often have you experienced someone try to poach you away unsuccessfully from an existing relationship you have had?" The latter two items were summated to create a composite measure of how often the participant was the target of the poacher's romantic desire. Participants were asked to circle their response on a 9-point scale, developed for purposes of this study, ranging from never to 8 or more times. Following the procedures outlined by Schmitt and Buss (2001) participants were provided with a short description explaining the concept of mate poaching. The description provided in the present study is as follows:

Sometimes people try to romantically attract one another. On occasion, people try to attract someone who is already in a romantic relationship. For example, a woman may try to attract a man even though he is already dating, in a relationship with or married to another woman. She might do this for a shortterm sexual affair with him or to try and obtain him for long-term relationship. Mate poaching then is attracting (or trying to attract) someone away from their current partner.

Height and Weight

Participants were asked to report their height and weight.

Physical Attractivenss

Participants responded to the statement "I am good-looking" along a 7-point

Likert Scale ranging from 1 = not at all to 7 = very much so, as an index of their physical attractivenss.

Self-Esteem

The 10-item Rosenberg (1965) Self-esteem scale was used to gauge global self-

esteem. Participants expressed the extent to which they agreed or disagreed on a 4-point

Likert scale ranging from 1 = strongly disagree to 4 = strongly agree. This scale had an

overall reliability of α =0.90 (males α = 0.94; females α = 0.87) in the present sample.

Submissiveness

Participants completed the 16-item Submissiveness Scale (Allan & Gilbert, 1997) to measure the participants" degree of deference in interpersonal situations. Items were scored on a 5-point Likert scale ranging from 0 = Never to 4 = Very often. Sample items

included: "I avoid starting conversations at social gatherings" and "I am not able to tell my friends I am angry with them." This scale had an overall reliability of $\alpha = 0.83$ (males $\alpha = 0.87$; females $\alpha = 0.79$) in this sample.

Sex drive

A 4-item scale measuring frequency of experienced sexual desire was administered to the participants (SDQ; Ostovich & Sabini, 2004). The SDQ utilizes a 7point Likert scale to assess the following items: "How often do you experience sexual desire?" and "How often do you masturbate in the average month?" These items were anchored at 0 = Never to 6 = Several times a day. A 6-point Likert scale was used to assess the following item "How often do you orgasm in the average month?" This item was anchored at 0 = Never to 5 = Several times a day. Finally the following item "How would you compare your level of sex drive to the average person of your age and gender?" was assessed using a 6-point Likert scale ranging from 1 = very much lower to 7 = very much higher. This scale had an overall reliability of α = 0.85 (males 0.75; females α =0.81) in this sample.

Indirect aggression

Participants were asked to complete the 35-item Indirect Aggression Scale-Aggressor Version (IAS-A; Forrest, Eatough, & Shevlin, 2005). Sample items include: "How often have you done the following to your peers "criticized them in public", "turned other people against them", "spread rumours about them" and "used emotional blackmail on them". The IAS-A uses a 5-point Likert scale ranging from 5 = very often to 1 = never. The measure of indirect aggression had an internal consistency of $\alpha = 0.95$ overall (males $\alpha = 0.95$; females $\alpha = 0.95$), in our sample.

Psychopathy

Participants completed the 64-item Self Report Psychopathy scale (SRP-III; Paulhus, Hemphill & Hare, in press), which uses a four factor structure to capture the heterogeneity found within the personality construct of psychopathy: interpersonal manipulation, cold affect, criminal tendencies, and erratic lifestyle developed for a noncriminal, non-forensic sample. The SRP-III uses a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.

Interpersonal manipulation refers to the use of scheming, manipulating, and deceitfulness. Sample items from the Interpersonal Manipulation subscale include "I would get a kick out of "scammingsomeone," and "I purposely flatter people to get them on my side" (overall $\alpha = 0.84$; males $\alpha = 0.83$; females $\alpha = 0.81$). Cold affect refers to the disregard of other people and lack of emotional care and concern. Sample items from the cold affect subscale include "People sometimes say I'm coldhearted" and "People cry way too much at funerals" (overall $\alpha = 0.83$; males $\alpha = 0.75$; females $\alpha = 0.75$). Erratic lifestyle refers to behaviors that are reckless, impulsive, and involve an element of high risk. Sample items from the Erratic Lifestyle subscale include "I'd be good at a dangerous job because I make fast decisions" and "I enjoy doing wild things" (overall $\alpha = 0.83$; males $\alpha = 0.82$; females $\alpha = 0.80$). Criminal tendencies refer to behaviors that are mainly antisocial in nature and are deemed illegal. Sample items from the criminal tendency subscale include "I have broken into a building or vehicle in order to steal

something or vandalize" and "Every now and then I carry a weapon (knife or gun) for protection" (overall $\alpha = 0.80$; males 0.84; females 0.65).

