Developmental and mating preference differences in primary and secondary psychopathy

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Abstract

There is a long-standing debate regarding developmental differences in primary and secondary psychopathy, and what these differences say in terms of their evolutionary origins. Although both are thought to be fast life history strategies that are adaptive in harsh and unpredictable environments, primary psychopathy is thought to have a genetic basis, while secondary psychopathy is thought to be caused by environmental factors. The aim of the thesis was to contribute further to the debate by investigating hitherto unexamined factors in the development of primary and secondary psychopathy using a Life History, Parental Investment Theory perspective. Specifically, whether quality of parental bonding, quality of attachment in close relationships, and fetal programming (pertaining to prenatal testosterone exposure) differed between men and women high in primary or secondary psychopathy. The contribution of prenatal testosterone to callous unemotional traits and externalising behaviours in children was also examined. Furthermore, as putative adaptive personality types, the attractiveness of primary or secondary psychopathy in partners to heterosexual men and women high or low in primary or secondary for short and long-term mating was investigated. The thesis consists of four studies that utilised a series of questionnaires, the 2D:4D digit ratio and vignettes measured in non-clinical samples:

Chapter 2 explored differences between men and women high in primary or secondary psychopathy in recollections of how cold and controlling their parents were during childhood alongside attachment style in adulthood. Primary psychopathy in men was associated with avoidant attachment and uncaring mothers, while in women it was related to uncaring fathers and anxious and avoidant attachment. Secondary psychopathy in men related to uncaring mothers and fathers, while in women it was not related to parental bonding quality or either attachment type.

Chapter 3 examined the quality of maternal bonding and exposure to prenatal testosterone (2D:4D ratio) as influences in the development of primary or secondary psychopathy between men and women. The findings re-confirmed differences between sex and psychopathy variants.

Chapter 4 investigated the effects of exposure to higher levels of prenatal testosterone (2D:4D ratio) on callous unemotional traits (CU) and externalising behaviour in children aged 5-6 years old. CU traits were found to moderate the relationship between prenatal testosterone and externalising behaviour.

Chapter 5 explores the attractiveness and mating preferences of men and women high or low in primary or secondary psychopathy for short and long term relationships. Men high in primary or secondary psychopathy did not discriminate in mate choice in either relationship context, however women high in primary or secondary psychopathy preferred their opposite sex equivalents in short and long-term relationships. Men and women low in primary or secondary psychopathy preferred partners equivalent to them in psychopathy regardless of relationship length.

In summary, the results of this thesis demonstrate differences in psychopathy variants between men and women, as well as in children, further highlighting contrasts in genetic and environmental contributions to primary and secondary psychopathy. Moreover, the variations between men and women high in primary or secondary psychopathy appear to function according to inequity in parental investment which also informs their mating preferences in short and long term mating.

For Honey and Ruby

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1. Introduction

Initially described by Pinel (1801) as "manie sans delire" (mania without delirium), psychopathy had been classified as a unique psychiatric condition by the end of the 19th century (Koch, 1891). Unlike other psychiatric patients however, psychopaths did not experience psychotic episodes as part of their disordered behaviour. This lack of disturbance led psychiatrist Harvey Cleckley to title his seminal book on psychopathy "The Mask of Sanity" (1941). "The Mask of Sanity" presented a behavioural-based approach to the disorder, although despite the impact of Cleckley's work for both theory and practice, it was questioned whether he had been over inclusive in his diagnosis of, and to what extent his patients' illnesses were truly representative of psychopathy (Hare & Neumann, 2008).

1.2. The two-factor model/ Primary psychopathy and Secondary psychopathy

It was shortly after the publication of "The Mask of Sanity" that the two-factor model of psychopathy became established. The two-factor model attempted to meaningfully categorise types of psychopathic behaviour beyond Cleckley's (1941) over-inclusive conceptualisation. Karpman (1948, p 523) made the distinction between behaviours that indicated a "specific mental disease… having in particular a virtual absence of any redeeming social interaction" from "psychoses and neuroses that have a strong antisocial or delinquent aspect", and categorised them as primary psychopathy and secondary psychopathy respectively. Findings from later research supported the two-factor model, and revealed fundamental differences between primary and secondary psychopathy (Lykken, 1957; Newman, MacCoon, Vaughn, & Sadeh, 2005).

For example, Lykken (1957) found that primary psychopaths demonstrated poor avoidance learning and abnormal fear processing (i.e., low anxiety) in a Generalised Skin Response test to electric

shocks. Problems with empathy and emotion recognition were also established as central features of primary psychopathy (Blair, 2005; Hicks & Patrick, 2006; Lishner, Swim, Hong, & Vitacco, 2011). Such deficits in fear and empathic responding explained primary psychopathic traits such as callousness, manipulation, and shallow affect (Hare, 2003). Consequently, primary psychopathy/Factor 1 was defined as the personality based dimension of psychopathy (Hare, 2003).

By comparison, secondary psychopathy is consistently associated with high anxiety (Levenson, Kiehl, & Fitzpatrick, 1995; Lykken, 1957; Skeem, Johansson, Andershed, Kerr, & Louden, 2007), negative emotionality, poor emotional control, and neuroticism (Anestis, Anestis, & Joiner, 2009; Donahue, McClure, & Moon, 2014; Hicks & Patrick, 2006; Lishner et al., 2011; Kimonis, Skeem, Cauffman, & Dmitrieva, 2011; Porter, ten Brinke, Baker, & Wallace, 2011; Vidal, Skeem, & Camp, 2010; Jakobwitz & Egan, 2006) which explains why impulsive and antisocial behaviours are characteristic of secondary psychopathy. Therefore, secondary psychopathy/Factor 2 became defined as the lifestyle and antisocial behavioural dimensions of psychopathy (Hare, 2008).

That primary and secondary psychopathy are characteristically distinctive has been attributed to differences in their developmental trajectories. Primary psychopathy is thought to stem from a genetically driven core neurological deficit that causes (principally) abnormal functioning of the amygdala, leading to abnormal fear recognition and poorer empathic responding (Blair, 2005; 2006; although many other brain regions and neurological functions are also implicated). Secondary psychopathy is attributed to emotional disturbance caused by environmental factors principally adverse childhood experience, compounded by an irritable temperament (Yildirim & Derksen, 2015). Developmental differences between primary and secondary psychopathy have consequently generated debate regarding the evolutionary origins of each psychopathy variant.

1.3. Evolutionary Psychology

Evolutionary Psychology (EP) was originally concerned with explaining the origins of "human nature". Human behaviour was theorised to stem from psychological adaptations that had evolved to address fitness-related "domain specific" problems repeatedly encountered by ancestral humans (Buss, 1991; Tooby & Cosmides, 1990). For example, sexual jealousy is a strategy for addressing sexual infidelity in a mate (Tooby & Cosmides, 1990). Such behaviour is continually and adaptively recalibrated in relation to the environment, prompting the activation (or not) of the relevant psychological adaptation. So, sexually jealousy should cease once the suspicion of sexual infidelity has gone. Thus, EP made a novel and important contribution to psychology by explaining the *why* rather than the *how* of human behaviour.

That EP concerned only universal features of human nature meant that some evolutionary psychologists considered heritable differences in personality relevant only to behavioural genetics, and not subject to evolutionary pressures. Personality traits resulted from genetic noise or were by-products of other psychological adaptations and are therefore non-adaptive and selectively neutral (Tooby & Cosmides, 1988; 1990). Yet, others have since made a case for the adaptiveness of individual differences (e.g., Belsky, Steinberg, & Draper, 1991; Penke, Denissen, & Miller, 2007; Nettle 2006, Kaplan & Gangestad, 2005). Buss (1991) suggests that personality is either a heritable alternative strategy maintained by balancing selection; a heritable calibration of psychological mechanisms shaped by environmental oscillations; a niche contingent alternative strategy; or a product of behavioural plasticity, whereby psychological mechanisms are calibrated according to developmental experience. Personality could be further considered as the overall output of a psychological adaptation for navigating complexities of human social interaction (Michalski & Shackelford, 2010). Universal personality traits such as those specified by the Five Factor Model (Costa & McCrae, 1985) may

have emerged due to their utility in communicating information about an individual's social disposition. For example, conscientiousness indicates reliability (important in reciprocal exchange), extraversion signals social adeptness, and agreeableness, the likelihood of cooperation (Michalski & Shackelford, 2010). Thus, despite contrasting theories on how personality is an evolutionary adaptation, evolutionary theory can be successfully applied as a framework for understanding personality (Michalski & Shackelford, 2010).

1.4. Psychopathy as an evolutionary adaptation

EP has been particularly successful in changing perceptions of adverse personality styles and psychopathologies by highlighting how they can afford fitness within particular environments. In particular, psychopathy is hypothesised to be a "cheater - defector" strategy that exploits trust between cooperative conspecifics (Barr & Quinsey, 2004; Figueredo et al., 2006; Mealey, 1995). In Prisoners' Dilemma Game studies, most people are shown to be cooperative (Nesse & Ellsworth, 2009), and individuals who do not cooperate are rejected by peers, live on the margins of society, and consequently incur health problems (Luo, Hawkley, Waite, & Cacioppo, 2012). Such is the importance of social inclusion that humans will make significant effort to avoid being ostracised, by monitoring their group membership and making efforts to rectify transgressions when they occur (Feinberg, Willer, & Schultz, 2014). However, the trust required to maintain cooperative relationships between individuals is vulnerable to psychopathic individuals who are willing to transgress social rules and illegitimately obtain resources from other people. Indeed, that psychopathy is evidenced cross-culturally indicates that it is a universal adaptation to human social groups that are reliant on cooperative interactions between group members (Ridley, 1997; Wright, 1994; Cooke, Michie, Hart, & Clark, 2005).

Despite considerable focus given to the negative outcomes (usually criminal) of psychopathy, beyond operating in altruistic environments, being high in either primary or secondary psychopathy is

advantageous when resources are uncertain or surviving long enough to have children is under question. Being emotionally unresponsive reduces the impact of situations that others would find very stressful, and aids in being able to formulate plans and find ways out of danger. The ability to charm people reduces the likelihood of physical harm when they find out that they have been conned. Conversely, being hyper-responsive to situations and in being quick to aggress (but not necessarily leading to violence) may allow an individual to protect themselves, their family and resources from others. The forensic emphasis given to psychopathy has been questioned as it goes beyond what Cleckley first defined the construct as (Skeem & Cooke, 2010), and ignores how psychopathy can work adaptively in particular contexts without necessarily leading to criminal behaviour wanting of incarceration. The temporal and spatial conditions of the environment should therefore be considered as it is likely that psychopathy is an optimal personality style for that particular context, and should not be expected to necessarily result in illegal outcomes.

There is good reason to argue that psychopathy is an adaptive, fitness affording cheater strategy. For example, numerous deceptive and exploitative personality traits and behaviours are associated with psychopathy (Billings, 2004; Hare, 1993; Seto, Khattar, Lalumiere, & Quinsey, 1997; Baughman, Jonason, Lyons, & Vernon, 2014). Furthermore, psychopathy has not been eradicated through natural selection. However, only a limited number of psychopaths can survive within a population. Cooperation would break down in groups with a higher proportion of cheaters, and non-psychopathic conspecifics would be too alert to the possibility of being exploited. Indeed, Hare (2003) has estimated a prevalence of 1% of psychopaths, which supports the argument that the perpetuation of psychopathy in a population relies on only a few psychopathic individuals exploiting the majority (i.e., a negative frequency dependent strategy (Mealey, 1995; Barr & Quinsey, 2004)). Thus psychopathy is arguably a dynamic, evolutionary stable strategy.

1.5. Life History Theory and psychopathy

Life History (LH) Theory is a mid-level evolutionary theory that links reproductive output to environmental conditions. To optimise reproductive output, individuals adaptively respond to cues from the environment that signal information about available energetic resources and shift development of their reproductive schedule accordingly (i.e., developmental plasticity) (MacDonald, 1988). Reproductive schedules concern key life events such as postnatal growth rate, age at first reproduction, inter-birth intervals, and life expectancy (Ellis, Figueredo, Brumbach, & Schlomer, 2009; Kaplan & Gangestad, 2005). When the environment is high in extrinsic morbidity-mortality, an individual should hasten their fertility schedule and make reproduction a priority at the expense of somatic investment. When extrinsic morbidity-mortality is low, individuals have more time to procure additional energy from the environment for growth and maintenance (Del Giudice, Ellis, & Shirtcliff, 2011).

Despite being unique in dedicating considerable resource to somatic investment, like other species, humans demonstrate differences in reproductive output according to environmental conditions. For example, younger age of parenthood is evident in families from low socio-economic backgrounds (Nettle & Cockerill, 2010; Wilson & Daly, 1997). Daughters of single-parent or step families are shown to mature quicker, reach puberty earlier and reproduce at an earlier age (Hackman & Hruschka, 2013, Belsky et al., 1991). Exposure to mortality cues can shift a preference to short-term mating (Dunkel, Mathes, & Decker, 2010) and earlier age of reproduction in people who, in comparison to those from wealthier backgrounds, retrospectively rate their childhood family income and socio-economic status as low (Griskevicius, Delton, Robertson, & Tybur, 2011; Griskevicius, Tybur, Delton, & Robertson, 2011).

LH strategies comprise a cohesive suite of traits and behaviours that work in concert to facilitate the appropriate *fast* or *slow* reproductive schedule and should therefore be selected for together

(Gladden, Sisco, & Figueredo, 2008). Those that are characteristic of a fast LH strategy are "*r*" selected, while those that are of a slow LH strategy are "*K*" selected (Rushton, 1985). Whether a LH strategy is fast or slow can be discerned from what type of LH trade-offs are prioritised in terms of current versus future reproduction; mating versus parenting effort, and offspring quality versus quantity. Individuals pursuing a fast LH strategy allocate resources to ongoing reproduction of more children of lower quality.

Psychopathy has been identified as a fast LH strategy because behaviours and traits associated with psychopathy characterise a lifestyle that enables short-term mating. For example, individuals high in psychopathy traits engage in more casual sex (Jonason, Luevano & Adams, 2012), risky sexual behaviour (Fulton, Marcus, & Payne, 2010; Seto et al., 1997), infidelity (Egan & Angus, 2004; Jones & Weiser, 2014), demonstrate low relationship commitment (Adams, Luevano, & Jonason, 2014), unrestricted sociosexuality (Holtzman & Strube, 2013; Mouilso & Calhoun, 2012), and dedicate more effort to mating (Charles & Egan, 2005; Egan et al., 2005; Otter & Egan, 2007). They employ aggressive mating tactics such as mate poaching (Kardum, Hudek-Knezevic, Schmitt, & Grundler, 2015), sexual aggression, and coercion (Harris, Rice, Hilton, Lalumiére, & Quinsey, 2007; Mouilso & Calhoun, 2012). They also pursue a game-playing love style (Jonason & Kavanagh, 2010), ridicule the reputation of love rivals (Goncalves & Campbell, 2014), and make for hostile partners (Horan, Guinn, & Banghart, 2015). Furthermore, traits commonly associated with psychopathy such as low empathy, low agreeableness, low conscientiousness, manipulation, lying, impulsiveness, callousness, and risk taking behaviour etc., would, for individuals pursuing a slow fast LH strategy, seem undesirable in a long-term partner, nor in a parent (although in fast, LH strategy contexts, these traits may be attractive for the purposes of acquiring resources more readily as well as prompting short-term sexual relationships). They even devalue kindness in both long term and short-term mates (Jonason, Valentine, Li & Harbeson, 2011). By comparison, slow LH strategists are attached to romantic

partners, do not dedicate time to mating (Figueredo et al., 2005), are satisfied with their romantic relationship (Olderbak & Figueredo, 2010), are less likely to break up with their romantic partner (Olderbak & Figueredo, 2010), consider themselves and their partner as having high mate value (Dillon, Adair, Wang, & Johnson, 2013), and rate themselves as supportive parents (van der Linden, Figueredo, de Leeuw, Scholte, & Engels, 2012). Therefore, psychopathy appears to be fast LH strategy, comprised of a suite of "*r*" selected traits that enable psychopathic individuals to cheat other people for mates and resources.

1.6. Primary and secondary psychopathy as phenotypically similar, but etiologically different

To argue that psychopathy functions as a fast LH strategy implies that the same must apply to primary and secondary psychopathy, although specific features indicate that they function differently. For example, both subtypes consist of traits that complement short-term mating, however, callousness and manipulative features of primary psychopathy perhaps reflect a more exploitative mating strategy, while impulsive and erratic aspects of secondary psychopathy suggest a more opportunistic approach to mating. These differences question whether primary and secondary psychopathy are subject to the same selection pressures (Glenn, Kurzban, & Raine, 2011). Indeed, LH strategies can differ between and within species according to niche, temporal and spatial changes to the landscape in which the niche exists, phylogenetic history and current condition of the organism (Ellis et al., 2009). LH strategies are therefore transmitted genetically between generations or emerge within a generation when necessitated by environmental change. Primary and secondary psychopathy are hypothesised to follow such developmental trajectories (Mealey, 1995). Primary psychopathy is an inherited, negative frequency dependent cheater strategy that originated in ancestral humans during the Environment of Evolutionary Adaptedness (Mealey, 1995), and developed as part of the psychological arms race in which altruism became established as the

preferred fitness affording strategy. Yet secondary psychopathy is purported as the outcome of behavioural plasticity, a conditional adaptation to adverse environments when a cheating strategy confers fitness. Essentially, secondary psychopathy is a "phenocopy" of primary psychopathy (Mealey, 1995, Glenn et al., 2011).

Proposed alternate developmental pathways to primary and secondary psychopathy are consistent with the argument that primary psychopathy is the product of a genetically caused, core-deficit of abnormal fear and emotional processing (Blair, 2006), and secondary psychopathy as acquired from environmental disturbance (Yildirim & Derksen, 2015). Child psychopathy research provides further support for this distinction. Callous-unemotional (CU) traits are considered the critical precursor to adult psychopathy, although findings suggest that they pertain more to primary rather than secondary psychopathy. For example, children with CU traits make less eye contact with their mother (Dadds et al., 2014), have problems in recognising fearful body poses and faces (Muñoz, 2009), are emotionally unresponsive to others' distress (de Wied, Boxtel, Matthys, & Meeus, 2012), are less responsive to fearful eyes (Viding et al., 2012), and others' pain (Lockwood et al., 2013). Therefore, as in primary psychopathy, CU traits indicate fear and emotion processing deficits. Early-onset of CU traits also suggests genetic causation as they buffer against moral socialisation, which is otherwise constructed through recognising another's feelings, and fear of being disciplined in the event of being harmful to someone (Kochanska, 1993). Indeed, children with CU traits develop conduct problems (CP) that are more harmful, pervasive and less treatable (Frick & Ellis, 1999) than externalising behaviours in children without CU traits. Children with CP without CU traits however, develop externalising behaviours later on in childhood and are more responsive to treatment, which suggests sensitivity to environmental factors (Frick & Ellis, 1999). Thus, externalising behaviours without the presence of CU traits is more analogous to secondary psychopathy.

Twin studies actually confirm a larger genetic contribution to CU traits than CP. For example, CU traits, with or without the presence of

antisocial behaviour (AB), are under strong genetic influence in children aged from 7 to 16 years of age (Viding, Blair, Moffitt, & Plomin, 2005; Viding, Jones, Frick, Moffitt, & Plomin, 2008; Viding, Fontaine, Oliver, & Plomin, 2009; Viding et al., 2013; Henry, Pengault, Boivin, Rijsdijk, & Viding, 2016). Heritability estimates for CU traits range from 40% to 78% (Viding & McCrory, 2012), with the remaining variance made up by non-shared environmental factors only (Taylor, Loney, Bobadilla, Iacono, & McGue, 2003; Blonigen, Carlson, Krueger, & Patrick, 2003; Blonigen, Hicks, Krueger, Patrick, & Iacono, 2006; Larsson, Viding, & Plomin, 2008) (although c.f. Fontaine, Rijsdijk, McCrory, & Viding, 2010; Viding, Frick, & Plomin, 2007 for studies that do evidence shared environmental influence, albeit in girls only). CU traits promote higher levels of AB and criminality exceeding what would be expected by negative parenting alone (Oxford, Cavell, & Hughes, 2003; Hipwell et al., 2007; Wooton, Frick, Shelton, & Silverthorn, 1997; Barker, Oliver, Viding, Salekin, & Maughan, 2011; Kendler, Patrick, Larsson, Gardner, & Lichtenstein, 2013). CU traits may even act as a safeguard against problematic rearing environments (Hicks et al., 2012), and mitigate the beneficial effects of positive parenting (Hawes & Dadds, 2007; Yeh, Chen, Raine, Baker, & Jacobson, 2011). In comparison, AB is moderately influenced by genes and determined by shared as well as non-shared environmental factors (Viding et al., 2005; Viding, Larsson, & Jones, 2008). Furthermore, harsh parenting is strongly related to CP in children who are normal for CU traits (e.g., Edens, Skopp, & Cahill, 2008; Hipwell et al., 2007; Oxford et al., 2003; Wooton et al., 1997; Viding et al., 2009).

However, antisocial and violent behaviour and criminality are also subject to genetic influence (Rhee & Waldman 2002; Waldman & Rhee, 2006; Moffitt, 2005; Ferguson, 2010). To reconcile genetic influence in secondary psychopathy with evolutionary explanations of primary and secondary psychopathy, it is important to take into account the type of genetic and non-shared environmental effects specific to psychopathy variant. For example, the personality facets of psychopathy (pertaining to primary psychopathy) are associated with

emergenic, non-additive genetic effects whereby a constellation of basic genetic traits produce an overall complex trait (Blonigen et al., 2003). In contrast, additive genetic effects are implicated in ASB (Blonigen et al., 2003) and CP in children (Waldmen et al., 2011).

Gene x environment correlations are also relevant (Beaver, Rowland, Schwartz, & Nedelec, 2011; Blonigen et al., 2003; Hicks et al., 2012). Environmental influence can be over-estimated due to hidden genetic effects, and can explain why some studies find primary psychopathy is associated with negative childhood life events (e.g., Christian, Meltzer, Thede, & Kosson, 2016; Barker et al., 2011; Fontaine, McCrory, Boivin, Moffitt, & Viding, 2011). Furthermore, children with CU traits elicit harsher discipline from parents and other authority figures (i.e., evocative gene x environment correlation) (Christian, Frick, Hill, Taylor, & Frazer, 1997; Kimonis, Frick, & Barry, 2004; Larsson et al., 2008). Children with CU traits will also seek out the company of likeminded peers (i.e., reactive gene x environment correlation). A passive gene-environment correlation may also be present. For example, (although not specific to primary psychopathy) psychopathic adult males report having a biological criminal father (Beaver et al., 2011). So both genetic and environmental factors may drive both primary and secondary psychopathy, albeit in different ways.

In summary, even though more research is needed to clarify the precise mechanisms between genes and environment in the development of psychopathy, there is currently enough evidence to support the argument that primary psychopathy is defined more by genetics. In contrast, quality of parenting, attachment and childhood experience is more significant for secondary psychopathy.

1.7. Attachment differences in primary and secondary psychopathy

Attachment theory (Bowlby, 1969; Ainsworth, Bleher, Waters, & Wall, 1978) is an evolutionary based theory that explains the relationship behind rearing environment and emergence of social

behaviour. The central tenet of Attachment theory states that infants have evolved an adaptive drive to seek proximity to an attachment figure, thereby increasing their chances of survival (Bowlby, 1969). Four types of attachment are proposed. "Secure" attachment develops in response to an attachment figure that reliably responds to their child with warmth and care. Insecure attachment types consist of either "ambivalent/resistant" or "avoidant" attachment that are formed from inconsistent or non-responsive attachment figures. "Disorganised" attachment stems from an attachment figure that is abusive, extreme and inconsistent. The type of attachment constructs an internal working model for all other relationships.

From an evolutionary perspective, attachment styles are adaptive as they provide the "best fit" for genetic fitness within the environment from which they originate. Essentially, they form the foundation for the appropriate LH strategy. For example, in a safe environment in which secure attachment is fostered, higher levels of empathy and the ability to solve particular types or problems with abstract reasoning (Kestenbaum, Farber, Sroufe, 1989; Jacobsen, Edelstein, & Hofman, 1994) increase fitness. In comparison, harsh and unpredictable environments promote parenting that elicits insecure or disorganised attachment. However, consequences of insecure attachment such as anxiety, depression (Muris, Meesters, van Melick, & Zwambag, 2001), social anxiety (Brumariu & Kerns, 2010), low sense of self (Kim, 2005), alexithymia (Wearden, Lamberton, Crook, & Walsh, 2005), and coercive sexual behaviour (Smallbone & Dadds, 2001) are in fact adaptive in environments where people are less trustworthy and long-term mating prospects are unknown.

Unsurprisingly then, psychopathy is associated with insecure or disorganised attachment. Psychopathic offenders report abusive and unstable backgrounds, absent of positive or loving interaction with parents (Bailey & Shelton, 2014; Frodi, Dernevik, Sepa, Philipson, & Bragesjö 2001; van IJzendoorn, 1997; Krischer & Sevecke, 2008; Weiler & Widom, 1996; Schimmenti et al., 2014). Similar findings are evidenced in non-forensic samples (Jonason, Lyons, & Bethell, 2014;

Craig, Gray, & Snowden, 2013). However, attachment studies show that adverse childhood environments are particularly characteristic of secondary psychopathy. For example, secondary psychopaths report harsher and inconsistent parental discipline, more foster placements, family-breakdowns, childhood abuse, and are more depressed and hostile (Edens et al., 2008, Krischer & Sevecke, 2008; Kimonis & Frick, 2010; Kimbrel, Nelson-Gray, & Mitchell, 2007; Poythress, Skeem, & Lilienfeld., 2006; Schraft, Kosson, & McBride, 2013) than primary psychopaths. Similar findings are evident in student and community samples (Gao, Raine, Venables, & Mednick, 2010; Hicks et al., 2012; Mack, Hackney, & Pyle, 2010). Internalising and externalising psychopathologies and violent behaviour in children are also associated with an adverse rearing environment (Moffitt, 2005; Thornberry, 1996; Jaffee, Caspi, Moffitt, & Taylor, 2004; Cohen, 1998; Fonagy & Target, 1997; Caspi, Henry, McGee, Moffitt, & Silva, 1995). Thus, environmental factors, specifically childhood experiences, are more crucial to the development of secondary, rather than primary psychopathy.

1.8. Fetal programming

One further parenting factor that is increasingly being considered in the development of adversarial behaviour is maternal stress during pregnancy. Although the precise mechanism is not yet established, it is hypothesised that elevated levels of cortisol caused by maternal stress are thought to act on the adrenal functioning of the fetal sex organs, thereby increasing production of PT (Gitau, Cameron, Fisk, & Glover, 1998; Mairesse et al., 2007; O'Donnell et al., 2012). From a LH perspective, maternal stress operates as a signal of an adverse external environment, thereby shifting fetal development to fast LH strategy physical and personality traits. Essentially, prenatal hormones drive neural organisation, therefore, increased PT may result in the masculinisation of the brain, thereby predisposing the unborn child to male-typical physical and personality traits. Developmental plasticity pre-birth is adaptive as the child is already prepared for the outside

world where, in the case of a hazardous environment, male-typical traits will be more successful. The process of fetal development shifting to the more adaptive LH strategy in response to maternal experience is described as "fetal programming" (Del Giudice, 2012). One way of investigating fetal programming is through 2D:4D ratio research.

1.9. The 2D:4D Ratio

The 2D:4D ratio is calculated by dividing the length of the second finger by the fourth finger. As men have on average, a longer fourth finger, they have a lower 2D:4D ratio. In women, the second and fourth fingers are generally equivalent, or the second finger is longer, resulting in a larger 2D:4D ratio (Manning, Scutt, Wilson, & Lewis-Jones, 1998). As a putative proxy marker for prenatal hormonal exposure (although prenatal testosterone (PT) is more commonly examined within the literature), the 2D:4D ratio may be able to show how prenatal hormones contribute to sex-typical traits and behaviours via neural organisation occurring in the first trimester of pregnancy.

Evidence consistently shows a link between prenatal hormones and 2D:4D ratio. Sex differences in 2D:4D ratio are observable from the 14th week of pregnancy, and remain relatively stable throughout childhood and puberty (Manning et al., 1998; Galis, Ten Broek, Van Dongen, & Wijnaendts, 2010; Malas, Dogan, Evcil, & Desdicioglu, 2006; Trivers, Manning, & Jacobson, 2006). Women with Congenital Adrenal Hyperplasia (CAH) (a disease that causes excessive production of prenatal testosterone) exhibit masculinised ratios (Brown, Hines, Fane, & Breedlove, 2002). Concentrations of PT measured in amniotic fluid also correlate with 2D:4D measured in the same children at two-years of age (Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, & Manning, 2004). Opposite sex female twins express masculinised 2D:4D ratios compared to same-sex twins (van Anders, Vernon, & Wilbur, 2006). In contrast, male to female transsexuals, men who produce lower sperm counts and women born by Intracytoplasmic Sperm Injection (a fertility treatment used in cases of males with

azoospermia or teratospermia) manifest larger 2D:4D ratios (Schneider, Pickel, & Stalla, 2006; Manning et al., 1998; Sutcliffe et al., 2010).

Both genetics and environmental factors are involved in the determination of finger length. For example, twin studies show that the 2D:4D ratio is highly heritable, and that additive genetic effects account for 50% of its variance (Gobrogge, Breedlove, & Klump, 2008). Finger length and prenatal hormones are potentially connected via the Hoxa and Hoxd genes that code for limb and urogenital development (Manning et al., 1998). In addition, the Sry gene on the Y chromosome in men and DAX1 gene on the X chromosome in women are also implicated (Gobrogge et al., 2008). A similar proportion of the variance in 2D:4D ratio (42%) is made up of non-shared environmental factors (Gobrogge et al., 2008), of which one may by maternal stress (although this may function according to sex). For example, girls who were exposed to prenatal maternal stress express a longer anogenital distance (the length from the anus to the genitals and a biomarker for PT) (Barrett et al., 2013), and engage in masculinised play (Barrett, Redmon, Wang, Sparks, & Swan, 2014; Hines, Golombok, Rust, Johnston, & Golding, 2002). These findings concur with those from animal research (Barrett et al., 2014). More research however, is needed to clarify the relationship between maternal stress and PT in boys, which currently stands as undetermined (Barrett et al., 2013; Barrett et al., 2014; Barrett et al, 2015). Nevertheless, the 2D:4D ratio potentially provides a retrospective viewpoint from which it is possible to observe environmentally driven pre-birth shifts to LH strategies.

Low 2D:4D ratios are associated with various fast LH strategy related traits and behaviours. These include aggression (Bailey & Hurd, 2005; Hönekopp, 2011; Hampson, Ellis, & Tenk, 2008; Coyne, Manning, Ringer, & Bailey, 2007; Benderlioglu & Nelson, 2004), sensation seeking and boredom susceptibility (Fink, Neave, Laughton, & Manning, 2006), risk taking (Honekopp, 2011; Stenstrom, Saad, Nepomuceno, & Mendenhall, 2011), dominance, status seeking, sensitivity to status (Manning & Fink, 2008; Millet & Dewitte, 2009; Millet, 2010), and mate-guarding (Cousins, Fugère, & Franklin, 2009).

Physical traits such as athleticism (Hönekopp & Schuster, 2010; Bennett, Manning, Cook, & Kilduff, 2010), strength (Fink, Thanzami, Seydel, & Manning, 2006), and high pain threshold (Schwerdtfeger & Heer, 2008) are also related to high PT. Women with masculinised ratios report shorter intimate relationships, irregular periods, (Scarbrough & Johnston, 2005), and sociosexuality (Clark, 2004). Arguably then, the 2D:4D ratio can be regarded as a proxy measure for male-typical fast LH traits that were established pre-birth

1.10. Sex differences in primary and secondary psychopathy

The fact that men score consistently higher than women in psychopathy has biased psychopathy research towards men (Rogstad & Rogers, 2008; Miller, Watts, & Jones, 2011; Zagon and Jackson, 1994). Indeed, the PCL-R, considered as the "gold standard" in psychopathy measurement (Lynam & Gudonis, 2005, p. 383), was devised from male forensic populations, and combined with its derivatives, the PCL-YV (Youth Version) and SRP-III (Self-Report), has further contributed to a male bias in what is understood about psychopathy (Forouzan & Cooke, 2005; Rogstad & Rogers, 2008; Vitale, Smith, Brinkley, & Newman, 2002). Yet, an increasing number of studies of psychopathy in women show that psychopathy operates similarly *and* differently as it does in men, highlighting the need to consider sex differences in psychopathy research.

For example, men and women high in psychopathy exhibit similar fear and emotion processing deficits (Salekin, Rogers, & Sewell, 1997; Blair, 2005; Blair, 1995; Eisenbarth et al., 2013; Newman, Patterson, & Kosson, 1987; Newman, Curtin, Bertsch, & Baskin-Sommers, 2010; Anderson & Stanford, 2012; Wilson, Demetrioff, & Porter, 2008; Fairchild, Stobbe, van Goozen, Calder, & Goodyear, 2010; Newman et al., 2005; Sellbom and Phillips, 2013) (c.f. Vitale and Newman 2001 and Vitale, 2011 for contrary findings), and the same primary psychopathy personality traits such as low empathy, (Salekin et al., 1997), resiliency against adverse life experiences (Hicks, Vaidyanathan, & Patrick, 2010), fewer substance abuse problems

(Verona, Hicks, & Patrick, 2005; Skeem et al., 2007), low anxiety (Vaillancourt & Sunderani, 2011; Skeem et al., 2007), less agreeableness (Miller et al., 2011; Jakobwitz & Egan, 2006), and callousness (Rutherford, Alternman, Cacciola, & McKay, 1996). Men and women high in secondary psychoathy also display the same adverse emotional style, antisocial, violent and criminal behaviour, alcohol and substance misuse, mental health problems and high anxiety levels (Hicks et. al., 2010; Miller et al., 2011; Rogstad and Rogers, 2008; Lewis, 2010; Skeem et al., 2007; Lee and Salekin, 2010; Verona et al., 2005; Kimonis & Frick, 2010; Newman et al., 2005; Coyne & Thomas, 2008; Vaughn, Edens, Howard, & Smith, 2009; Karpman, 1948, Vitale et al., 2002).

However, primary and secondary psychopathy can manifest differently between men and women (Forouzan & Cooke, 2005). Women are less likely to engage in violence (either proactive or reactive), and instead use indirect or relational aggression (Vaillancourt & Sunderani, 2011; Marsee, Silverthorn, & Frick, 2005; although see Lehmann & Ittel, 2012 for contrary findings), or commit non-violent crimes such as theft and prostitution (Warren & South, 2006). Women are also more likely to internalise impulsive behaviour in terms of self-harm and running away (Forouzan & Cooke, 2005). Studies also point to a greater degree of psychopathology associated with psychopathy and especially secondary psychopathy in females (Hicks et al., 2010, Krischer & Sevecke, 2008; Sevecke, Pukrop, Kosson, & Krischer, 2009; Miller et al., 2011; Mulder, Wells, & Bushnell, 1994). More psychiatric interventions (Cook, Barese, & Dictaldo, 2010), suicide attempts (Verona et al., 2005), and internalising symptoms (Verona, Bresin, & Patrick, 2013) are evidenced in women high in secondary psychopathy compared to men high in secondary psychopathy. Differences between primary and secondary psychopathy are less distinct in women as both report feelings of alienation, high stress reactivity, and higher levels of neuroticism, shame, and anxiety (Hicks et al., 2010; Lee & Salekin, 2010). A further consideration is whether the same manifest behaviour is attributable to the same underlying

psychopathy traits. For example, promiscuity may relate to exploitative gains for women, or sensation seeking in men (Forouzan & Cooke, 2005).

How and why psychopathy operates differently in men and women currently remains largely unexamined, although there are possible explanations that provide some insight as to the processes involved. For example, estrogen may attenuate the effect of abnormal neural functioning in psychopathy related brain regions such as the amygdala (Blair, 1995, 2005). Genes have a stronger influence in ASB in women compared to men where environmental factors are more important (van Hulle, Rodgers, D'Onofrio, Waldman, & Lahey, 2007). Even though adverse childhood experiences are as likely to influence the development of secondary psychopathy in men and women (Frodi et al., 2001; Krischer & Sevecke, 2008, Weiler & Widom, 1996; Verona et al., 2005; Hicks et al., 2010; Poythress et al., 2006; Sevecke et al., 2009), a poor quality of father relationship appears particularly pertinent to secondary psychopathic behaviours in women (Krischer & Sevecke, 2008; Boyd, Ashcraft, & Belgrave, 2006). Thus, environmental and genetic factors are likewise implicated in the development of primary and secondary psychopathy in men and women, although the degree of influence of each factor may vary according to sex.