Cortisol and Testosterone

Following procedures by Vaillancourt et al. (2008) and Vaillancourt, de Catanzaro, Duku and Muir (2009), participants were provided with *Wrigley's Extra Peppermint* sugar-free gum and asked to chew it prior to providing each saliva sample. They were instructed to supply one saliva sample in the morning (20 minutes after waking) and to produce another sample in the late afternoon (at 16:00) across 4 days, adding up to a total of 8 saliva samples.

Participants were asked to drool up to the 1 ml mark in polyethylene tube-shaped vials manufactured by Nalgene Co. All saliva samples were stored at -20° C until they were ready to be assayed for both testosterone and cortisol. For a detailed description of assaying procedures see Vaillancourt et al. (2008, 2009).

All of the four morning samples were found to be highly correlated with each other and all four evening samples were highly correlated with each other. In addition, morning samples were also correlated with evening samples. As a result, all eight of the saliva samples (i.e., morning and evening samples inclusive) were aggregated together to create an overall composite measure of testosterone and cortisol levels. Multi-level modeling techniques were used to confirm the aggregation of the data. Both testosterone and cortisol data were log transformed using log base 10 as indicated in the results section due to high variance in the sample. The internal consistency of cortsiol and

testosterone were: $\alpha = 0.83$ (males $\alpha = 0.90$; females $\alpha = 0.87$) and $\alpha = 0.86$ (males $\alpha = 0.87$; females $\alpha = 0.90$), respectively.

Results

Table 3 shows the means and SD of the variables used in this study. Of the 13 predictors used in this study, four were statistically significantly correlated with successful poaching by males and four were significantly correlated with successful poaching by females. The intercorrelations are displayed in Table 4.

Being a target for a poach was significantly correlated with self-perceived attractiveness for males and females. Moreover, for females being targeted was significantly correlated with only one of the examined variables- physical attractiveness.

Multiple regression models were used to examine the predictors of both matepoaching and being the target of poaching attempts. Each regression equation included 13 predictor variables believed to be related to experiences of poaching within romantic relationships. Because certain traits have been shown to affect poaching differently for males and females, each sex was examined independently of the other.

Successful Poaching

Of 13 predictors, only one significantly predicted successful mate poaching by females: being good-looking ($\beta = .43$, p = .01, $SR^2 = 0.10$).

For males, six of the independent variables predicted successful mate poaching: height ($\beta = .35$, p = .01, $SR^2 = 0.09$), self-esteem ($\beta = .59$, p = .01, $SR^2 = 0.11$), criminal tendencies ($\beta = .50$, p = 0, $SR^2 = 0.16$), displaying cold affect ($\beta = .42$, p = .02, $SR^2 =$ 0.09), having higher levels of cortisol ($\beta = .36$, p = .02, $SR^2 = 0.08$), and lower levels of testosterone ($\beta = -.35$, p = .03, $SR^2 = 0.08$). See Table 5 for details of our findings. *Participant reports of being the target of poaching*

For females, being good looking ($\beta = .40$, p = .03, $SR^2 = 0.04$) predicted being a target of poaching, as it did for males ($\beta = .46$, p = 0.04, $SR^2 = 0.09$). None of the other study variables predicted being the target of poaching.

Discussion

The present study examined the hormonal, dispositional and behavioral qualities believed to be advantageous to human mating and examined their independent contributions to two important aspects of mate poaching—poaching and being poached. *The poachers*

Consistent with the literature showing that physically attractive females are more successful at attracting romantic partners (Rhodes et al. 2005), females in this study who reported that they were attractive also reported being more successful at poaching. For females, none of the other hormonal, dispositional and/or behavioral mate-value traits were associated with successful poaching. We suggest that none of the other traits may have influenced being a successful poacher for females because of the premium males impose on physical attractiveness (e.g., Buss & Schmitt, 1993). Indeed, studies have shown that attractiveness in females is the most important determinant in eliciting romantic interest and in acquiring a larger quantity of dates for romantic purposes (e.g., Berscheid & Walster, 1974). Research on speed-dating confirms the importance of physical attractiveness on selecting a mate, in which, participants of an adult dating

service who were better looking were more successful at gaining dates (e.g., Kurzban & Weeden, 2005).