From an evolutionary perspective, sex differences in primary and secondary psychopathy should be expected. Parental Investment Theory (PIT) provides a context for understanding why sex differences should exist. For example, PIT states that sexual selection is defined by the comparative investment in offspring between males and females (Trivers, 1972). In humans, women are automatically subject to a larger degree of parental investment than men, as they are at the least, committed to nine-months of pregnancy. Therefore, as the primary caregiver, it is adaptive for women to avoid injury from violent behaviour and revert to relational and indirect aggression instead (Archer, 2009; Trivers, 1972; Verona et al., 2013). Other psychological differences such as higher levels of guilt, shame, and agreeableness in

both types of psychopathic women may similarly indicate non-antagonistic personality traits that protect from physical harm (Lee & Salekin, 2010). By comparison, men can risk injury as they are, to some degree, less essential to the survival of the offspring. Therefore, because sex is a significant factor in how primary and secondary psychopathy are expressed, sex differences in psychopathy should be examined.

1.11. Psychopathy and mating

Sex differences in psychopathy may also provide insight as to how those that are higher in psychopathy can attract and secure a partner. Considering the nefarious personality of the individual high in either primary or secondary psychopathy, it is surprising that anyone could enter into a relationship with them sufficiently to produce a child. Nevertheless, there are plenty of people who, to their detriment, find that they have to cope with the outcomes of involvement with a partner high in psychopathy.

Men who are high in primary or secondary psychopathy are potentially attractive to women for a number of reasons. As stipulated by PIT, women contribute the greatest investment to childcare so a man that can provision for them and their child is attractive. Indeed, individuals higher in primary psychopathy are successful in business (Babiak & Hare, 2006; Babiak, Neumann, & Hare, 2010; Board & Fritzon, 2005; Stewart, Wilson, & McCarthy, 2011), politics (Lilienfeld et al., 2012), and similar high-ranking professions (Babiak & Hare, 2006). They are also highly competitive, confident (Ross & Rausch, 2001), and self-entitled (Ross, Bye, Wrobel, & Horton, 2008). It might also be the case that he is effective at obtaining goods although obtained through lies and deception. However, through manipulation and charm, he can convince the woman into believing that he has done so legitimately. Furthermore, a man high in primary psychopathy could deceive the woman into thinking that he will be with her for the long-term despite potentially pursuing other mating opportunities behind her back. A man high in secondary psychopathy is perhaps similarly

effective at accruing resources, although achieved opportunistically without too much consideration for the risks involved.

Men high in either primary or secondary psychopathy may also signal "good genes" which are particularly advantageous in fast LH environments. Indeed, women consider behaviours associated with psychopathy such as social dominance, conspicuous consumption, and charisma as indicators of genetic quality (Kruger, Fisher, & Jobling, 2003; Griskevicius et al., 2007, Durante, Griskevicius, Simpson, Cantú, & Li, 2012). Men high in secondary psychopathy perhaps have the edge in intra-sexual competition, where they can outdo competitors due to risk taking, sensation seeking, and reactively aggressive behaviour (Weiss, Egan, & Figueredo, 2002). Women might even perceive them as fun and exciting (Jonason, Koenig, & Tost, 2010).

How mating success operates in women who are higher in primary or secondary psychopathy is less investigated, although one study recently revealed that the adaptive qualities of psychopathy might also pertain to women (Carter, Campbell, & Muncer, 2014). Increased levels of agreeableness in women high in psychopathy might facilitate promiscuity (Visser, Pozzebon, Bogaert, & Ashton, 2010). Women could be more likely to, or actually more often use sexual behaviour to manipulate for financial gain (Rogstad & Rogers, 2008). Women high in primary or secondary psychopathy may well signal only a desire for short-term mating, which some men may find attractive if they want to avoid paternal investment. The signal maybe overt or intentional or the higher degree of psychopathology in women with psychopathy might make them also more susceptible to short-term mating scenarios. Furthermore, if a woman demonstrates an ability to acquire resources herself, it perhaps shows that she does not need a man to provide for her. It may well be the case that the same criteria that makes men high in primary or secondary psychopathy attractive likewise applies to women, although research has yet to establish this.

One final thought to consider is whether individuals who are high in primary or secondary psychopathy are attracted to their equivalents, i.e., mate assortatively. Partnering with someone similar is

thought beneficial in terms of strengthening the pair bond in terms of communication, altruism, genetic relatedness, thereby supporting bi-parental care (Thiessen & Gregg, 1980). People choose partners who are similar to them on a variety of personality and situational factors (e.g., socioeconomic status, education; Kalmijn, 1994; Krzyżanowska & Mascie-Taylor, 2014), and research shows that this extends also to men and women high in psychopathy in both short and long term mating scenarios (Jonason, Lyons, & Blanchard, 2015). Considering that psychopathy is a fast LH strategy, it is curious as to why someone high in psychopathy would be seeking to build a stronger foundation for a relationship. Yet there are reasons as to why this mating preference might be the case. For example, women might opt for their psychopathy equivalents for the same reasons as non-psychopathy women do (e.g., "good genes"; ability to acquire resources). Individuals who are low in psychopathy might seem boring (Jonason et al., 2015). As fast LH strategists themselves, perhaps individuals high in psychopathy consider psychopathy as the optimal LH strategy (either because they are too self-centred to consider any other strategy as optional, or that they have an accurate assessment of the advantages it confers) and therefore seek that in other people. Following, the environment that they inhabit might force a preference for a likewise partner. The current paucity of research in this area requires further studies to elucidate mating preferences of individuals high in psychopathy.

1.12. Research questions

In view of the current literature, the major lines of investigation are as follows:

1) If primary and secondary psychopathy follow different developmental trajectories as a reflection of their proximate causes, do they differ in regards to quality of parental bonding and attachment style, and fetal programming in relation to prenatal testosterone?

2) In contextualising primary and secondary psychopathy within a LH theoretical framework, with implications for parental investment and development over the life course, differences in developmental trajectories are also compared between and examined in men and women, adults and children

That primary and secondary psychopathy are hypothesised fast LH strategies that afford fitness in particular environments suggests that they are attractive phenotypes. Following, despite phenotypic similarities as adverse personality types, primary and secondary psychopathy are notably different in key behaviours and traits (e.g., manipulative, charming, and cunning in primary psychopathy; sensation seeking, and impulsivity in secondary psychopathy), and may therefore be differentially attractive. Furthermore, within a LH framework, inequity in parental investment may also prompt sex differences in mating preferences. Therefore, the following will be examined:

3) Mating preferences of men and women for men and women high in primary or secondary psychopathy in short and long-term mating contexts.
4) Mating preferences of men and women high in primary or secondary psychopathy for men and women also high in primary or secondary psychopathy in short and long-term mating contexts.

Specific predictions are presented in the following section.

1.13. Chapter outlines

1.13.1. Chapter 2: Sex differences between primary and secondary psychopathy, parental bonding and attachment style

Expanding on what is already known regarding differences in the extent to which childhood experience influences the development of

primary and secondary psychopathy, this chapter will specifically examine quality of recalled maternal and paternal bonding during childhood in men and women separately. Differences across psychopathy variant and sex are expected. Secondary psychopathic traits in both men and women are expected to be associated with lower quality parental bonding. However, as per the remit of LH theory, in that girls are more sensitive to cues of environmental stability as signalled via their father's behaviour and presence (Belsky et al., 1991), it is expected that low quality paternal bonding (i.e., uncaring and controlling) will have a specifically greater impact on women than men. In extension, the status of current attachment style will also be considered. It is expected that primary psychopathic traits will be related to avoidant attachment in men and women, and anxious attachment associated with secondary psychopathic traits in both men and women.

1.13.2. Chapter 3: Baby was a black sheep: Digit ratio (2D:4D), maternal bonding and primary and secondary psychopathy

A hitherto unexplored developmental factor in the development of primary and secondary psychopathy is exposure to prenatal testosterone (PT). Maternal stress is thought to increase levels of PT (Barrett et al., 2013; Barrett et al., 2014; Barrett et al., 2015), and operates as the signal by which information about the status of the environment is communicated to the unborn child. As an environmental factor, exposure to higher levels of PT are expected to be associated with secondary psychopathy. However, considering that the 2D:4D ratio, (which will be used as a proxy marker for PT), is highly heritable, it may also be the case that primary psychopathy is associated with high PT, if the same genes are implicated in both primary psychopathy and PT. Following, low quality of maternal bonding (i.e., uncaring and/or controlling mothers) is predicted, as an environmental factor, to be associated with secondary psychopathy; and also primary psychopathy if low quality maternal bonding is an output of primary

psychopathy behaviour in the mother. Lastly, due to suggested differences in parental investment, PT exposure and the quality of maternal bonding may differ across men and women.

1.13.3. Chapter 4. Callous-unemotional traits moderate the relation between prenatal testosterone (2D:4D) and externalising behaviours in children

Following from Chapter 3, the relevance of PT exposure to the development of primary and secondary psychopathy is extended to children. Callous-unemotional (CU) traits in children are highly heritable and considered the precursor to primary psychopathy (Frick, Ray, Thornton, & Kahn, 2014). Children with CU traits seem particularly vulnerable to developing serious externalising behavioural problems because, due to their lack of fear and empathy, they are unable to benefit from moral socialisation. In this chapter, the interplay between CU traits and corresponding vulnerability to environmental influence is examined pre-birth. Therefore, as in Chapter 3, it is predicted that CU traits and externalising behaviours are associated with exposure to higher levels of PT, but also that CU traits moderate the relationship between PT and externalising behaviour.

1.13.4. Chapter 5. An effective way to deal with predators is to taste terrible: Primary and secondary psychopathy, and mate preference

Previous research has shown that women, within a short-term mating context, choose men higher in "dark" traits such as Machiavellianism and psychopathy (Jonason et al., 2015). It is suggested these types of men offer "good genes"; i.e., genes associated with traits and behaviours that do well in adverse environments when the optimal strategy is short-term mating. Both primary and secondary psychopathy are fast LH strategies, which suggests that men who have these personality styles also do well in adverse environments. Using a series of personality profile vignettes that describe members of the

opposite sex as either high or low in primary or secondary psychopathy, it is predicted that women will evaluate men high in primary or secondary psychopathy as preferable for short-term mating. Due to a paucity of research regarding whether women high in primary or secondary psychopathy are fitness enhancing mates, it is left open as to whether men also positively evaluate these women in either short or long-term mating contexts.

Assortative mating, which describes the process of preferring similar partners (potentially for the benefits of bonding in strengthening bi-parental care) has only recently been examined in individuals high in "dark" personality traits. A pattern for assortative mating has been observed in women high in psychopathy for both short and long term mating. As the primary caregiver, any woman is automatically disposed to greater parental investment beyond that of men. Therefore, even for women high in either primary or secondary psychopathy, it remains important to be discriminant in mate choice. Mate matching for LH strategy maybe adaptive, benefitting from "good genes" or the ability to acquire resources. Thus, it is predicted that women high in primary or secondary psychopathy will prefer men also high in primary or secondary psychopathy for short and/or long-term mating. Whether men high in primary or secondary psychopathy also choose similar partners is left open. A previous study found no pattern for assortative mating in men high in psychopathy (as an overall construct) however, the lack of research in this area necessitates further investigation to establish if this is a consistent finding.

2. Sex differences between primary and secondary psychopathy, parental bonding and attachment style

Research consistently demonstrates that adversarial or sub-optimal parenting is a factor in the development of primary and, but more especially, secondary psychopathy. In offender samples, secondary psychopaths recall harsh and inconsistent parents (Edens et al., 2008), a dysfunctional family environment (Kimonis & Frick 2010), and childhood abuse (Poythress et al., 2006) more than primary psychopaths. There is considerably less examination of childhood environmental contributions to primary and secondary psychopathy in non-clinical samples, although they too demonstrate a connection between parental separation and low maternal care (Farrington, 2005, Kimbrel et al., 2007). In the context of Bowlby's (1969) Attachment Theory, as expected, insecure attachment types are related to psychopathy although differs according to psychopathy variant. So, anxious attachment pertains more to secondary psychopathy and primary psychopathy, avoidant attachment. Yet, avoidant attachment could be symptomatic of emotional deficits that cause primary psychopathy, rather than adverse parenting. Thus, Chapter 2 will specifically examine recalled quality of maternal and paternal bonding during childhood, and attachment types as potential contributors to primary and secondary psychopathic traits in an adult, nonclinical sample.

A further point of consideration from a Life History perspective is whether the quality of the relationship, as an indicator of environmental conditions, with either mother or father differentially affects primary and secondary psychopathic traits according to sex. Research shows that a low quality or absent father-daughter relationship is related to an earlier age at menarche, sexual activity and first child (Belsky et al., 1991), and therefore could contribute to primary or secondary psychopathy (as a fast LH strategy). Much less is known regarding mother-daughter or mother-son relationships. To address

these questions, Chapter 2 will also investigate whether the sex of the parent and individual is an influential factor in the development of primary and secondary psychopathic traits.

Differences across psychopathy variants and sex are therefore expected. Secondary psychopathy in both men and women is expected to be associated with low quality parental bonding, although low quality paternal bonding (i.e., uncaring and controlling) will have a greater impact on women than men. It is also predicted that primary psychopathy will be related to avoidant attachment, and anxious attachment to secondary psychopathy, which could function according to sex.

Note: Chapter 2 has been published as Blanchard, A., & Lyons, M. (2016). Sex differences between primary and secondary psychopathy, parental bonding, and attachment style, *Evolutionary Behavioural Sciences, 10*, 56–63.

2.1. Abstract

Sex differences in primary and secondary psychopathic traits and behaviours are consistently evidenced, although less is known about the developmental trajectories of these differences and why they might arise. In this study (N = 362) we investigated whether males and females reporting higher levels of primary or secondary psychopathic traits differed in retrospective accounts of how cold and controlling both their mother and father were during childhood, and how anxious and avoidant they are about contemporary relationships. Primary psychopathic traits in men related to controlling mothers and avoidant attachment, while in women they related to uncaring fathers and both anxious and avoidant attachment. Secondary psychopathic traits in men were predicted by uncaring mothers and fathers, as well as anxious attachment, while in women, neither parental bonding nor attachment style were related. Results are discussed from an evolutionary, life history theory paradigm.

2.2. Introduction

Life History Theory paradigm, a middle-level evolutionary theory, can explain how psychopathy affords genetic fitness in certain environments. Evidence suggests that psychopathy is a male-typical fast life history mating strategy (Glenn, Kurzban, & Raine, 2011; Figueredo et al., 2006), defined by short-term mating orientation, unrestricted sociosexuality, and multiple sexual partners (Jonason, Li, Webster, & Schmitt, 2009), and is adaptive in high morbidity-mortality environments (Glenn et al., 2011). Primary psychopathy has been suggested as the "successful" psychopathy as deceitful, ruthless and manipulative behaviours are evidenced in business leaders (Babiak, Neumann, & Hare, 2010; Hare, 1993) and other high-ranking professions (Mullins-Sweatt, Glover, Derefinko, Miller, & Widiger, 2010). These traits may garner competitive advantage and signal a preferable mate to women (Carter, Campbell & Muncer, 2014). Traits that expedite secondary psychopathy are risk taking, impulsivity and short-term thinking (Figueredo et al., 2006). Despite adverse outcomes such as criminality and substance abuse (Hare, 2003), secondary psychopathy may also be adaptive. For example, sensation seeking and aggressive behaviour are potentially advantageous in intra-sexual competition, as well as in obtaining resources (Weiss, Egan, & Figueredo,

2004). The core difference between psychopathy subtypes is that primary psychopathy is an inherited "cheater strategy", developed in the environment of evolutionary adaptedness, while secondary psychopathy is a conditional adaptation to current deleterious environments (Mealey, 1995).

The adaptive quality of psychopathy in women is less understood because, by virtue of a higher level of parental investment, they are obligated to a slower life history strategy than men (Figueredo et al., 2006). However, indirect and relational aggression in primary psychopathy women (Vaillancourt & Sunderani, 2011; Verona, Bresin, & Patrick, 2013), and in both subtypes, higher levels of neuroticism (Lee & Salekin, 2010), and low self-esteem and body shame (Visser, Pozzebon, Bogaert, & Ashton, 2010) may constitute a female-typical fast life history strategy that avoids physical harm but promotes short-term mating. The presence of primary and secondary psychopathy in women may also similarly reflect the inherited/conditional adaptation model proposed for men. Therefore, sex differences in psychopathy might be a consequence of the demands of the sex-typical, life history strategy that is selected for. However, the adaptive function of psychopathy in women is currently an under-investigated area of research.

There is evidence to suggest that environmental factors, namely adverse childhood experiences, are associated with secondary psychopathy via insecure attachment patterns (Craig, Gray, & Snowden, 2013). According to attachment theory (Bowlby, 1969), innate adaptive mechanisms drive a child to seek physical and psychological proximity to the main caregiver. However, inconsistent affection, praise and discipline from the parent will instil insecure attachment patterns that can be classed as avoidant and anxious (Bowlby, 1973). An adverse parenting style may serve as a proxy to a harsh environment to which the child must correspondingly react to. Such attachments may demonstrate developmental plasticity that cultivates adaptive attachment styles suited to a particular environment (e.g., those that are harsh and unpredictable; Ellis, Boyce, Belsky, Bakermans-Kranenburg, & van Ijzendoorn, 2011). Attachment patterns also appear to manifest differently in men and women as a function of parental investment. For example, avoidant attachment, which is more common in men, can facilitate high mating effort. Women exhibit higher levels of anxious attachment, which may promote a heightened state of alert in

women that helps them to monitor their partner, who may be more likely to desert them when times are tough (Schmitt et al., 2003, although see Schmitt & Jonason, 2014).

Indeed, the quality of bonding with each parent appears to influence men and women differently. For example, in women, poor quality, or absent father-daughter relationships relate to behaviours characteristic of secondary psychopathy, such as susceptibility for substance abuse (Boyd, Aschraft, & Belgrave, 2006). Although adverse parenting, overall, appears to be a factor in the development of psychopathy in men, it is less known whether this is because of specific relationships with either the mother or father (Belsky, Steinberg, & Draper, 1991). Genetic influences might also function differently according to sex and psychopathy subtype. For example, the link between psychopathic traits and biological criminal fathers is evidenced in men only (Beaver, Barnes, May, & Schwartz, 2011), suggesting that psychopathy in men is under more genetic influence than in women. Evidently, both environmental and genetic factors are implicated in the development of psychopathy, but phenotypic outputs are different according to sex (Hicks, Vaidyanathan, & Patrick, 2010; Krisher & Sevecke, 2008).

The aim of the present study is to investigate sex differences in the manifestation of primary and secondary psychopathic traits in relation to recollections of childhood parental bonding experiences and current attachment patterns in a non-institutional sample. We predict that the sex of the parent will have a different effect on primary and secondary psychopathic traits levels in the participants. Specifically, in line with the literature (Belsky et al., 1991), we also predict that sub-optimal father-daughter bonding will relate to higher levels of either primary or secondary psychopathic traits in women. In addition, women are expected to express higher levels of anxious attachment compared to men, who will be more avoidant in their attachment type.