Consistent with past research showing females prefer taller males in unattached romantic relationships, it follows that, in the context of mate-poaching, taller men should also be more successful (e.g., Nettle, 2002a;, 2002b). This prediction was supported in the present study. Moreover, for males, self-esteem, displaying cold affect, criminal tendencies, physical attractiveness, and higher levels of cortisol were also all positively associated with successful poaching attempts.

It was not surprising to find that higher levels of cortisol were associated with successful mate poaching behavior in men as previous studies have associated higher cortisol with both impulsivity (King, Jones, Scheuer, Curtis, & Zarcone 1990) and extroversion (e.g., Oswald et al., 2006; Schommer, Kudileka, Hellhammer, & Kirchbaum, 1999), factors shown to influence mate poaching (Schmitt & Buss, 2001). It was, however, surprising that lower levels of testosterone were associated with successful mate poaching. This result may be due to the fact that our sample was drawn from undergraduate students living in co-ed residence buildings. Studies have shown that male testosterone levels decrease when married and/or in a long-term committed relationship to females (e.g., Burnham et al., 2003). It is possible that the lower levels of testosterone found in our sample mirror the findings of other studies which have shown that males who are in long-term relationships have lower levels of testosterone because of the constant close proximity to females. An alternative possibility is that the males in our sample who were deemed physically and behaviorally attractive to females would also be

more likely to have opportunities to engage in sexual intercourse more often, thereby temporarily lowering their androgen levels reflecting sexual satiety due to their recent mating experience (e.g., Romano-Torres, Phillips-Farfan, Chavira, Rodriguez-Manzo, & Fernadez-Guasti, 2007). Studies have also found that testosterone and cortisol have an inverse relationship (e.g., Terburg, Morgan, & van Honk, 2009), suggesting that it is possible that the androgen dynamics of this study were largely of adrenocortical origin (see Vaillancourt et al., 2009). Finally, we entertain the possibility that less masculine males with lowered levels of testosterone may appear less threatening to "poaches" thereby allowing them increased access to the target in order to successfully infiltrate the relationship.

Individual characteristics known to comprise mate-value, such as physical attractiveness in females, have shown to be related to high self-esteem (e.g., Patzer, 1996). It is plausible that those higher in mate-value characteristics are more likely to engage in mate poaching behavior, because they may perceive themselves as having an increased likelihood of success in luring away a partner involved in a romantic dyad and a lower probability of rejection. Brase and Guy (2004) found the possession of a greater number of mate value characteristics predicted higher self-esteem, known as the *sociometer hypothesis* (also see Kirkpatrick & Ellis, 2001). The results of the present study support the *sociometer hypothesis* showing a positive correlation between successful mate poaching and self-esteem. In effect, the decision to mate poach may be predicated on one's own evaluation of self attractiveness. It is also tenable that the

direction may be reversed insofar as successful poaching and being the target of a poach can contribute to one's increased self-esteem and self-attractiveness ratings.

Consistent with Williams et al. (2005), our results supported that certain elements of psychopathy, including cold affect and criminal tendencies, were associated with being a successful poacher among male participants. Schmitt and Buss (2001) suggest low empathy can facilitate the poacher to not be concerned with the person who's mate they are stealing; a suggestion which corroborates with our finding insofar as cold affect in men enhances mate poaching success. Moreover, some have argued that psychopathy may have evolved as a unique short-term mating strategy (e.g., Jonason, Li, Webster, & Schmitt, 2009), which may also be implicated in mate-poaching endeavors.

The poached

In regards to being the target of others' poaching attempts, both males and females tended to rate themselves as being better looking than their non-poached counterparts. This finding was consistent with the literature highlighting the importance of physical attractiveness in the realm of mating; suggesting physically attractive individuals annex a greater number of sexual partners (e.g., Bogaert & Fisher, 1995; Buss, 1994; Fisher, 1958). In the present study, none of the other variables examined were associated with being poached for either sex.

Limitations

A limitation of the present study was the primary use of self-report data; however, as Schmitt and Buss (2001) noted the surreptitious nature of mate poaching renders it difficult to study through observational methods.