2.3. Method

2.3.1. Participants and procedure

Three hundred and sixty-two participants (185 men; mean age: 30.52, *SD* = 10.00) were recruited either from a student population at a UK North-West University (*n* = 149), or community sample through social media advertising (*n* = 213) to participate in a survey on Personality Traits and Parental Bonding Experiences. The front page of the survey contained relevant ethics information, and the contact details of the researchers. After completing the survey, participants were thanked for their time, and presented with a debrief page.

2.3.2. Measures

2.3.2.1. *Self-Report Psychopathy Scale* (SRP-III)

The SRP-III (Paulhus, Neumann, & Hare, 2009) is a 64-item, self-report questionnaire that provides a measure of psychopathic traits and behaviours in non-clinical populations. It consists of four subscales: Callous affect, Interpersonal manipulation, Erratic lifestyle and Criminal tendencies. Using a 5-point Likert scale, participants indicate to what degree they agree with statements such as "I think I could beat a lie detector" or "I like to see fist fights". The subscales, "Callous affect" and "Interpersonal manipulation" are combined to obtain a primary psychopathic traits score; the subscales "Erratic life style" and "Criminal tendencies" combine to produce a secondary psychopathic traits score, and also had good internal reliability for both sexes.

2.3.2.2. *Parental Bonding Instrument* (PBI)

The PBI (Parker, Tupling, & Brown, 1970) is a self-report 50-item questionnaire measuring retrospective evaluations of quality of maternal (25 items) and paternal (25 items) parenting received during childhood. Participants use a 4-point Likert scale to indicate how representative statements such as "Spoke to me in a warm and friendly voice" or "Tried to control everything I did" were of their parents during childhood. Two scales capture '*Mother care*' and '*Father care*', and two others; '*Mother protection*' and '*Father protection*', high values of which indicate over-controlling behaviour.

2.3.2.3. *Relationship Scales Questionnaire* (RSQ)

We used Creasey and Ladd's (2005) Anxiety and Avoidant Scales that they adopted from the RSQ Scale (Griffin & Bartholomew, 1994). Nineteen items in total are used to measure anxious (eleven questions) and avoidant (eight questions) attachment styles. Participants evaluate themselves on a 5-point Likert scale to indicate how strongly they agree with statements such as: "People are never there when you need them" or "I want emotionally close relationships". RSQ Anxious Attachment scale had good internal reliability (.90), although RSQ Avoidant scale produced moderate reliability values (.65 - .67).

2.4. Results

As expected, men scored significantly higher in primary and secondary psychopathic traits than women (see Table 1). Women scored significantly higher for recollections of over-controlling mothers. There were no significant sex differences for any of the other parental bonding measures or anxious and avoidance attachment styles.

Table 1.

Means, standard deviations and Cronbach's alpha for all variables

	Men	*α*	Women	*α*	*t*	*d*
Primary psychopathy	87.29 (14.28)	0.83	69.28 (16.91)	0.90	10.92[a]	1.15
Secondary psychopathy	77.80 (16.56)	0.85	65.05 (15.31)	0.84	7.61[a]	0.80
Mother care	35.28 (7.28)	0.80	36.57 (7.77)	0.85	-1.63	-0.17
Mother protection	29.85 (6.44)	0.67	32.14 (7.74)	0.75	-3.04[a]	-0.32
Father care	32.72 (8.48)	0.87	34.37 (10.37)	0.92	-1.66	-0.17
Father protection	29.10 (7.72)	0.77	29.95 (10.22)	0.85	-0.90	-0.09
Anxious	28.08 (9.19)	0.90	28.49 (10.11)	0.90	-0.40	-0.04
Avoidant	24.79 (4.90)	0.65	23.57 (5.14)	0.67	1.75[a]	0.24

[a] Significant difference between men and women, $p < .01$

In order to explore the relationship between psychopathy subtypes, recollections of parental bonding and attachment type in men and women, we conducted zero order and partial correlation analyses (see Table 2). We adjusted the alpha level to .001 to correct for multiple testing. Primary psychopathic traits in men were significantly associated with over-controlling mothers and avoidant attachment; in women, they were associated with low-care fathers and anxious attachment. Secondary psychopathic traits in men were associated with low-care mothers and fathers; in women they were associated with over-controlling fathers and anxious attachment. Partial correlation analyses, controlling each time for the variance in primary and secondary psychopathic traits respectively showed that primary psychopathic traits in men were not associated with any type of sub-optimal bonding with each parent. However, low-care fathers were related to primary psychopathic traits in women. Further, both low-care mothers were associated with secondary psychopathic traits in men, and in women, none of the parental variables related to secondary psychopathic traits. Primary psychopathic traits were associated with avoidant attachment in men, and anxious attachment in women. Secondary psychopathic traits in men related to reduced avoidant attachment, whereas in women, neither attachment style was associated with secondary psychopathic traits.

To look at the relative contribution of each variable to primary psychopathic traits in both sexes, we conducted linear multiple regression, where secondary psychopathic traits were added as a predictor at Step 1, low-care mothers at Step 2, over-controlling mothers at Step 3, low-care fathers at Step 4, over-controlling fathers at Step 5, anxious attachment at Step 6, and avoidant attachment at Step 7 (see Table 3). In men, the overall model accounted for 40% of the variance in primary psychopathic traits. Secondary psychopathic traits, over-controlling mothers and avoidant attachment significantly added to the model. However, the model was not improved by adding low-care mothers, low-care fathers, over-controlling fathers or anxious attachment. Secondary psychopathic traits, over-controlling mothers and avoidant attachment emerged as significant predictors.

In women, the overall model explained 37% of the variance in primary psychopathic traits. Secondary psychopathic traits, low care fathers, anxious and avoidant attachment added significantly to the model. However, the model

was not improved by adding either low-care or over-controlling mothers, or over-controlling fathers. Secondary psychopathic traits, anxious attachment and avoidant attachment emerged as significant predictors, whilst low-care fathers did not.

Table 2.

Zero order correlations between all variables for men and women

	Primary psychopathy			Secondary psychopathy		
	Men	Women	*z*	Men	Women	*z*
Mother care	-.15	-.17	0.19	-.31**	-.14	-1.69*
Mother protection	.21**	.00	2.01	.14	-.07	1.99*
Father care	-.05	-.26**	-2.98	-.22**	-.20**	-0.20
Father protection	.09	.01	0.76	.11	-.04	1.42
Anxious	.06	.42**	-3.66**	.17	.26**	-0.89
Avoidant	.22**	.15	0.68	-.08	.00	-0.76
Partial correlations between all variables for men and women						
Mother care	.02	-.11	1.23	-.27**	-.04	2.99**
Mother protection	.17	.05	1.15	.03	-.08	1.04
Father care	.09	-.18*	2.57**	-.23	-.05	2.68**
Father protection	.03	.05	-0.19	.08	-.06	1.32
Anxious	-.05	.34**	-3.81**	.17	.01	1.52
Avoidant	.31**	.19	1.21	-.25**	-.12	-1.27

*$p < .05$ ** $p < .01$

Note. *z* is Fisher's *z* to compare dependent correlations.

Note. *Alpha levels corrected for multiple comparisons.*

Table 3

Stepwise Regression Analysis of primary psychopathy in men and women on all independent variables

	Men					Women				
Variable Entered	*R*	*F* to enter	Δ in R^2	*β*	*t*	*R*	*F* to enter	Δ in R^2	*β*	*t*
	.63					.70				
1. Secondary psychopathy		77.68	0.30**	.57	9.17**		102.70	0.37**	.51	8.78**
2. Low care mothers		38.70	0.01	-.04	-0.53		52.83	0.01	-.02	-0.29
3. Over controlling mothers		28.39	0.02*	.18	2.25*		35.04	0.01	.01	-0.03
4. Low care fathers		21.65	0.01	.14	1.83		27.94	0.02*	-.12	-1.86
5. Over controlling fathers		18.10	0.01	-.09	-1.13		22.97	0.01	.06	0.81
6. Anxious attachment		15.11	0.01	.01	0.01		24.21	0.06*	.27	4.55**
7. Avoidant attachment		16.56	0.06**	.25	4.13**		22.63	0.02**	.15	2.75**

*$p < .05$ **$p < .01$

To look at the relative contribution of each variable to secondary psychopathic traits in both sexes, primary psychopathic traits were added as a predictor at Step 1, low-care mothers at Step 2, over-controlling mothers at Step 3, low-care fathers at Step 4, over-controlling fathers at Step 5, anxious attachment at Step 6, and avoidant attachment at Step 7 (see Table 4). For secondary psychopathic traits in men, the overall model accounted for 40% of the variance, 30% of which was contributed to by primary psychopathic traits which also emerged as a significant predictor. Low care mothers improved the model and significantly predicted secondary psychopathic traits as did avoidant attachment. The model was not improved by over-controlling mothers, low-care and over-controlling fathers, or anxious attachment. This indicates that the influence of low-care mothers and avoidant attachment are important in the development of secondary psychopathic traits in men. In women, apart from primary psychopathic traits which accounted for 37% of the model, none of the other variables made a significant contribution to the model.

2.5. Discussion

In this study, we have added to the current literature (Mack, Hackney, & Pyle, 2011) regarding influences of negative parenting styles in the expression of primary and secondary psychopathic traits. Our results indicate that these influences and their outcomes may function in relation to inequity in parental investment between men and women. We found that primary psychopathic traits related uniquely to controlling mothers and avoidant attachment in men, and low-care fathers and anxious and avoidant attachment types in women. In contrast, secondary psychopathic traits were predicted by anxious attachment and uncaring mothers, and were associated with low care fathers in men, whereas parental bonding experiences and attachment had no relationship to secondary psychopathic traits in women. These findings may partially support the argument that secondary psychopathy is an environmentally-derived phenocopy of primary psychopathy, which is an inherited male-typical cheater strategy (Glenn et al., 2011; Mealey, 1995), because maternal overprotection aside, recalled parenting had little influence on men's primary psychopathy scores. Nevertheless, the association with over-controlling mothers could be an example of passive gene-environment

interaction, where controlling behaviour is inherited as a primary psychopathic trait whose expression is reinforced by the mother's behaviour within the rearing environment (Loney, Huntenburg, Counts-Allan, & Schmeelk, 2007). Overall, this could indicate a larger genetic component for this trait in men.

Table 4

Stepwise Regression Analysis of secondary psychopathy in men and women on all independent variables

	Men					Women				
Variable Entered	*R*	*F* to enter	Δ in R^2	*β*	*t*	*R*	*F* to enter	Δ in R^2	*β*	*t*
	.63					.62				
1. Primary psychopathy		77.68	.30**	.57	9.17**		102.70	0.37**	.61	8.78**
2. Low care mothers		49.17	.05**	-.13	-1.77		51.30	0	-.06	-0.87
3. Over controlling mothers		32.71	0	-.08	-.99		34.88	.01	-.09	-1.15
4. Low care fathers		24.93	.01	-.13	-1.68		26.15	0	-.05	-0.65
5. Over controlling fathers		20.61	.01	.09	1.08		20.80	0	.01	0.07
6. Anxious attachment		17.38	0	.04	.59		17.23	0	-.02	-0.25
7. Avoidant attachment		16.70	.03**	-.18	-2.89**		15.36	.01	-.11	-1.71

*$p < .05$ **$p < .01$

Primary psychopathic traits in men also related to avoidant attachment, which makes sense knowing that both avoidant attachment (Del Giudice, 2009) and primary psychopathy (Jonason et al., 2009; Ross & Rausch, 2001) have a relationship with male mating strategies characterised by low commitment, and high competition for status.

The relationship between low-care fathers and primary psychopathic traits in women would be partly expected considering that father absence during childhood promotes a range of internalising behaviours that co-vary with female-typical psychopathic traits (Belsky et al., 1991) and fast life history strategies (Visser et al., 2010). Again, this relationship may also be indicative of passive gene-environment interaction if low-care is taken to mean un-empathetic. Although internalising behaviours appear to pertain more to secondary psychopathy, the distinction between psychopathy subtypes in women is less distinct and can therefore explain this finding (Lehmann & Ittel, 2012; Rogstad & Rogers, 2008). Indeed, the relationship between primary psychopathic traits and anxious attachment type may be indicative of higher levels of anxiety that are associated with primary psychopathy in women (Hicks et al., 2010; Lee & Salekin, 2010). Therefore, internalising behaviours such as neuroticism, low self-esteem and indirect aggression, in tandem with anxious and avoidant attachment could together operate as a successful fast, life history strategy for two reasons. Firstly, by fostering short-term mating behaviours, and, secondly, by heightening a woman's awareness to danger, reducing the likelihood of physical harm to her or her children while she pursues other mates.

Our findings for secondary psychopathic traits in men complements research that consistently evidences adverse home environments as a source of influence in the expression of secondary psychopathy for forensic and normative samples (e.g., Mack et al., 2011; Poythress, Skeem &, Liliensfeld, 2006). However, in contrast to primary psychopathic traits, uncaring parents are more important than an over-controlling mother in the development of secondary psychopathic traits, which may indicate multiple environmental influences rather than genetic inheritance. This would also support the argument that secondary psychopathy is an environmentally derived "phenocopy" of primary psychopathy, which functions as an adaptive developmental response

to unfavourable circumstances (Mealey, 1995). Indeed, behavioural plasticity (Ellis et al., 2011) and attachment theory (Bowlby, 1969; Frodi, Dernevik, Sepa, Phillipson, & Bragesjö, 2001) would predict the relationship found here between secondary psychopathic traits and anxious attachment type, and might explain why secondary psychopathic individuals are significantly more anxious, rather than avoidant in their behaviour.

The absence of any notable influential factor in secondary psychopathic traits in women is interesting considering that previous research clearly implicates the effect of adverse childhood experiences, although in forensic samples only (Krischer & Sevecke, 2008; Hicks et al., 2010). Women who exhibit secondary psychopathic behaviour may have been subjected to other influencing factors not measured in this study. These could include more specific adverse childhood experiences that do not pertain to parental bonding, such as physical abuse and parental conflict (Belsky et al., 1991). Alternatively, a conglomerate of these factors might be necessary, while individual differences might exacerbate or attenuate certain influences. Furthermore, research shows that the expression of primary and secondary psychopathy in women can vary as a response to cultural factors (Neumann, Schmitt, Carter, Embley, & Hare, 2012). In this situation also, it might serve one woman to employ an anxious attachment type, or another woman, an avoidant attachment type. Thus a heterogeneous environmental input might result in a heterogeneous output of differently tailored adaptive attachment types, such that no particular one is associated with secondary psychopathy. Overall, these findings support the notion that, although the precise dynamics are less clear, secondary psychopathy in women is more environmentally influenced and as such, may demonstrate adaptive developmental plasticity.

2.6. Limitations and Conclusions

Although convenient, self-report measures are subject to self-bias. Consideration should also be given to the fact that psychopathic individuals are skilled at deception (Seto, Khattar, Lalumière, & Quinsey, 1996). Scores for the PBI and RSQ could therefore be likewise distorted. Furthermore, recollections of childhood experiences are likely affected by the accuracy of recall. Parental bonding is only one measure out of many different childhood experiences that

are potential influences in the development of psychopathy. Similarly, attachment styles may be more discrete than simply anxious or avoidant. Nevertheless, this study has demonstrated sex differences in the developmental trajectory of primary and secondary psychopathy and, by utilising life history theoretical perspective, has suggested that these differences are necessary for short-term mating strategies that are determined by sexually differentiated levels of parental investment.

3. Baby was a black sheep: Digit ratio (2D:4D), maternal bonding and primary and secondary psychopathy

A hitherto unexplored developmental factor in the development of primary and secondary psychopathy is prenatal maternal stress. From a LH perspective, it is more adaptive to respond and adjust accordingly to environmental cues *before* as well as after birth, in preparation for the outside world. As such, maternal stress may be the prequel to mother-child bonding post birth. One potential mechanism that allows for the flow of information from mother to unborn child is alterations in prenatal hormone levels, and there is some evidence to suggest that maternal stress elevates levels of prenatal testosterone (Barrett et al., 2013; Barrett et al., 2014; Barrett et al., 2015). Surges in prenatal testosterone may cause neurological changes that in the long term promote male typical behavioural dispositions (such as those associated with psychopathy), which are potentially more favourable in hostile environments. Genetic effects however, also contribute to prenatal testosterone levels

Therefore, in Chapter 3, by way of extension to Chapter 2, exposure to higher levels of prenatal testosterone (as indicated by the 2D:4D digit ratio) are considered as an additional developmental factor alongside quality of maternal bonding (i.e., uncaring and controlling mothers) as a risk factor for the development of primary and secondary psychopathic traits. As per Chapter 2, sex differences will also be investigated because psychopathy is generally proposed as a male, fast LH strategy (Jonason et al., 2009). Increased exposure to prenatal testosterone may only cause an effect in men. However, the relative lack of studies of primary and secondary psychopathy in women means presents the possibility that women are also sensitive to prenatal testosterone in the development of psychopathy. Indeed, one recent study indicates that psychopathy is not necessarily a male adaptation (Carter et al., 2014). Therefore, the prediction made in Chapter 3 is that exposure to PT (indicated by the 2D:4D ratio) will be associated with

primary and secondary psychopathy, although quality of maternal bonding may mediate the strength of this relationship. Lastly, the relationship between prenatal testosterone and primary and secondary psychopathy may also differ according to sex.

Note: Chapter 3 has been published as Blanchard, A., Lyons, M., & Centifanti, L. (2016). Baby was a black sheep: Digit ratio (2D:4D), maternal bonding and primary and secondary psychopathy. *Personality and Individual Differences*, *99*, 67–71.

A corrigendum was requested to the editor of Personality and Individual Differences due to an error in the abstract as per follows:

The following line appears in the abstract:

"In men, low maternal care predicted primary psychopathy and high maternal protection predicted secondary psychopathy".

This should in fact read:

"In men, high maternal protection predicted primary psychopathy and low maternal care predicted secondary psychopathy".

3.1. Abstract

Psychopathy is generally considered to be a male adaptation. While studies have elucidated a relationship to freely circulating testosterone, less is known about the role of prenatal testosterone (PT) in the development of primary and secondary psychopathy and how this pertains to sex differences. In this study (*N*=148), digit ratio (2D:4D) was used to investigate the relationship between prenatal testosterone and primary and secondary psychopathy. In addition, quality of recalled maternal bonding was measured to see if postnatal experience could affect the influence of PT on psychopathic behaviours. Low LH2D:4D predicted primary and secondary psychopathy in women but not in men. In men, high maternal control predicted primary psychopathy and low maternal care predicted secondary psychopathy. Low maternal care also predicted primary psychopathy in women. Combining men and women together in the overall sample, lower levels of maternal care and higher levels of maternal control contributed to primary psychopathy above and beyond PT. Lower levels of maternal care were also an influential factor for secondary psychopathy above and beyond PT, although higher levels of mother control were not.