We also acknowledge that the list of mate-poaching variables used in the present study is not exhaustive. It has been recently questioned as to whether attractiveness is the best predictor of mating success. Puts (2010) has argued that success in contest competition may be more important in predicting mating success. Hodges-Simeon, Gaulin, and Puts (2010) showed that a voice feature associated with dominance, but not physical attractiveness, was associated with mating success. Other variables of importance to mate poaching attraction can include but are not limited to athletic ability, muscularity, and strength which were not examined in the present study.

Another limitation of the present study was the assessment of degree one defects from an existing relationship. In the present study, poaching can refer to any form of defection from an existing romantic dyad and was left open-ended for the participant to evaluate. From the perspective of the poached, for example, the use of the term poaching can cover a broad spectrum of behaviors including but not limited to kissing someone else while in a relationship, agreeing to go out on a date with the poacher, a one-night sexual liaison with another person while maintaining the existing relationship or abandoning one's current mate to engage in a more long-term romantic relationship with someone else.

A third limitation of the present study was the use of an undergraduate student sample. As Buss and Schmitt (2001) suggested, the extent to which mate poaching is overrepresented in young adults and the degree to which these findings can be generalized to other samples remains unknown. Undergraduate students are typically unmarried and, although they do form long-term relationships (e.g., Buss, Larsen,

Westen, & Semmelroth, 1992), it is likely that many of their relationships are also ephemeral and transient. Future research could profit from examining the personality profiles of the poachers and the poached in other age brackets and/or in married couples.

Another limitation is to compare the number of successful mate poaches to the mate poaching success rate. It is entirely possible that people who have successfully mate poached more often are in actuality worse at mate poaching. This is may be a consequence of making more attempts and thereby increasing one's odds of finding a mate opposed to achieving success through a smaller proportion of attempts. Future research can benefit from calculating proportions of unsuccessful mate poaching attempts to successful mate poaching occurrences for each participant.

Finally, we recognize both testosterone and cortisol are dynamic hormones that exhibit a clear circadian rhythm (e.g., Dabbs, 1990; for a review see, Mazur & Booth, 1998) and are known to be sensitive to context. For example, simply winning a competitive bout can lead to a sharp spike in testosterone for males (e.g., Bernhardt et al., 1998; Booth et al., 1989). Using a global estimate accessed via multiple measures of testosterone allows researchers to examine 'trait' testosterone and thus guard against dramatic fluctuations in testosterone due to an isolated emotional occurrence on a specific day/time (e.g., see Dabbs, 2000 for a collection and summary of empirical studies treating single and/or multiple samples of testosterone as a fixed trait).

Despite these limitations, the present study was novel in that a set of different hormonal, dispositional, and behavioral mate-value traits that have not been previously investigated until now were incorporated. Future research could benefit from

investigating person-situation interactions in terms of mate-poaching. For example, the present study examined individual differences but other studies have proposed situational factors from the mate poacher's perspective, such as an inability to find a viable mate through normal channels of attraction and/or the use of a short-term mating strategy lending itself to engaging in mate-poaching attraction. From the perspective of the "poached", situational factors such as better options in the mating market presenting itself (i.e., trading upwards), dissatisfaction with one's current relationship, the thrill of initiating a clandestine romance with another partner and/or the novelty of initiating a new romantic dyad may all interact with personality dispositions to better profile the characteristics of the "poacher" and the "poached."

Future studies could also benefit from ascertaining the qualities that lead poachers to attempt yet fail to lure away a target. In a similar vein, the field of mate poaching attraction has understudied the mate "poachee" Moreover it has also failed to distinguish between those who successfully retain their mate versus those who unsuccessfully defend against a same-sex rival, ultimately surrendering their romantic partner to the poacher that had initially created the wedge in his/her relationship.

Conclusion

The present study contributes to the rather elusive topic of mate poaching attraction by commencing the process of profiling the traits that characterize the two members of the poaching dyad (i.e., the poacher and the poached). This advancement subsumed under the broader topic of human mating assists in deciphering the personality types involved in a central aspect of human experience-- mate poaching.

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	Ν		Ν	1	SI)	Range		
	Female	Male	Female	Male	Female	Male	Female	Male	
Successful Poaching	89	62	0.53	0.42	1.25	0.96	6.00	8.00	
Target of being poached	79	56	2.04	2.76	2.24	2.72	11.00	10.00	
Height (inches)	85	62	5.49	5.05	0.46	0.15	22.68	11.94	
Weight	84	61	169	136	21.80	23.92	110.00	163.00	
Self esteem	89	62	3.07	3.11	0.62	0.47	2.30	2.70	
Good looking	91	62	5.03	4.95	1.46	1.11	5.00	6.00	
Erratic lifestyle	90	59	3.12	2.69	0.56	0.54	2.81	3.13	
Criminal tendencies	89	58	1.82	1.45	0.59	0.37	1.75	2.69	
Cold affect	91	60	2.85	2.16	0.47	0.44	2.63	2.44	
Interp. Manip.	89	59	2.95	2.50	0.54	0.51	2.38	2.88	
Indirect aggression	88	63	1.06	0.90	0.56	0.15	2.44	3.32	
Sex drive	81	57	3.37	2.00	0.89	1.09	4.50	5.25	
Submissive	89	63	1.65	1.68	0.58	0.49	2.56	3.38	
Log 10 (C)	83	60	3.76	3.89	2.99	3.05	5.86	4.17	
Log 10 (T)	81	59	45.85	48.57	6.96	8.17	3.50	3.99	

Table 3. Descriptive statistics by sex.

Table 4. Intercorrelations by sex

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Successful poaching		.55**	.00	14	.08	.25*	.27*	.23*	.18	.28**	.11	.17	09	.04	.16
2. Target being poached	.17		.03	05	.05	.21	.25*	.15	.34**	.42**	.19	.14	02	03	10
3. Height	.24	.12		.21	.08	.05	.23*	.24*	.03	.07	.08	.18	.01	07	13
4. Weight	.14	.00	.38**		04	15	.03	.01	.11	03	.24*	.14	.05	16	05
5. Self esteem	.28*	.11	.15	.09		.37**	12	00	21	18	29**	.00	56**	.06	12
6. Good looking	.21	.34*	.09	.09	.60**		.04	.19	05	02	.07	.20	45**	.12	.13
7. Erratic lifestyle	.28*	.10	.20	.34**	.26*	.39**		.52**	.55**	.41**	.36**	.13	.05	.20	.14
8. Criminal tendencies	.33*	14	.00	.15	.56**	.10	.45**		.40**	.40**	.35**	.13	14	04	.12
9. Cold affect	.37**	.20	.16	.32*	16	.20	.53**	.33*		.62**	.57**	.03	02	17	.03
10. Interpersonal manipulation	.17	.12	.12	.25	.19	.31*	.64**	.39*	.65**		.62**	.04	.08	25**	05
11. Indirect agression	.11	.09	.12	.12	.09	.17	.47**	.28*	.37**	.64**		.09	.09	14	.00
12. Sex drive	.07	.26	.06	.21	.14	.14	.24	.02	01	.12	.27*		09	.01	15
13. Submissive	19	26	11	28*	60**	49**	35**	07	29*	24	.24	36**		04	.00
14. Log 10 (C)	.10	08	.00	25*	17	02	02	.05	.00	02	.08	03	.15		.36**
15. Log 10 (T)	17	14	06	18	25	23	13	.03	09	00	.08	.20	.15	.47**	

 $\log 10 (C) = \log (\text{cortisol ng/ml}); \log 10 (T) = \log(\text{testosterone pg/ml});$ Female data are presented above the diagonal and means and standard deviations are shown in brackets. *correlation is significant at the 0.05 level (2-tailed); ** correlation is significant at the 0.01 level (2-tailed).

	Successful	Poacher	Target of Poaching Attempts			
-	Female (ß)	Male (ß)	Female (ß)	Male (ß)		
Height	06	.35*	07	.22		
Weight	22	.06	02	.04		
Self-esteem	.01	.59*	.05	25		
Good looking	.43*	.02	.40*	.46*		
Erratic lifestyle	.14	45	08	33		
Criminal tendencies	01	.50**	.00	.13		
Cold affect	02	.42*	.21	.30		
Interp. Manip.	.32	10	.19	06		
Indirect aggression	20	20	33	03		
Sex drive	02	.26	06	.28		
Submissiveness	.10	.26	.37	07		
Log 10 (C)	.25	.36*	16	12		
Log 10 (T)	09	35*	.08	.05		

Table 5. Summary of regression analyses highlighting predictors of poaching behaviour and being targeted for a poach split by sex. Control for wake time, steroid medication use, cigarette use not depicted.