3.2. Introduction

Although there is extensive research on the development of primary and secondary psychopathy, the contribution of prenatal hormones currently remains relatively under-investigated. Psychopathy is hypothesised as a male-typical personality style (Jonason, Li, Webster, & Schmitt, 2009) and is related to circulating testosterone (Stålenheim, Eriksson, von Knorring, & Wide, 1998; van Honk & Schutter, 2006), therefore prenatal testosterone (PT) could be a factor in its development. Maternal stress may elevate prenatal testosterone levels, which, from an evolutionary perspective, could indicate the process of fetal programming - the mechanism by which prenatal development is adjusted according to in utero hormonal changes caused by maternal experience (Del Guidice, 2012). Postnatal experience, such as relationship quality between mother and child, may either reinforce or negate the effect of fetal programming. Therefore, we investigated the contribution of PT and quality of mother-child

relationships in the development of primary (i.e., callous and exploitive predisposition) and secondary (i.e., risky and impulsive behaviours) psychopathic traits and behaviours in men and women using the 2D:4D digit ratio (as a biomarker for PT) and recalled maternal bonding.

Psychopathy, PT and parenting practices can be contextualised within a Life History theoretical framework. People vary in a fitness optimising strategy continuum from slow (i.e., high parenting and low mating effort) to fast (i.e., low parenting and high mating effort), which is regulated in response to cues signalling information about socio-ecological conditions (Kaplan & Gangestad, 2005). Primary and secondary psychopathy are putative fast life-history strategies. Psychopathic individuals use deception and antisocial behaviours to exploit others for resources and mating opportunities (Mealey, 1995) and exhibit short-term mating behaviours such as mate poaching (Kardum, Hudek-Knezevic, Schmitt, & Grundler, 2015) and sexual coerciveness (Muñoz, Khan, & Cordwell, 2011). Being psychopathic could be successful in harsh environments, as a "live fast, die young" (have more children) strategy.

From a developmental perspective, to adopt a mating strategy that will optimise fitness, a child should be sensitive to cues that signal information about the environment before puberty. Inadequate parental care may be one such proximate trigger. Children are more likely to have experienced sub-optimal parenting in harsh socio-ecological conditions (Pinderhughes, Nix, Foster, & Jones, 2001). Parenting also plays a crucial role in the development of fast life history strategies (Lukaszewski, 2015), and psychopathic traits and behaviours (Beaver et al., 2014). Sub-optimal maternal bonding is associated with primary and secondary psychopathic traits and behaviours (Blanchard & Lyons, 2016; Gao, Raine, Chan, Venables, & Mednick, 2010). However, what remains un-investigated is whether information about the environment can reach an unborn child, prompting development of psychopathic traits and behaviours. The mechanism in this case is "fetal programming", specifically, the alteration of in-utero hormone levels that change the fetal neurobiological development (Del Giudice, 2012).

Therefore, the connection between high levels prenatal maternal stress and higher levels of PT implicates PT as a proximate trigger in the development of psychopathic traits and behaviours.

The precise mechanism between prenatal stress and elevated levels of PT is not clear, although increased cortisol caused by the activation of the hypothalamic-pituitary-adrenal (HPA) axis in response to stress is implicated (Barrett & Swan, 2015; Gitau, Adams, Fisk & Glover, 2005; Sarkar, Bergman, O'Connor, & Glover, 2008). One hypothesis suggests that biological changes caused by maternal stress eases transference of maternal cortisol into the placenta, which then augments adrenal, ovarian/testicular function of the fetus (Barrett, Redmond, Wang, Sparks, & Swan, 2014). Although evidence demonstrates that the link between maternal stress and PT pertain only to female fetuses (Ward & Weisz, 1984). There are comparable behavioural outcomes for children subjected to stress prenatally and those exposed to higher levels of PT. Maternal anxiety is associated with externalising behaviours and emotional problems in children (O'Connor, Heron, Golding & Glover, 2003; Van Den Bergh & Marcoen, 2004), while PT is associated with a range of psychopathic-type behaviours. In men these include physical aggression (Bailey & Hurd, 2005), sensation seeking and boredom (Fink, Neave, Laughton & Manning, 2006). In women, PT is related to low empathy and aggression (Benderlioglu & Nelson, 2004; Kempe & Heffernan, 2011). Only one study previously has investigated PT and psychopathy (Blanchard & Lyons, 2010), and contrary to expectations, found higher levels of prenatal estrogen were associated with overall psychopathy in females and callous affect in males. Nevertheless, the general lack of research on psychopathy in this area highlights the need for further investigation.

Another question that remains relatively unexplored relates to sex differences. As men consistently score higher in psychopathy, psychopathy is generally considered as a male adaptation (Jonason et al., 2009). Less is known about female psychopathy (Rogstad & Rogers, 2008), so developmental trajectories to psychopathy could be

different in women. Similar proximate triggers are implicated in both sexes such as adverse childhood experiences (Craig, Gray, & Snowden, 2013; Mack, Hackney, & Pyle, 2011; Krischer & Sevecke, 2008). However, when these triggers take effect may be determined by when they have the most adaptive impact on reproductive schedule. Although a fast life history strategy implies minimal parental investment, women are still expected to commit to a higher level of parental investment as the primary caregiver. Mate quality in terms of genes or resource acquisition are perhaps more important to women and might affect when psychopathic behaviours emerge as compared to men. The occurrence and role of fetal programming and postnatal influences may differ according to sex, although these ideas remain untested.

Postnatal maternal bonding quality may either compliment or limit the impact of the behavioural consequences of changes in hormonal levels caused by maternal stress. If the outside environment improves after birth and allows for longer-term parental investment, then higher levels of maternal care and lower levels of maternal control should signal to the child to augment their behaviour in relation to their future mating strategy. Indeed, a life history strategy must demonstrate developmental plasticity (West-Eberhard, 2003) in shifting to what is most adaptive for that environment. Taking risks, such as those associated with psychopathic behaviour, may not confer advantage when the environment is not suitable to that strategy.

We were interested in investigating the relative contribution of PT and the type of child-mother bonding in the development of primary and secondary psychopathic traits and behaviours in men and women. We expected that higher levels of PT and lower levels of maternal care and high maternal control to be related to primary and secondary psychopathy. We also wanted to investigate whether maternal factors would influence primary and secondary psychopathy over and above the effect of PT. The overall sample, and men and women separately were examined, owing to the inequity in parental investment between

men and women, and how this might affect the development of primary and secondary psychopathy.

3.3. Method

3.3.1. Participants

148 participants, of which 67 were men (mean age: 23.48, *SD* = 7.00), and 81 were women (mean age: 21.62, *SD* = 6.07), were recruited from a North-West England university in exchange for course credits, and from the local community via snowball sampling.

3.3.2. Measures

3.3.2.1. *Self-Report Psychopathy Scale* (SRP-III)

The SRP-III (Paulhus, Neumann, & Hare, 2009) is 64-item self-report questionnaire that measures psychopathy in non-clinical populations. Participants, using a 5-point Likert scale (*1* = strongly disagree, *5* = strongly agree), assess the extent to which they agree or disagree with 64 statements such as "Most people are wimps". Items (n=32) are summed and averaged to create a score for primary psychopathy (Callous Affect and Interpersonal Manipulation) and secondary psychopathy (Erratic Lifestyle and Criminal Tendencies). Both had good internal reliability (Cronbach's alpha = .81 and .87 respectively).

3.3.2.2. *Prenatal Testosterone Exposure*

The 2D:4D digit ratio is considered as a proxy marker for PT exposure (Lutchmaya, Baron-Cohen, Raggatt, & Knickmeyer, & Manning, 2004). The length of the second finger (2D) is divided by the length of the fourth finger (4D). Finger measurements were obtained from handscans using a Canon Canoscan LiDE120 scanner and measured using the ruler tool in Adobe Photoshop CS5. This is considered a superior method to using callipers or rulers (Kemper & Schwerdtfeger, 2009). Measurement was taken from the tip of the finger to the proximal crease of the palm by two independent raters. Digit ratio was calculated for the right (RH2D:4D) and left (LH2D:4D) hand. Intraclass correlation coefficients (ICCs) were calculated via a two-way mixed effects model with absolute agreement (Voracek,

Manning, & Dressler, 2007) to ascertain interobserver repeatabilities of the finger measurements. Reliability was low to high between two observers. ICCs were .848 for R2D, .868 for R4D, .347 for RH2D4D, .892 for L2D, .913 for L4D and .468 for LH2D:4D (all *ps* <.001).

3.3.2.3. *Parental Bonding Instrument (PBI)*

Items (n=25) were used from the PBI (Parker, Tupling, & Brown, 1979) to measure recollections of parental bonding from which a score for maternal care (12 items) and maternal control (13 items) were gathered. Using a 4-point Likert scale (*1* = very like, *4* = very unlike), participants rate how statements such as "Spoke to me in a warm and friendly voice" are representative of their mother's parenting style. Both had moderate to good internal reliability (Cronbach's alpha = .92 and .67 respectively).

3.4. Results

Men scored significantly higher than women for primary and secondary psychopathy, and significantly lower for RH2D:4D and LH2D:4D (Table 1). Women scored significantly higher for recalled maternal care.

To explore whether primary and secondary psychopathy are related to 2D:4D and maternal care and control, zero-order (Table 2) and partial correlation coefficients (Table 3) were calculated, controlling for primary and secondary psychopathy respectively, to ensure that relationships were driven by the particular psychopathy variant rather than the shared variance. To compensate for multiple testing, the minimum alpha level was set at .001. Only women had a significant negative relationship between LH2D:4D and primary psychopathy. Comparisons of correlations between men and women revealed significant differences in the relationship between RH2D:4D and maternal care.

To determine the predictive power of each variable in primary and secondary psychopathy for men and women, we conducted a series of standard, simultaneous regressions (Table 4). In men, primary psychopathy was predicted by secondary psychopathy and maternal

protection; in women, secondary psychopathy, LH2D:4D and maternal care. In men, secondary psychopathy was predicted by primary psychopathy and maternal care; in women, primary psychopathy and LH2D:4D only.

To look at the contribution of maternal bonding above and beyond PT on primary and secondary psychopathy for the overall sample, we ran four hierarchical regressions (Table 5). In the first step 2D:4D (RH and LH alternately) was regressed on to primary and secondary psychopathy (alternately). In the second step, mother care and mother protection were added to the model. In all models, 2D:4D significantly predicted both primary and secondary psychopathy. At the second step, apart from secondary psychopathy in the RH and LH2D:4D models, mother care and mother protection added significantly to all other models. Specifically, lower levels of mother care and higher levels of mother protection significantly predicted levels of primary psychopathy over and above the influence of PT. Lower levels of mother care also significantly added to secondary psychopathy above and beyond PT in the final model, however, mother control did not. In all of the final models, PT remained a significant predictor.

Table 5

Means, standard deviations and Cronbach's alpha for variables.

	Total	α	Men	α	Women	α	*t*	*d*
Primary psychopathy	2.51(.57)	.87	3.91(.40)	.68	2.19(.49)	.87	9.85**	1.61
Secondary psychopathy	2.18(.47)	.79	2.50(.35)	.58	1.92(.38)	.79	9.60**	1.59
Mother care	32.61 (10.20)	.92	32.61 (10.20)	.8	39.28 (9.13)	.92	-4.15**	-.69
Mother protection	28.24 (6.81)	.67	28.24 (6.81)	.67	27.28 (5.42)	.67	0.92	.16
RH 2D:4D	.961 (.048)		.961 (.048)		.977 (.038)		-2.20*	-.37
LH 2D:4D	.955 (.054)		.955 (.054)		.983 (.037)		-3.67**	-.6

*$p < .05$
**$p < .01$

Table 6

Zero order correlations between right and left hand 2D:4D, psychopathy variants and maternal bonding.

	RH2D:4D				LH2D:4D			
	Total	Men	Women	*z*	Total	Men	Women	*z*
Primary psychopathy	-.21**	-.03	-.23*	-1.20	-.37**	-.22	-.28*	.44
Secondary psychopathy	-.21**	-.11	-.16	.24	-.29**	-.22	-.06	-.97
Maternal care	.02	-.17	.10	-1.61	.25**	.17	.17	0
Maternal protection	-.20*	-.18	-.20	.12	-.17*	-.14	-.17	.18

Note. *z* is Fisher's *z* to compare dependent correlations.
*$p < .05$
**$p < .01$

Table 7

Partial correlations (controlling for other psychopathy variant) between variables for men and women.

	RH2D:4D				LH2D:4D			
	Total	Men	Women	*z*	Total	Men	Women	*z*
Primary/secondary psychopathy	-.09/-.09	.01/-.10	-.17/-.02	1.08/-.48	-.23**/-.05	-.14/-.16	-.31**/-.15	1.06/-.06
Mother care	-.07/-.09	-.22/-.18	.08/.01	-1.68*/-1.14	.16/.10	.11/.12	.16/.06	-.30/.36
Mother control	-.18*/-.16	-.17/-.18	-.20/-.17	.18/-.06	-.13/-.09	-.10/-.08	-.17/-.13	.42/.30

Note. *z* is Fisher's *z* to compare dependent correlations. Primary psychopathy controlling for secondary psychopathy is above the diagonal, secondary psychopathy controlling for primary psychopathy is below the diagonal.

*$p < .05$
** $p < .01$

Table 8

Summary of standard regression analyses for variables predicting primary and secondary psychopathy in men and women

	Primary psychopathy			Secondary psychopathy		
Variable	B	SEB	*β*	B	SEB	*β*
Secondary/Primary psychopathy	.28/.74	.14/.11	.25*/.58**	.23/.54	.11/.07	.25*/.69**
RH2D:4D	12.08/39.19	32.72/48.92	.05/.10	-23.45/-68.66	29.19/41.03	-.10/-.21
LH2D:4D	-24.23/-108.09	29.03/49.35	-.10/-.26*	-14.54/86.25	26.09/42.14	-.07/.26*
Maternal care	-.26/-.42	.16/.14	-.21/-.25**	-.31/.09	.14/.13	-.28*/.07
Maternal protection	.48/.30	.22/.24	.26*/.10	.20/-.17	.20/.20	.12/-.08
R^2			.25/.53			.24/.44
F			4.08**/16.74**			3.87**/11.57**

Note: Men are above the diagonal, women below the diagonal.

*$p < .05$

** $p < .01$

Table 9

Hierarchical regression of 2D:4D and mother care and protection on primary and secondary psychopathy

	PP/SP RH2D:4D				PP/SP LH2D:4D			
	B	SE	*β*	ΔR²	B	SE	*β*	ΔR²
Step 1								
2D:4D	-2.89/-2.32	1.07/.88	-.22**/-.21**	.04**/.05**	-4.41/-2.89	.93/.78	-.37**/-.29**	.13**/.09**
Step 2								
2D:4D	-2.28/-2.03	.96/.82	-.17*/-.19*		-2.86/-1.90	.88/.77	-.24**/-.19*	
Mother care	-.03/-.02	0/0	-.45**/-.38**		-.02/-.02	0/0	-.40**/-.34**	
Mother protection	.02/.01	.01/.01	.18*/.09	.24**/.15**	.02/.01	.01/.01	.18*/.10	.17**/.11**

*$p < .05$

**$p < .01$

Note: Scores for primary psychopathy are above the diagonal, scores for secondary psychopathy are below the diagonal. PP in the RH2D:4D model: $R^2 = .28$, F (3, 144) = 19.01, $p < .001$; Step 1: $\Delta R^2 = .05$, F (1, 146) = 7.25, $p < .01$; Step 2: $\Delta R^2 = .24$, F (2, 144) = 23.76, $p < .001$. PP in the LH2D:4D model: $R^2 = .31$, F (3, 144) = 21.23, $p < .001$; Step 1: $\Delta R^2 = .13$, F (1, 146) = 22.54, $p < .001$; Step 2: $\Delta R^2 = .17$, F (2, 144) = 17.96, $p < .001$. SP in the RH2D:4D model: $R^2 = .20$, F (3, 144) = 11.93, $p < .001$; Step 1: $\Delta R^2 = .05$, F (1, 146) = 7.03, $p < .01$; Step 2: $\Delta R^2 = .15$, F (2, 144) = 13.77, $p < .001$. SP in the LH2D:4D model: $R^2 = .20$, F (3, 144) = 11.94, $p < .001$; Step 1: $\Delta R^2 = .09$, F (1, 146) = 13.76, $p < .001$; Step 2: $\Delta R^2 = .11$, F (2, 144) = 10.17, $p < .001$.

3.5. Discussion

We investigated whether PT and quality of maternal-child bonding are related to primary and secondary psychopathic traits and behaviours in men and women. Only in women were higher levels of PT related to primary and secondary psychopathic traits, although they also reported uncaring mothers. Quality of mother-child bonding was implicated in the development or primary and secondary psychopathic traits in men, for which PT was not relevant. For the overall sample, PT was, independently, an important contributing factor to primary and secondary psychopathy. However, mother bonding was also influential. Primary psychopathic individuals who had been exposed to more PT recalled mothers as cold or controlling. While secondary psychopathic individuals exposed to more PT also reported uncaring mothers, they had not experienced controlling mothers.

Psychopathy is considered a male fast life history strategy (Jonason at al., 2009), and psychopathic type behaviours are associated with higher levels of PT (e.g., Bailey & Hurd, 2005; Fink et al., 2006), as well as freely circulating testosterone (Yildirim & Derksen, 2012). So it is interesting to find that only women appear subject to fetal programming for psychopathic behaviour. Perhaps fetal programming is more important in women, or female fetuses are more responsive to fluctuations in in-utero hormone levels. Indeed, the relationship between personality traits and PT are more often evidenced in women rather than men (Fink, Manning, & Neave, 2004) and the developmental outcomes of prenatal maternal stress are more detrimental in females than males (Barrett & Swan, 2015). Evidence suggests that maternal stress increases prenatal testosterone in female fetuses only (Barrett et al., 2014; Sarkar et al., 2008). There is also little to no relationship between the development of primary psychopathic behaviours and adverse postnatal environmental factors in girls (Hicks et al., 2012). Estrogen may serve as a postnatal protective factor against the development of neurobiological imperfections (Wise, Dubal, Wilson, Rau, & Böttner, 2001) that are associated with primary

psychopathy in men. It should be noted that as male fetuses are often exposed to higher levels of PT, the absence of a significant finding in men may be due to a ceiling effect where the lengths of the fingers cannot go beyond a masculinisation threshold (Hampson, Ellis & Tenk, 2008). Nevertheless, relationships between PT and types of offending behaviour in men are evidenced (Hoskin & Ellis, 2015).