* p < .05 (two-tailed), ** p < .01 (two-tailed)

CHAPTER 5

GENERAL CONCLUSION

The preceding chapters highlight the interrelations among self-serving traits and behaviours (i.e., dominance, psychopathy, indirect aggression, mate poaching). Study 1 showed that dominance was linked to increased levels of testosterone in men and women whereas the aggregation of popularity, power, and the prestige construct was linked to lower levels of testosterone in men and women. These findings are consistent with empirical data showing links between testosterone and dominance in humans (see Mazur & Booth, 1998 for a review). The significance of this study is that it four separate types of social status are examined. In the peer relations literature, researchers typically focus on power and popularity as the main types of social status. Moreover, the relationship between testosterone levels and social status is rarely examined within the field of peer relations. In evolutionary psychology, dominance and prestige are the constructs which are typically used when examining social status. This dissertation takes an integrative approach to the study of social status and to tease apart the various conceptualizations of this variegated construct. The results of Study 1 bring to the forefront two issues for researchers to explore: 1) contrary to existing theoretical conceptualizations, this study suggests there is little difference among popularity, power, and prestige - although future experimental research is needed to confirm this assertion. 2) The items used to measure popularity, power, and prestige may need further refinement in order to accurately gauge differences for these constructs.

In Study 2, for women but not for men, lowered levels of cortisol were associated with higher levels of primary psychopathy, whereas higher levels of cortisol were associated with higher levels of secondary psychopathy. In this study, stronger links were found between primary psychopathy and indirect aggression than between secondary psychopathy and indirect aggression. The significance of the findings presented in Study 2 support the notion that lowered levels of empathy combined with a reduction in fear (both characteristics of primary psychopathy) likely enable an individual to inflict surreptitious harm onto a target. Study 2 is a logical extension of recent work in this area, and is one of the first studies to link both primary and secondary psychopathy to cortisol levels using a non-clinical sample.

Dominance, indirect aggression, and psychopathy facilitate an individual's ascension within a social hierarchy. The emerging theme of improving one's social standing links Study 1 and Study 2 together. For example, recent studies have linked social status with the use of indirect aggression (Cillessen & Mayeux, 2004; Prinstein & Cillessen, 2003; Rose, Swenson & Waller, 2004; Vaillancourt & Hymel, 2006). Some scholars have suggested the use of indirect aggression is an effective strategy for both social status accrual and mate competition (Vaillancourt, 2005) and can be deemed as highly adaptive behaviour (Hawley & Vaughn, 2003).

In Study 3, the acquisition of mates is studied within the specific context of mate poaching. The dearth of scholarship on mate poaching renders this study a useful contribution to the empirical literature. Study 3 showed that in females, successful poachers were characterized by self-reported physical attractiveness. None of the other

measured traits were statistically significant in predicting poaching success. Males and females who were physically attractive also reported being the target of a mate poach. These results are consistent with previous studies that show physical attractiveness is one of the most important variables when it comes to opposite-sex romantic mate attraction (e.g., Buss, 1989; Buss & Barnes, 1986; Buss & Schmitt, 1993; Ford & Beach, 1951; Berscheid & Walster, 1974; Langlois et al., 2000; Schmitt & Buss, 2001) and that physical beauty is especially important for males when selecting a female partner because of the imposed premium they place on it (e.g., Buss & Schmitt, 1993). Again, none of the other variables measured predicted being targets of a mate poach. For male poachers, the results were more complicated, likely reflecting the heterogeneity of female mate preferences (Buss & Shackelford, 2008). Male mate poachers were characterized by higher cortisol, self-esteem, cold affect and criminal tendencies scores and lower testosterone levels. Cold affect and criminal tendencies are sub-dimensions of the overarching trait of psychopathy thereby allowing the poaching male to steal someone else's partner with ostensibly less guilt and less fear of retaliation from their sexual competition. In evolutionary terms, a successful mate poacher poses a major threat to the rival already in the existing mateship by potentially stifling the opportunities to reproduce with the female. The possession of psychopathic traits for a mate poacher can aid them in their goal to lure away their target with minimal concern for the victim of a poach (see Schmitt & Buss, 2001).

Cortisol was another variable examined in Study 3, to determine if it would be associated with mate poaching behaviours. The specific relationship of cortisol to the

behavioural pattern of mate poaching is unclear. In Study 3, positive correlations were found between cortisol levels and frequency of successful mate poaching but experimental data are required to verify this relationship. It is likely that the aforementioned traits are necessary in a poaching encounter such as a display of social competence and confidence which increase the likelihood of poaching success. We also examined the role of testosterone which was surprisingly inversely related to successful poaching. This result, however, may be a by-product of successful mate poachers engaging in more frequent sexual intercourse thereby reaching their level of sexual satiety more rapidly. Sexual satiety has been shown in previous studies to be associated with temporarily lowered testosterone levels (e.g., Romano-Torres et al., 2007).

Limitations

All of the studies that are presented within this dissertation share a number of common limitations. The use of self-report information in all of these studies render the data susceptible to an assortment of biases including but not limited to: impression management effects, self-deception, the overestimation of positive traits and the underestimation of negative traits. However, some of these results were qualified by the recruitment of a large sample size to reduce the effects of any outliers, the careful monitoring of participants' surveys for any response style biases, and most importantly, having an awareness that the scores on any psychological measure were not absolute but rather relative in nature. The production of saliva samples by the participants in the studies comprising this dissertation were not witnessed by anyone from our research team. Therefore, saliva samples run the risk of being tampered with by the participants
recruited for the above studies- albeit this is unlikely since there is no inherent motivation to tamper with the data built into the research design. Moreover, all three studies relied on an undergraduate sample thereby limiting the generalizability to other demographic groups of society. Another limitation of the present study is female menstrual cycling was not controlled for. The stage of a female's menstrual cycle is a known factor in influencing cortisol and testosterone levels (Gardner & Shoback, 2007; Judd & Yen, 1973). Finally, the results of all of these studies presented were correlational and not causal. Future research using an experimental design could be helpful in confirming the veracity of the results found within this dissertation.

Implications

The implications of this dissertation transcend academic scholarship. Dominance and the use of indirect aggression are commonplace in locations where groups of people congregate for a shared purpose such as school, work, and sports. Studies on social hierarchies in the workplace (e.g., Fournier, Moskovitz, & Zuroff, 2001) and indirect aggression in the workplace (e.g., Schat, Frone, & Kelloway, 2006) are surfacing within the scholarly literature. Hierarchies and bullying in the workforce can contribute to stress and job dissatisfaction (see Schat & Kelloway, 2005 for a review). This dissertation has provided support or has implicated the idea that personality traits such as psychopathy and dominance are related to the use of indirect aggression and thus there is a greater need to circumvent harassment in applied settings such as in schools and in the workplace. Fortunately, research on initiatives and on the buffering effects that aid in reducing aggression within the workplace are being conducted (e.g., Schat & Kelloway,

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2003). Moreover, there is no shortage of research on efforts to reduce bullying within the school system (e.g., Horne, Stoddard, & Bell, 2007; Baldry & Farrington, 2004; Vreeman & Carroll, 2007). These aforementioned studies highlight the need to better understand dominance and indirect aggression in applied contexts because of the physical/ mental health issues and economic costs associated with being victimized in this process. Taken together, the studies reviewed herein support Keltner, Gruenfield and Anderson's (2003) argument that social stratification is ubiquitous.

Finally mate poaching, albeit understudied, bears implications with respect to the high divorce rates (e.g., Davis, Smith & Marsden, 2005; Laumann, Gagnon, Michael, & Michaels, 1994). Defection from a relationship is one of the most reported reasons for the dissolution of a relationship (Amato & Rogers, 1997; Atkins, Baucom, & Jacobson, 2001). The deserted partner of a mate poach often experiences a range of negative emotions including anger, jealousy and sadness (e.g., Glass & Wright, 1988; Greene, Lee, & Lusting, 1974; Whisman, Dixon, & Johnson, 1997). Scholars and practitioners alike in the field of couples and marital therapy address the importance of commitment in a romantic relationship (see Gottman, 1999 for a review). Straying away from an existing relationship is a display of lowered commitment on the part of the defector and can often involve an 'interloper' (i.e. the mate poacher) who entices or at the least offers an invitation to engage in an affair. In the field of clinical-counselling psychology, a better understanding of the individual involved in the 'love triangle' who attempts to seduce another away from their current romantic dyad would be important before any remedy can be proposed to console the party whose partner has strayed away from him/her.

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This research presented herein suggests that dominating others, using indirect aggression, and poaching away someone else's partner are various possible strategies that can increase one's odds in both social and mating success.

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