It is also interesting that the influence of suboptimal levels of maternal bonding in primary and secondary psychopathic traits differed in men and women. Primary and secondary psychopathy are suggested to have different etiologies, namely, primary as genetic and secondary as environmental (Karpman, 1941; Mealey, 1995, although see Hicks et al., 2012). Low maternal care might serve as a proximate trigger for the development of psychopathic behaviours in both men and women (Gao et al., 2010). However, women high in primary psychopathic traits may inherit those traits from a mother who have a similar cold and un-empathetic personality style to them (Loney, Huntenburg, Counts-Allan, & Schmeelk, 2007). Men could develop psychopathic traits as a postnatal response to their mother's behaviour. Research also shows that the sex of the fetus alters gene expression caused by maternal stress (Grundwald & Brunton, 2015). There could be a yet undiscovered genetic relationship between PT and the manifestation of primary psychopathic behaviours in women, since the 2D:4D ratio is highly heritable (Voracek & Dressler, 2009).

The finding that primary psychopathic individuals had experienced cold and controlling mothering is to be expected. If fluctuations in PT are caused by maternal stress, then unless the status of the rearing environment had improved between pregnancy and post-birth, there should be a continuation of factors that encourage a "tough-minded" personality that is adaptive for a hostile environment. Actually, psychopathic behaviour in children lessens if their parents receive parent training and emotional support, and worsens in the absence of such interventions (McDonald, Dodson, Rosenfield, & Jouriles, 2011). If levels of PT were attributed more to genetic influences, then it is possible that the same genes could also contribute

to a mother who is less empathetic and more controlling of her children. Furthermore, controlling mothers producing primary psychopathic children may be attributed to passive gene x environment correlation. Indeed, it is interesting that secondary psychopathic individuals also reported uncaring mothers, but had not been subject to controlling behaviour. It is possible then that these mothers do not exhibit primary psychopathic behaviour but are less caring due to environmental circumstances. For example, they maybe more focused on attending to more-needy siblings, and have limited emotional resources when pursuing practical solutions to the parenting challenges they face on a daily basis. Evidently, PT is an important factor that should be considered in developmental models of psychopathy, yet maternal caring appeared more important and may indeed be a mechanism by which PT leads to psychopathic behaviours. However, examining genetic and environmental causation remains complicated and speculative until we know more about the precise mechanisms involved.

There are limitations to our study. Using 2D:4D as a biomarker in the context of studying individual differences has been challenged (Berenbaum, Korman Bryk, Nowak, Quigly, & Moffat, 2009). However, its popularity as a measure in personality research indicates that it is sufficient for an exploratory study such as this one. Retrospective and self-report measures engender potential problems of accurate recall and self-serving bias. It is important to note that differences in the size of the digit ratio can vary more between countries than between sexes (Manning, Churchill, & Peters, 2007), thus in the future, it is essential to use participants from different countries and ethnic backgrounds.

To our knowledge, this is only the second study that has highlighted a relationship between primary and secondary psychopathy and the in-utero hormonal environment, but is unique in having also examined the role of maternal bonding. We revealed prenatal and postnatal influences for primary psychopathic behaviours in women, while in men, secondary psychopathic behaviours derive from postnatal

experiences. Our findings add to the current literature, by highlighting how fledging psychopathy may be nurtured before birth, and that this biological preparedness is more important for women.

4. Callous-Unemotional Traits Moderate the Relation Between Prenatal Testosterone (2D:4D) and Externalising Behaviours in Children

Following from Chapter 3, the relevance of PT exposure in the development of primary and secondary psychopathy is extended to children. In children, callous-unemotional (CU) traits are considered as the precursor to primary psychopathy (Frick et al., 2014). CU traits drive the development of serious conduct problems by emerging on in childhood, thereby limiting or preventing moral socialisation. It appears that CU traits emerge early because of genetic rather than environmental factors such as adverse parenting, which are more significant to the development of externalising problems alone. It is therefore arguable that externalising behaviours are characteristically similar to secondary rather than primary psychopathy. Thus, in Chapter 4, exposure to prenatal testosterone, as measured using the 2D:4D digit ratio, is investigated in relation to the development of CU traits and externalising behaviours in children aged 5-6 years old. If CU traits present as a precursor to the development of severe externalising behaviours, then CU traits are expected to moderate the influence of exposure to prenatal testosterone. Specifically, that CU traits should moderate the effect of exposure to prenatal testosterone on externalising behaviours.

Note: Chapter 4 has been published as Blanchard, A., & Munoz, L. C. (2016). Callous-unemotional traits moderate the relation between prenatal testosterone (2D:4D) and externalising behaviours in children. *Child Psychiatry & Human Development.*

4.1. Abstract

Children who exhibit callous-unemotional (CU) traits are identified as developing particularly severe forms of externalising behaviours (EB). A number of risk factors have been identified in the development of CU traits, including biological, physiological, and genetic factors. Prenatal testosterone (PT) remains un-investigated, though could signal fetal programming of a combination of CU/EB. Using the 2D:4D digit ratio, the current study examined whether CU traits moderated the relationship between PT and EB. Hand scans were obtained from 79 children aged between 5 and 6 years old whose parents completed the parent report ICU (Inventory of Callous Unemotional Traits) and SDQ (Strengths and Difficulties Questionnaire). CU traits were found to moderate the relationship between PT and EB so that children who were exposed to increased PT and were higher in CU traits exhibited more EB. Findings emphasize the importance of recognising that vulnerability for EB that is accompanied by callousness may arise before birth.

Keywords: Callous-unemotional traits; Externalising behaviours; Maternal stress, Prenatal testosterone; 2D:4D; Moderation.

4.2. Introduction

Biological factors identify children with a profile of externalizing behaviours (EB) accompanied by callous-unemotional (CU) personality traits: lack of empathy, callous disregard for others' wellbeing and their feelings, and a lack of responsibility and care over performance (Levy et al., 2015; Lockwood et al., 2013; Moul, Dobson-Stone, Brennan, Hawes, & Dadds, 2013). Biological factors may include exposure to hormones in the womb, which might set the stage for callous or cruelly perpetrated problem behaviors (Chapman et al., 2006; Knickmeyer, Baron-Cohen, Raggatt, Taylor, & Hackett, 2006, Lutchmaya, Baron-Cohen, & Raggatt, 2002). Given the relation between testosterone and psychopathy and our recent demonstration of an association between prenatal testosterone (PT; measured by the 2D:4D ratio) and primary and secondary psychopathy (callousness and the affective traits; antisocial and impulsive behaviours) (Blanchard, Lyons, & Centifanti, 2016), we investigate the possibility that exposure to PT is related to CU traits and EB. Research demonstrates that children with CU traits and EB evince biological profiles that are distinct from those children with CU traits alone or those with EB that are not accompanied by CU traits (Gao, Tuvblad, Schell, Baker, & Raine, 2015; Lockwood et al., 2016). Thus, we tested interactive effects of PT and CU traits on EB.

CU traits have been shown to differentiate distinct subgroups of children and adolescents with serious EB (e.g., conduct problems, conduct disorder, aggression and antisocial behaviour) (Frick, Ray, Thornton, & Kahn, 2014). For example, children with EB *and* CU traits have been characterized as temperamentally fearless with diminished emotionality, which is suggested to explain their propensity toward lifelong antisocial behavior [Panayiotou, Fanti, & Lazarou, 2015; Viding et al., 2012). Children with CU traits and EB have reduced emotional and physiological reactivity that is not evident in children with EB alone (De Wied, Van Boxtel, Matthys, & Meeus, 2012; Muñoz, Frick, Kimonis, & Aucoin, 2008). Their emotional

deficits may be driven by a dysfunctional amygdala, given research showing reduced potentiated startle to violent images for those children with CU traits and EB (Fanti, Kyranides, & Panayiotou, 2015). Atypical neurological development may explain the hypoactivity to others' distress, which impairs important brain regions for social and affective functioning (Breeden, Cardinale, Lozier, van Meter, & Marsh, 2015; Hoppenbrouwers et al., 2013; Wolf et al., 2015). Further, EB with CU traits show substantial heritability, greater than the heritability estimates for EB without CU traits (Viding et al., 2004). These biological influences suggest that a lack of emotional and physiological reactivity to fearful events could explain why children with CU traits are less receptive to learning via punitive measures, hindering normative social development, and predisposing these children to lifelong antisocial behavior (Kochanska, 1993).

Although the psychophysiological and biological profile of youths with CU traits is relatively well researched (Viding & Larsson, 2007; Viding, Larsson, & Jones, 2008; Marsh et al., 2008), the prenatal biology of children who later show CU traits is unknown. There is reason to speculate that PT exposure might play a role in the development of behaviours associated with psychopathy (Lomardo et al., 2012; Yildirim & Derksen, 2012). For example, using the 2D:4D digit ratio as a biomarker for PT, research shows that high PT exposure is related to higher trait aggression (Bailey & Hurd, 2005), indirect and reactive aggression (Coyne, Manning, Ringer, & Bailey, 2007; Benderliogly & Nelson, 2004; Hampson, Ellis, & Tenk, 2008), sensation seeking and boredom susceptibility (Fink, Neave, Laughton, & Manning, 2006), recreational, financial and social risk taking (Stenstrom, Saad, Nepomuceno, & Mendenhall, 2011; Hönekopp, 2011), increased sensitivity to status cues (Millet & Dewitte, 2009), and dis-inhibition (Austin, Manning, McInroy, & Mathews, 2002). In contrast, higher levels of prenatal estrogen (PE) are associated with empathy (Kempe & Heffernan, 2011, Wakabayashi & Nakazawa, 2010), pro-social behaviour (Fink, Manning, Williams, & Podmore-Nappin, 2007), neuroticism (Fink, Neave, Laughton, & Manning,

2006), and anxiety (de Bruin, Verheij, Wiegman, & Ferdinand, 2006). Thus, the effects of PT on prenatal neural development appear to have long-lasting consequences for psychopathic behaviours, starting from childhood into adulthood.

One causal factor implicated in the fluctuation of PT is maternal stress, which could provide a proximate environmental determinant for the development of psychopathic behaviours. Maternal stress is hypothesised to elevate levels of cortisol, which, via the hypothalamic-pituitary adrenal (HPA) axis, act on the adrenal, ovarian/testicular functioning of the fetus thereby stimulating the production of PT (Sarkar, Bergman, O'Connor, & Glover, 2008; Barrett & Swan, 2015; Gitau, Adams, Fisk, & Glover, 2005; Barrett et al., 2013). Indeed, EB (e.g., aggression and sensation seeking) associated with higher levels of PT are also related to maternal anxiety (O'Connor, Heron, Golding, & Glover, 2003; van den Bergh & Marcoen, 2004). This may indicate a kind of "fetal programming" (Del Giudice, 2012) whereby maternal stress acts as a cue that the environment outside the womb is stressful. Therefore, in-utero hormone levels may prompt masculinisation of the unborn infant's brain to prepare them for a competitive environment. The child is then equipped with masculinsed traits and behaviours that are adaptive in the harsh environment that they are born into. However, studies also show that the 2D:4D ratio is moderately to highly heritable (Gobrogge, Breedlove, & Klump, 2008) and therefore, while PT is evidently an important contributor to the development of certain behaviours, both non-shared environmental factors and genetic influence should be taken into consideration.

Nevertheless, the relationship between testosterone and psychopathic behaviours is not entirely clear. For example, testosterone has been associated with impulsivity, and people with high testosterone readily activate aggressive coping strategies when provoked (Susman et al., 1987). People with CU traits tend to show instrumental or planned aggressive behaviour rather than reactive or provoked aggression (Coyne & Thomas, 2008; Vaillancourt & Sunderani, 2011; Lee & Salekin, 2010). However, ratios between testosterone and cortisol,

specifically lower ratios (i.e., lower levels of testosterone to higher levels of cortisol), have been argued to be indicative of good, rather than the abnormal amygdala functioning, characteristic of CU traits and primary psychopathy (van Honk, Peper, & Schutter, 2005). As expected, people with high ratios, indicating high levels of testosterone and low levels of cortisol, have been shown to be high on psychopathic traits (Glenn, Raine, Schug, & Granger, 2011; van Honk & Schutter, 2006). Interestingly, a similar finding has emerged from a 2D:4D ratio study of adolescent males in which those that had been exposed to higher levels of PT, low cortisol reactivity was associated with self-reported aggression and rule-breaking behaviour (Portnoy et al., 2015). Thus, the relation between testosterone and CU traits may be complex and involves interacting hormonal systems.

In light of the current literature, we examined whether children between the ages of 5 and 6 years who were exposed to greater levels of PT expressed higher levels of CU traits and EB. Children at the age of 5 to 6 years are the age at which they enter school, and this group is of particular relevance to study because of developments in empathy, emotion understanding, and cognition that demonstrate extensive growth at this age (Izard et al., 2001). Additionally, empathy and emotion understanding deficits have been found to be associated with CU traits at this age (Centifanti, Meins, & Fernyhough, 2016). Children who are entering school are in a position to develop independence from their parents and therefore become susceptible to positive and negative peer influences (Deater-Deckard, 2001; Gulay, 2011). Furthermore, CU traits have yet to be examined in this particular age group. Previous studies have shown that CU traits emerge as early as age 2 years (Lynam, 2002; Waller et al., 2012) and remain relatively stable throughout childhood [Salekin & Frick, 2005; Waller et al., 2012; Hawes & Dadds, 2007). Therefore, the influence of prenatal experiences in the development of CU traits and EB may be observable in our sample of children. Studies investigating "fetal programming" (Blanchard et al., 2016; Hoskin & Ellis, 2015) with regards to psychopathic and antisocial behaviour have also so far only

concerned adults.

Therefore, based on our prior research (Blanchard et al., 2016) and that both genes and environmental (i.e., maternal stress) factors are implicated in the status of PT, we expected elevated levels of PT to be associated with higher CU traits and higher EB. Considering that the presence of CU traits combined with EB designates a unique group of children with serious EB, we hypothesized an interaction between exposure to increased PT and more CU traits in the expression of higher levels of EB.

4.3. Method

4.3.2. Participants and Procedure

Seventy-nine parents and children (48 girls) were recruited from five primary schools in the Merseyside area of the United Kingdom. Schools came from areas of varying socio-economic backgrounds as indicated by their Index of Multiple Deprivation (IMD) score (Department for Communities and Local Government, 2015), ranging from 3.40 to 47.93. Four children came from 10% of the most deprived areas; 24 children came from the 20% most deprived areas; nine children came from the 40% most deprived areas and 43 children came from the 10% least deprived areas in England. Children were in Year 1 of The British Education System and aged between five and six years.

4.3.2. Measures

4.3.2.1. *Inventory of Callous-Unemotional Traits (ICU)*

The ICU Parent Report (Frick, 2004) is a 24-item questionnaire that assesses CU traits in children. Using a four-point Likert scale, the parent rates how true (*0* = not at all true, *3* = definitely true) certain statements are of their child (e.g., "Does not show emotions" and "Does not care about doing things well"). Ratings are summed to produce an overall score of CU traits. Internal consistency was good though improved by removing item 10 ("Does not let feelings control him/her") (Cronbach's alpha = .83), which is a consistent item underperformer in prior research [65].

4.3.2.2. *Strengths and Difficulties Questionnaire (SDQ)*

The SDQ (Goodman, 1997) is a 25-item questionnaire that

screens for various positive and negative behaviours. Each subscale consists of five items, and we combined the Conduct Problems and Hyperactivity subscales to produce an overall Externalising score, as has been done in prior research [56]. On a three-point Likert scale, parents rated how true (*0* = not true, *2* = certainly true) statements such as: "Often lies or cheats" (Conduct problems), and "Restless, overactive" (Hyperactivity) were of their child. The Externalising score produced acceptable internal consistency (Cronbach's alpha = .76).

4.3.2.3. *Prenatal Testosterone Exposure*

The 2D:4D digit ratio is an accepted measure for PT exposure (Manning, Scutt, Wilson, & Lewis-Jones, 1998; Putz, Gaulin, Sporter, & McBurney, 2004; Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, & Manning, 2004) and is calculated by dividing the length of the second finger digit (2D) by the length of the fourth finger digit (4D). Sexual dimorphism in 2D:4D is present from at least the 14th week of pregnancy and remains stable into adulthood (Malas, Dogan, Evcil, & Desdicioglu, 2006; Galis, Ten Broek, Van Dongen, & Wijnaendts, 2010; Trivers, Manning, & Jacobson, 2006; Ventura, Gomes, Pita, Neto, & Taylor, 2013; Zheng & Cohn, 2011). Postnatal hormonal surges also drive finger length growth; however, research shows that high levels of circulating testosterone during adolescence actually reduce the impact of stress (Lürzel, Kaiser, Krüger, & Sachser, 2011). Therefore, the 2D:4D ratio should be robust to postnatal stresses.

We used a Canon Canoscan LiDE120 scanner to obtain hand scans from which fingers were measured using the measurement tool in Adobe Photoshop CS5. Hand scans and computer-assisted measurement are argued as a preferable method to using callipers or rulers (Kemper & Schwerdtfeger, 2009; Allaway, Bloski, Pierson, & Lujan, 2009). The length of the finger measurement is taken from the tip of the finger to the proximal crease of the palm. Both right-hand (RH) and left-hand (LH) ratios were calculated. Inter-observer repeatabilities of the finger measurements were assessed using Intraclass correlation coefficients (ICCs) (Voracek, Manning, & Dressler, 2007) and revealed low to good reliability between two

observers. ICCs were .848 for R2D, .868 for R4D, .347 for RH2D4D, .892 for L2D, .913 for L4D and .468 for LH2D:4D (all *ps* <.001).

4.3.3. Procedure

Head Teachers were approached via email or telephone and were provided with an Access Letter that described the nature and purpose of the study, and the data collection process. On obtaining authorization for the study to be carried out, individual study packs for each child containing an Information Sheet, Consent Forms (Parent Consent for child participation, Child Consent and Parent Consent), ICU and SDQ were sent to the school. The Information Sheet stated the nature and purpose of the study; that it involved the parent completing two questionnaires about their child's behaviour, and for their child's hands to be scanned at school. Teachers distributed the packs to children who were to take them home to their parents. A period of at least two weeks was given for parents to return the packs (in a sealed envelope provided) with completed consent forms and questionnaires. The children whose parents had consented for them to take part were asked for their consent. If they agreed, they had their hand scanned at a later date whilst they were at school.

4.4. Results

Descriptive statistics are shown in Table 1. Digit ratios for both hands were smaller in boys than in girls but were not significantly so. Boys also scored higher in all reported measures, but not significantly.

In order to look at the relationship between 2D:4D ratio, CU traits and EB, we conducted a series of zero-order correlations (Table 2). Due to multiple comparisons and the increased likelihood of making a Type 1 error, a Bonferonni correction set the minimum alpha level to .001. No significant relationships at .001 were found between any of the

variables. Next we conducted two stepwise regression analyses (Table 3) where in the first step either RH or LH2D:4D and CU traits were regressed onto the SDQ Externalising score, and then on the second

step we added an interaction term of either RH X CU traits or LH2D:4D X CU traits. In the first step of the RH2D:4D model, SDQ Externalising was significantly and uniquely predicted by CU traits, but not RH2D:4D. With the addition of the interaction term, CU remained a significant predictor, and the standardised beta for RH2D:4D became significant. The interaction term was also significant. The interaction between RH2D:4D and CU traits explained 4% of the variance in SDQ Externalising. In the first step of the LH2D:4D model, SDQ Externalising was uniquely predicted by CU traits. Neither LH2D:4D nor the interaction term was significant in predicting SDQ Externalising scores. Post hoc testing was applied using PROCESS (Hayes, 2012) to examine the association between RH2D:4D and SDQ Externalising at low (-1SD), mean, and high (+1SD) levels of CU traits. The form of the interaction is shown in Figure 1.

Table 11. *Zero order correlations for RH2D:4D and LH2D:4D.*

	RH2D:4D	LH2D:4D	ICU	SDQ Externalising
RH2D:4D	1	0.74***	.23*	.10
LH2D:4D		1	.14	.11
ICU			1	.47***
SDQ Externalising				1

*$p < .05$
**$p < .01$
***$p < .001$

Table 10. *Means and stand deviations for all variables.*

	Total	Boys	Girls	*t*
RH2D:4D	.956(.037)	.956(.036)	.956(.037)	-.09
LH2D:4D	.963(.038)	.959(.037)	.965(.039)	-.72
ICU	16.34(4.64)	17.26(5.26)	15.83(4.15)	1.34
SDQ Externalising	4.92(3.47)	5.48(3.54)	4.56(3.41)	1.15

*$p < .05$
**$p < .01$

Table 12.

Stepwise regression of 2D:4D and CU traits on SDQ Externalising scores

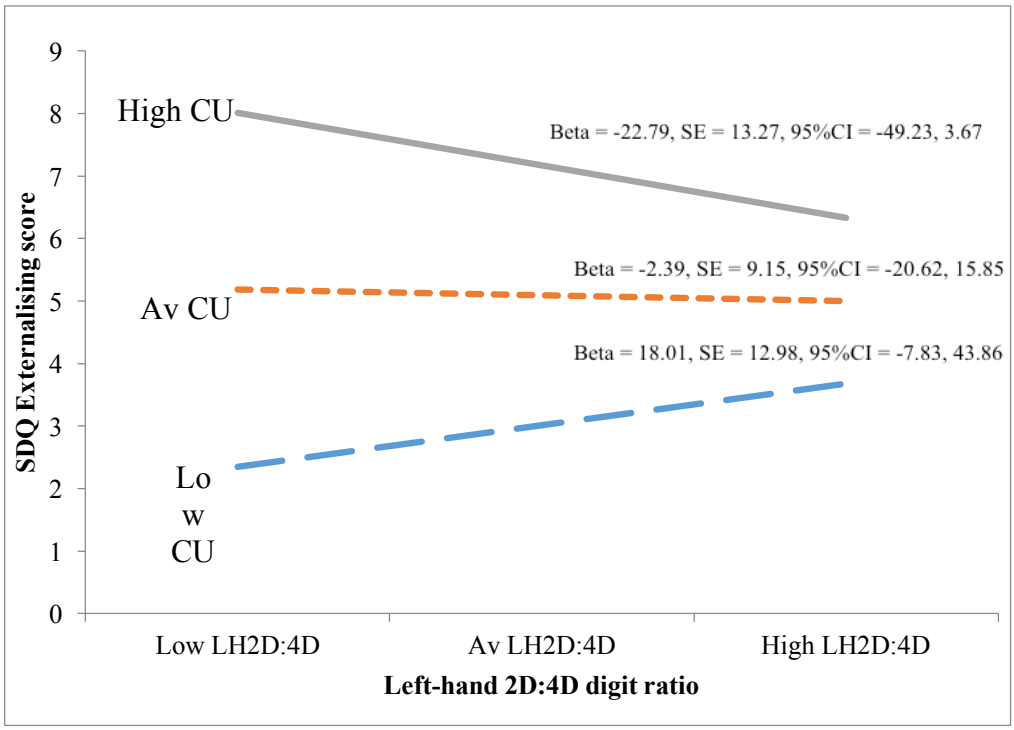
	SDQ (RH2D:4D)				SDQ (LH2D:4D)			
	B	SE	*β*	ΔR²	B	SE	*β*	ΔR²
Step 1								
2D:4D	-1.93	9.37	-.02		2.95	9	.03	
CU traits	.04	.08	.54**	15.12**	.40	.07	.53**	15.17**
Step 2								
2D:4D	69.7	34.28	.74*		39.61	32.45	.43	
CU traits	4.65	1.96	6.21		2.44	1.74	3.26	
2D:4D x CU traits	-4.34	2.03	-5.9	4.70*	-2.12	1.81	-2.82	1.38

*$p < .05$

** $p < .01$

Note: SDQ and RH2D:4D model: $R^2 = .33$, F (3, 78) = 12.14, $p < .001$; Step 1: ΔR² = .29, F (2, 76) = 15.12, $p < .001$; Step 2: ΔR² = .04, F (1, 75) = 4.70, $p = .03$. SDQ and LH2D:4D model: $R^2 = .30$, F (3, 78) = 10.62, $p < .001$; Step 1: ΔR² = .29, F (2, 76) = 15.12, $p < .001$; Step 2: ΔR² = .01, F (1, 75) = 1.38, p = ns.

Figure 1. Externalising scores for exposure to prenatal testosterone (RH2D:4D), split by low, average and high CU traits scores.



4.5. Discussion

We investigated whether PT was related to CU traits and EB in children between 5 and 6 years of age. We also examined whether there was an interaction between exposure to PT and CU traits in being associated with higher levels of EB. We found that children who were higher in CU traits who had been exposed to greater levels of PT were higher in EB reported by parents. Children who were higher in CU traits, but who had been exposed to lower levels of PT (i.e., indicative of greater prenatal estrogen), demonstrated fewer EB. This finding suggests that CU traits can worsen or enhance the masculinising influence of PT in the development of EB. To our knowledge, this is the first study to suggest that prenatal neuroendocrinology may be a factor involved in CU traits and EB exhibited in children aged between 5 and 6 years old.

Our findings are consistent with what is understood about the interplay between genetic and environmental factors in the development of child psychopathy. Although our study is the first to demonstrate that this interplay may start before birth, research reliably indicates that some children are genetically vulnerable to the development of a cold and callous temperament style of interacting with others. Such findings are demonstrated in 7-year olds (Humayun, Kahn, Frick, & Viding, 2014; Viding & Larsson, 2007; Bezdjian, Tuvblad, Raine, & Baker, 2011), 9-10 year olds (Fontaine, McCrory, Boivan, Moffitt, & Viding, 2011), 12-year olds (Hick et al., 2012), adolescents (Taylor, Loney, Bobadilla, Iacono, & McGue, 2003; Blomigen, Carlson, Krueger, Patrick, 2003) and adults (Blonigen, Hicks, Krueger, Patrick, & Iacono, 2006). However, children with CU traits may be further exposed to stressors that result in pervasive and serious EB because of how they interact with their environment. For example, children with CU traits have been shown to experience greater negative life events over time, which may be a consequence of their own fearless and risky behaviours that lead to encountering dangerous environments or situations where they are likely to suffer stressful events (Kimonis, Centifanti, Allen, &

Frick, 2014; Blair, 2006; Frick & Ellis, 1999; Muñoz, 2009; O'Brien & Frick, 1996). Our main finding suggests that a child with a genetic vulnerability to CU traits is already, *pre-birth*, susceptible to developing EB caused by environmental factors; in this case, elevated levels of PT activated by maternal stress. Specifically, the high-CU child may be more sensitive to the masculinising effects that higher levels of PT have on neural organisation. We would like to address whether it is adaptive to be predisposed to problem behaviours so early on in life. Essentially, does our finding indicate a potential role for fetal programming (Del Giudice, 2012)?

Maternal stress has been suggested to operate as a signal of impending harsh environmental conditions to the fetus. Specifically, stress increases cortisol, which changes fetal adrenal, ovarian and testicular functioning, and therefore PT production (Sarkar et al., 2008; Barrett & Swan, 2015; Gitau et al., 2005; Barrett et al., 2013). We would therefore expect an association between higher levels of PT and aggressive, competitive behaviours once entering the world. Fetal programming predicts that this association should be observed in both adults *and* children because an early start to problem behaviour would be adaptive in successfully navigating a hostile environment through to adulthood. Aggressive and impulsive behaviours are valuable in self-defense, while stealing and cheating facilitate gaining access to goods, and perhaps more essentially, food.

Yet, a range of diverse and unaccounted for factors may act on PT and thus the association may not be straightforward. For example, PT levels are highly heritable (Gobrogge et al., 2008) and thus genetic effects should be given due consideration. In which case, one might observe externalizing behaviour in those high on CU traits and PT regardless of the harshness of the environment. Thus, when either researching or in treatment planning, the child's entire life history, including whether the mother experienced stress during pregnancy, is needed to construct the most informative account of their developmental trajectory to problem behaviour. This might also be

helpful in prevention, by monitoring the expectant mother's mental health and intervening as appropriate (e.g., additional support) during pregnancy.

Our results suggest that from pre-birth, children with CU traits who were also exposed to more PT, are potentially more liable in developing behaviours that are adaptive in harsh environments, thereby providing some support for "fetal programming". Interestingly, our findings corroborate what prior studies revealed. Namely, that high PT is related to hyperactivity, ADHD symptoms, conduct problems and poor social cognitive functioning in children from 3 to 7 years of age (Fink et al., 2007; de Bruin et al., 2006). We extend these findings to include children who exhibit traits and behaviours associated with child psychopathy.

The case for fetal programming is gaining support, although further investigation is needed to identify the precise biological mechanism between maternal stress and PT, which currently remains a topic for investigation. The fetal programming hypothesis is challenged by high heritability values for 2D:4D (Gobrogge et al., 2008; Voracek & Dressler, 2009), and therefore multiple factors (biological *and* environmental) need consideration. Perhaps there is an association between the genes that code for CU traits and those that code for PT levels. However, in our study, we did not find evidence for zero-order correlations between CU traits and PT. It should be borne in mind that phenotypic output is the product of a highly complex process involving genes, the environment, and gene x environment interactions. Therefore, we can only speculate as to the implications of our results at this time.

A final point of interest is that children exposed to higher levels of PE have fewer EB only if they were higher on CU traits. Research reliably shows that high PE is associated with empathy and prosocial behaviour (Knickmeyer et al., 2006; Kempe & Heffernan, 2011; Wakabayashi & Nakazawa, 2010), as well as anxiety and neuroticism (de Bruin et al., 2006; Manning & Fink, 2011; Austin, Manning, McInroy, & Mathews, 2002). Seeing that psychopathy is hypothesised

to be a male adaptation (Jonason, Li, Webster, & Schmitt, 2009), it is possible to speculate that feminising effects of PE counterbalance CU traits by some yet unknown mechanism. Children high on CU traits exposed to higher levels of PE may not end up eliciting adverse reactions from parents or peers, perhaps because they are more prosocial or empathetic, at least cognitively rather than affectively (i.e., they can "talk the talk"). Consequently, they reduce the likelihood of developing EB usually associated with harsh environments. Of particular relevance is evidence from prior 2D:4D ratio research where PT moderated the association between exposure to aggression cues and prosocial behaviour. Specifically, individuals exposed to higher levels of PE became more prosocial in the presence of an aggression cue (Millet & Dewitte, 2009). The authors suggested that contextual cues should be considered as moderating effects when interpreting associations between PT and personality traits, and might explain why findings from 2D:4D research can produce inconsistent results (Millet & Dewitte, 2009). Our findings similarly highlight the need to consider other factors that might potentially moderate the relationship between PT and personality.

There are limitations to our study. We used the parent report versions of both the SDQ and ICU, which increases the potential for shared-method variance. It would have been beneficial to include the teacher report versions by way of verification. However, due to the need to limit the time required by the school to administer the data collection, we felt that the parent report versions were adequate. Assigning CU traits as the main focus for psychopathy research in children has also been challenged. Some argue that this ignores other important behavioural and interpersonal aspects of psychopathic personality that the ICU does not measure (Collins et al., 2014). However, research consistently demonstrates CU traits as a key factor in identifying children who go on to develop psychopathy (Frick et al., 2014; Panayiotou et al., 2015, Viding et al., 2012). In the absence of equally compelling research that pinpoints another key factor, we are therefore confident in using the ICU as an indicator of traits and

behaviors associated with psychopathy. Future studies should also measure CU traits in parents and siblings, as well as employ a longitudinal design in order to elucidate further the direction and strength of environmental influences. Debate also surrounds the accuracy of using the 2D:4D ratio as a biomarker for PT and results can be inconsistent across sex, for even studies investigating similar behaviours (Berenbaum, Bryk, Nowak, Quigley, & Moffat, 2009). However, there is good evidence to suggest that the 2D:4D reflects PT exposure (Manning et al., 1998; Putz et al., 2004; Lutchmaya et al., 2004) and has become a popular measure used in studies over the last fifteen years. We therefore feel that our results make a unique contribution to the literature and provide the basis for investigating the subject area further. A final issue concerns sex differences. Both psychopathy and 2D:4D ratio are sexually dimorphic, however in our study, due to our sample size, to compare boys and girls would have failed to generate enough power to make any findings truly inferential. Future studies should aim to investigate gender as a potential moderator.

Our study is unique in including children. For example, studies that have linked aggression (Bailey & Hurd, 2005; Coyne et al., 2007; Benderlioglu & Nelson, 2004; Cleveland, 2014; although c.f. Hönekopp & Watson, 2011), sensation seeking (Fink et al., 2006), low empathy (Chapman et al., 2006; Knickmeyer et al., 2006; Kempe & Heffernan, 2011, Wakabayashi & Nakazawa, 2010), dominance (Manning & Fink, 2008) and antisocial behaviour (Yildirim & Derksen, 2012) to high PT have only used adult samples. Our findings will also contribute to the further advancement of developmental psychopathological theories of CP behaviour. Frick and colleagues (Frick et al., 2014) state that the most sufficient causal model can only be achieved by considering multiple risk factors, both biological and environmental. We have presented a hitherto unconsidered risk factor, and have also highlighted the timing for when this risk factor (e.g., before birth) takes effect. The most comprehensive theory helps to improve prevention or intervention treatment for at-risk or affected children. Indeed, early intervention is

more effective (Hyde et al., 2013; McDonald, Dodson, Rosenfield, & Jouriles, 2011; Feinberg, Jones, Roettger, Solmeyer, & Hostetler, 2016; Feinberg et al., 2015) and may prevent the negative consequences of harsh parenting [58]. Pregnant women who are encountering stress should be identified early in the pregnancy so that they can be provided with mental health support. Unresolved maternal stress may also make these women more vulnerable to developing a harsh parenting style; thus early intervention is critical to prevention of CP [Millet & Dewitte, 2009; Collins et al., 2014].

Our findings contribute to an ever increasing and important body of research in child psychopathy. Researchers acknowledge that developmental pathways to adult psychopathy are not easily discovered and concern varied environmental and biological factors (Frick et al., 2014). This is the first study to forward another biological factor in the form of PT, and highlights the need to acknowledge that children are potentially on the path to problem behaviour even before they are born.

4.6. Summary

CU traits are readily acknowledged as the key to the development of serious EB behaviour in children. Multiple risk factors for CU combined with EB have already been identified in previous studies. However, this is the first to examine if prenatal experiences also contribute to this type of behaviour. Studies show that adverse traits and behaviours are expressed in adults who were subject to higher levels of PT, highlighting PT as a potential risk factor for CU traits in children. Hence, in the current study, we examined CU traits as a moderating factor in the association between exposure to PT and EB. The 2D:4D digit ratio was used to measure exposure to PT in children 5 to 6 years old, who were also evaluated for CU traits and EB by their parents. A moderating effect was found for CU traits such that children speculatively exposed to higher levels of PT expressed more EB if they were high in CU traits. Conversely, children exposed to lower levels of PT but were high in CU traits expressed less EB. These findings suggest that CU traits can enhance or weaken the influence of prenatal

masculinisation on CP EB. This study has therefore provided a fresh perspective on CU traits and EB in children by highlighting neuroendocrinoloy and prenatal experiences as potential factors in their development.

5. An effective way to deal with predators is to taste terrible: Primary and secondary psychopathy and mate preference

The previous chapters have compared developmental differences in primary and secondary psychopathy to investigate further the argument that primary psychopathy is principally a genetically determined phenotype and secondary psychopathy is a conditional adaptation to the environment. Nevertheless, primary and secondary psychopathy are both supposedly adaptive, fast LH strategies. Therefore, unlikely though it is in light of obvious un-pleasantries about their character, primary and secondary psychopathic individuals must hold some sexual appeal to other people. Indeed, charm and success in business or some other high ranking profession garnered from being manipulative and cunning could be regarded as sexy. Likewise, individuals who take risks and seek heady and exciting experiences might also be thought of as dangerous but thrilling to be around. Indeed, if either psychopathy type was not attractive, then primary psychopathy would have become extinct due to natural selection and developmental plasticity would not allow a shift to secondary psychopathic behaviour if it did not afford any fitness consequences. Furthermore, as cheater strategies

Previous research (Aitken et al., 2013; Jonason et al., 2015) demonstrates that psychopathy and other adverse personality traits and behaviours (including Machiavellianism and narcissism) are attractive on a short-term mating basis, which would be expected of fast LH strategies. Behaviour associated with psychopathy such as aggression, risk taking, status seeking and dominance may afford advantage in intra-sexual competition and therefore signal "good genes" more effective in hostile environments. Yet, due to characteristic differences, primary and secondary psychopathy in partners may hold appeal in distinctive ways. Furthermore, individuals high in primary psychopathy persons may solely rely on manipulation to attract a

partner, hiding their "true" personality in the process. Or, their charm and narcissistic personality may well seem appealing on first impressions. Thus in Chapter 5, attractiveness of individuals high in subclinical primary and secondary psychopathy is investigated across short and long-term mating contexts. Behavioural and trait characteristics of high and low primary and secondary psychopathy individuals are presented in a personality profile/vignette for evaluation. As women choose men high in Machiavellianism for short-term relationships (Aitken et al., 2013), potentially due to "good genes", it is predicted that high primary and secondary psychopathy partners are potentially considered attractive for short-term and not long term relationships. As per Parental Investment Theory, men and women should differ in mating preferences, even for partners high in primary or secondary psychopathy, and thus comparisons between sex are also explored.

Lastly, assortative mating, whereby people select mates that are similar to them, is a common phenomenon, evidenced for a diverse range of factors such as educational and economic background, attractiveness and personality. Assortative mating is thought to be adaptive as it increases genetic relatedness and encourages familial communication, altruism and bi-parental care (Thiessen & Gregg, 1980). Research shows assortative mating for psychopathy, sensation seeking, and antisocial behaviour (Jonason et al., 2015; Glicksohn & Golan, 2001; Knight, 2011), so it is possible that this also happens for primary and secondary psychopathic traits. Therefore, in Chapter 5, assortative mating between individuals high in subclinical primary and secondary psychopathy is also investigated and expected to occur.

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5.1. Abstract

Despite their reputation for taking advantage of other people, previous research shows that psychopathic individuals are attractive for short-term relationships. Furthermore, individuals with psychopathic traits have been found to be attracted to other psychopathic persons in both short and long-term relationships. The current study ($N = 258$), is the first to extend the investigation further by examining whether these findings pertain to the affective (i.e., primary) or behavioural (i.e., secondary) aspects of psychopathy, and if this varies according to sex. Using a series of personality profiles, we found that men and women evaluated individuals higher in primary or secondary psychopathic traits unattractive for both short and long-term relationships. However, a pattern for assortative mating was evidenced in women higher in primary psychopathy who preferred high primary psychopathy men in long-term relationships, and for women higher in secondary psychopathy who preferred men higher in secondary psychopathy for short-term relationships. Men higher in either primary or secondary psychopathy were indiscriminate in make choice across in both short and long-term relationships. Results are discussed from an evolutionary theoretical perspective.

5.2. Introduction

Psychopathic individuals are callous, manipulative, impulsive and irresponsible (Hare, 2003). Their toxicity would not be expected to bode well for romance. They engage in risky sexual behaviour (Fulton, Marcus & Payne, 2010), mate poach (Jonason, Li & Buss, 2010), are sexually aggressive (Mouilso & Calhoun, 2012), and enjoy multiple sexual partners (Visser, Pozzebon, Bogaert, & Ashton, 2010). It is unsurprising that psychopathy negatively affects relationship satisfaction and commitment (Smith et al., 2014; Visser et al., 2010). Nevertheless, studies show that people find psychopathic individuals attractive at least for short-term romantic encounters (Jonason, Lyons, & Blanchard, 2015), which raises the question, what is it that people find alluring about a psychopathic partner?

The aversive nature of psychopathic individuals (although they may initially seem charming and confident) suggests that they must offer something else in a relationship. In the context of mating psychology, "good genes" is perhaps the answer. Women perceive socially dominant behaviour (Kruger, Fisher, & Jobling, 2003), conspicuous consumption (Griskevicius et al., 2007), sexual attractiveness, and charisma (Durante, Griskevicius, Simpson, Cantú, & Li, 2012) as indicators of genetic quality, which are all associated with psychopathy (Babiak, Neumann, & Hare, 2010; Lee et al., 2013; Verona, Patrick, & Joiner, 2001). Men's preference for psychopathic traits in women is less well understood, perhaps because psychopathy is hypothesised to have provided fitness only to males and not to females (Jonason, Webster, & Schmitt, 2009). Yet, it is possible that psychopathic women are attractive to men as they similarly pursue short-term relationships and may offer the opportunity for an affair.

However, the literature has yet to address how psychopathic traits associated with "good genes" pertain to primary and secondary psychopathy, which is important considering there are phenotypic and possible etiological differences between them (Mealey, 1995). Primary psychopathy refers to the affective and interpersonal characteristics of

psychopathy (e.g., callousness and manipulation); secondary psychopathy concerns the behavioural aspects of psychopathy (e.g., impulsivity and reactive aggression). Thus, primary psychopathy is described as "successful", and secondary psychopathy as "unsuccessful" (Vidal, Skeem, & Camp, 2010). Negative behaviours associated with secondary psychopathy include anxiety (Schmitt & Newman, 1999), negative urgency (Whiteside & Lynam, 2001), emotional-instability, and poor interpersonal functioning (Ray, Poythress, Weir & Rickelm, 2009). Primary psychopathic individuals do not experience negative urgency or anxiety (Anestis, Anestis, & Joiner, 2009), are assertive (Levenson, Kiehl, & Fitzpatrick, 1995) and good at emotion management (Ali, Amorim & Chamorro-Premuzic, 2009). They succeed in business environments (Babiak et al., 2010), are ambitious and self-disciplined (Mullins-Sweatt, Glover, Derefinko, Miller, & Widiger, 2010), which, with the ability to manipulate, confers success in high-ranking professions (Skeem, Polaschek, Patrick, & Lilienfeld, 2011). However, sensation seeking, risk taking and reactive aggression in secondary psychopathy could be adaptive in intrasexual competition (Weiss, Egan, & Figueredo, 2002). Nevertheless, unlike primary psychopathic individuals who are cunning, secondary psychopathic individuals perhaps are more likely to be caught and punished (Wilkowski & Robinson, 2008). Therefore, the "good genes" of psychopathy potentially pertain more to primary psychopathy. In the current study, we explore this argument.

What also remains un-investigated is whether primary or secondary psychopathic individuals find their equivalents attractive. Assortative mating is the process by which individuals select romantic partners who are similar to them on a range of physical, psychological, educational and socio-economic factors (Thiessen & Gregg, 1980). Assortative mating is adaptive because it increases familial genetic relatedness, which helps bond and promote communication between family members (Thiessen & Gregg, 1980). Shared traits and lifestyles increase relationship satisfaction (Gonzaga, Carter, & Galen Buckwalter, 2010) and marital quality (Luo & Klohen, 2005), and

therefore improve relationship longevity. Long-term relationship commitment is conducive to high-quality parenting, however, individuals who are high in secondary psychopathic traits also choose similar partners to them. Patterns of assortative mating has been evidenced in individuals who engage in antisocial and criminal behaviour (Krueger, Moffitt, Caspi, Bleske & Silva, 1998; Boutwell, Beaver, & Barnes, 2012), as well as substance use. Currently, whether mate choice for similarity also pertains to primary psychopathic traits remains, we believe, un-investigated. Considering that assortative mating encourages high-quality child-care queries how it can benefit those with psychopathy who invest in mating effort. However, partners who share proclivities to cheat and deceive each other should experience relationship dissatisfaction and consequently move on to a new partner (and have more children) (Olderbak & Figueredo, 2012). Alternatively, psychopathic individuals might choose a similar partner because they enjoy the drama of the relationship (Jonason, Valentine, Li, & Harbeson, 2011). Perhaps individuals higher in secondary psychopathy want someone who can participate in their sensation seeking and impulsive behaviour, or because someone higher in primary psychopathy is under aroused and needs a partner whose behaviour is so outrageous that they find them interesting and stimulating to be with. It is arguable then, that primary or secondary psychopathic individuals do not differentiate between short and long-term relationships because mating effort is always more important than parenting.

In the current study, we investigated mate choice for primary and secondary psychopathic individuals for short and long-term mating. As well as looking at the overall preference, we were interested in assortative mating for these traits. This is the first study that examines the attractiveness of the two psychopathy sub-types, elucidating the success of these traits in the mating domain.

5.3. Method

5.3.1. Participants

Two hundred and fifty-eight participants, of which 107 were male (M_{age}: 37.48, *SD* = 12.40) and 151 female (M_{age}: 40.72, *SD* = 12.03) were recruited via CrowdFlower from countries whose first language is English (United States, Canada, Australia and the United Kingdom). CrowdFlower is a crowdsourcing company that enables customers to access large numbers of individuals (i.e., contributors) who are paid to complete surveys posted by researchers or marketing companies.

5.3.2. Measures

5.3.2.1. *Self-Report Psychopathy Scale* (SRP-III)

The SRP-III (Paulhus, Neumann, & Hare, 2009) is a 64-item, self-report questionnaire used to measure psychopathy in a non-clinical population. A 5-point Likert scale (*1* = disagree strongly, *5* = agree strongly) measures how much participants agree with statements such as "I have tricked someone into giving me money". Thirty-two items each are summed and then averaged to provide scores for primary psychopathy and secondary psychopathy. Both had good internal reliability (Cronbach's alpha = .87 and .87 respectively).

5.3.2.1. *Personality Profile Vignettes*

Personality profiles were based on the SRP-III and described individuals as high or low in primary psychopathy, and high or low in secondary psychopathy (see Appendix A). Twelve vignettes were created, three each for high and low primary psychopathy, and high and low secondary psychopathy. Primary psychopathic profiles described calculating and un-empathetic individuals. Secondary psychopathic profiles described impulsive and criminal individuals. Non-psychopathic profiles were empathetic and stable. Vignettes were made sex specific (e.g., changing admiration of Donald Trump for the male high primary psychopathy vignette to Kim Kardashian for the female equivalent). Participants used a 5-point Likert scale (*1* = not at all attractive - *5* = extremely attractive) to rate the profiles on the following

criteria: one-night stand; physical attractiveness; potential husband/wife and potential parent. One-night stand and physical attractiveness ratings were summed and averaged to produce a score for short-term mating preference; ratings for potential husband/wife and potential parent were summed and averaged to produce a score for long-term mating preference. There were eight mating preference scores (per sex) in total: high/low, primary/secondary psychopathy in short/long-term mating. Vignettes had weak to good internal consistency (Cronbach's alpha = .55 to .86).

5.3.3. Procedure

Participants took part in an online survey titled "Personality Style and Mating Preferences". They were allocated to twelve opposite-sex "personality profile" vignettes, that were alternately presented on individual web-pages: high and low primary psychopathic, then high and low secondary psychopathic to rate for short and long-term mating. Next, participants completed the SRP-III and were thanked for their participation. Participants were paid 10¢ for their time.

5.4. Results

Two independent samples *t*-tests showed that men rated themselves higher in both primary (M_{male} = 2.76, SD = .42; M_{female} = 2.30, SD = 47; $t(256) = 8.07$, $p < .001$, $d = 1.03$) and secondary psychopathy (M_{male} = 2.44, SD = .55; M_{female} = 2.02, SD = .44, $t(256) = 6.80$, $p < .001$, $d = 0.84$) than women. A series of dependent samples *t*-tests showed that men and women rated higher individuals lower in primary and secondary psychopathic traits for both short and long-term mating, although the effect sizes for long-term mating were larger than for short-term mating (Table 1).

To determine if men and women scoring higher in primary and secondary psychopathic traits prefer partners of a similar personality, we conducted a series of partial correlations (Table 2), controlling for secondary psychopathy in the primary psychopathy analyses, and primary psychopathy in the secondary psychopathy analyses.

Table 13.

Descriptive statistics for ratings of high and low primary and secondary psychopathic personality profiles in different mating contexts.

	Mean (SD)									
	Primary psychopathy					Secondary psychopathy				
	High	Low	*t*	*d*	*df*	High	Lower	*t*	*d*	*df*
Women										
Short-term mating	1.27(.49)	1.55(.37)	-6.71**	-0.64	150	1.27(.55)	1.67(.36)	-8.49**	-0.86	150
Long-term mating	.92(.45)	1.83(.38)	-17.29**	-2.19	150	.91(.49)	1.91(.37)	-17.83**	-2.3	150
Men										
Short-term mating	1.35(.50)	1.56(.33)	-3.99**	-0.5	106	1.36(.52)	1.66(.31)	-5.78**	-0.7	106
Long-term mating	.94(.38)	1.79(.41)	-12.84**	-2.15	106	.97(.41)	1.81(.39)	-13.18**	-2.1	106

Note: *d* is Cohen's *d*.

* $p < .05$

** $p < .01$

Table 14.

Partial correlations between men and women's ratings of high and low primary and secondary personality profiles.

	Primary psychopathy			Secondary psychopathy		
	High	Low	*z*	High	Low	*z*
	Men/women	Men/women	Men/women	Men/women	Men/women	Men/women
Short-term mating	-.09/.09	.06/.05	-1.09/.34	.19/.26**	-.01/-.01	1.46/2.38*
Long-term mating	.03/.30**	.10/-.10	-0.51/3.55**	.18/.06	-.09/-.11	1.97/*1.50

Note: z is Steiger's *z* to compare correlations between high and low PP and SP mate preference. Men are reported above the diagonal, women are reported below the diagonal.

* $p < .05$

** $p < .01$

This was to ensure that relationships were determined by the particular psychopathy variant, rather than their shared variance. Owing to the age range of our participants, we controlled for age. We adjusted the alpha level to .001 to correct for multiple testing. Women scoring higher in primary psychopathy rated primary psychopathic profiles higher for long-term mating. Women scoring higher in secondary psychopathy rated secondary psychopathic profiles higher, but for both short and long-term mating. Men scoring higher in primary or secondary psychopathy did not rate higher or lower their equivalents in either mating context.

To further explore the effect of the sex of the rater on mate preference, we performed eight, two-step hierarchical regressions (Tables 3, 4, 5 and 6), with each psychopathy variant in each mating context as the dependent variable (for example, high primary psychopathy for short-term mating, high primary psychopathy for long-term mating etc.). The first step in the model regressed age, the psychopathy variant, and the sex of the rater on to mating preference. The second step added an interaction variable of psychopathy variant and sex of the rater. Age, primary psychopathy and sex of the rater were uniquely predictive of higher ratings for primary psychopathic partners in long-term mating, $\beta = -.18$, $t = -2.94$, $p < .05$; $\beta = .30$, $t = 4.33$, $p < .001$; $\beta = .14$, $t = 2.16$, $p < .05$, respectively. With the addition of the interaction variable, standardized betas for primary psychopathy and sex of the rater reduced, although age remained significant, $\beta = -.18$, $t = -2.97$, $p < .05$. The interaction variable was a significant predictor, $\beta = .69$, $t = 2.16$, $p < .05$. No other models for primary psychopathy produced significant predictors. Therefore, men and women did not differ in their preferences for partners higher and lower in primary psychopaths in these contexts.

Age and secondary psychopathy significantly predicted higher ratings for secondary psychopathic partners for short-term mating, $\beta = -.14$, $t = -2.18$, $p < .05$; $\beta = .19$, $t = 2.70$, $p < .05$, respectively. With the addition of the interaction variable, the standardized betas for age and secondary psychopathy remained significant, $\beta = -.14$, $t = 2.15$, $p < .05$,

β = -.43, t = 2.14, p < .05, and became significant for sex, β = -.87, t = -3.16, p < .05. The interaction variable was a significant predictor, β = .87, t = 3.25, p = .001. Age and secondary psychopathy significantly predicted higher ratings for secondary psychopathic partners in long-term mating, β = -.18, t = -2.80, p < .05; β = .20, t = 3.0, p < .05, respectively.

Table 15.

Stepwise regression of higher primary psychopathy mate preference in short and long-term mating.

	High primary psychopathy, short-term mating				High primary psychopathy, long-term mating			
	B	SE	β	ΔR^2	B	SE	β	ΔR^2
Step 1								
Age	0	0	-.09		.0	0	-.18	
Primary psychopathy	.09	.07	.10		.26	.06	.30	
Sex of rater	-.03	.07	-.03	.03	.12	.06	.14	.14**
Step 2								
Primary psychopathy x Sex of rater	.21	.14	.49	.0	.25	.12	.69	.02*

Note: Higher primary psychopathy in short-term mating context model: $R^2 = .04$, F (4, 254) = 2.32, p = ns; Step 1: $\Delta R^2 = .03$, F (3, 255) = 2.39, p = ns; Step 2: $\Delta R^2 = .01$, F (1, 257) = 2.09, p = ns; higher primary psychopathy in long-term mating context model: $R^2 = .15$, F (4, 254) = 11.35, $p < .001$; Step 1: $\Delta R^2 = .14$, F (3, 255) = 13.38, $p < .001$; Step 2: $\Delta R^2 = .02$, F (1, 257) = 4.67, $p < .05$.

* $p < .05$
** $p < .01$

Table 16.

Stepwise regression of lower primary psychopathy mate preference in short and long-term mating.

	Low primary psychopathy, short-term mating				Low primary psychopathy, long-term mating			
	B	SE	β	ΔR^2	B	SE	β	ΔR^2
Step 1								
Age	0	0	0.03		0	0	0.13	
Primary psychopathy	0.05	0.05	0.07		-0.1	0.06	-0.12	
Sex of rater	0	0.05	0	0	-0.02	0.06	-0.03	.04*
Step 2								
Primary psychopathy x Sex of rater	0.03	0.11	0.09	.0	-0.07	0.11	-0.22	.0

* $p < .05$, ** $p < .01$

Note: Lower primary psychopathy in short-term mating model: $R^2 = 0$, F (4, 254) = .27, p = ns; Step 1: $\Delta R^2 = .0$, F (3, 255) = .35, p = ns; Step 2: $\Delta R^2 = 0$, F (1, 257) = .06, p = ns; Lower primary psychopathy in the long-term mating model; $R^2 = .04$, F (4, 254) = 2.69, p = ns; Step 1: $\Delta R^2 = .04$, F (3, 255) = 3.46, $p < .05$; Step 2: $\Delta R^2 = 0$, F (1, 257) = .41, p = ns.

Table 17.

Stepwise regression of higher secondary psychopathy mate preference in short and long-term mating.

	Higher secondary psychopathy, short-term mating				Higher secondary psychopathy, long-term mating			
	B	SE	β	ΔR^2	B	SE	β	ΔR^2
Step 1								
Age	0	0	-.14		0	0	-.18	
Secondary psychopathy	.19	.07	.19		.18	.06	.20	
Sex	0	.07	0	.07**	.04	.06	.04	.09**
Step 2								
Secondary psychopathy x Sex of rater	.43	.13	.87	.04**	.26	.11	.63	.02*

* $p < .05$, ** $p < .01$

Note: Higher secondary psychopathy in short-term mating model: $R^2 = .11$, F (4, 254) = 7.60, $p <. 001$; Step 1: $\Delta R^2 = .07$, F (3, 255) = 6.38, $p < .001$; Step 2: $\Delta R^2 = .04$, F (1, 257) = 10.53, $p = .001$; Higher secondary psychopathy in long-term mating model: $R^2 = .11$, F (4, 254) = 7.51, $p <. 001$; Step 1: $\Delta R^2 = .09$, F (3, 255) = 8.05, $p <. 001$; Step 2: $\Delta R^2 = .02$, F (1, 257) = 5.48, $p < .05$

Table 18.

Stepwise regression of lower secondary psychopathy mate preference in short and long-term mating.

	Lower secondary psychopathy, short-term mating				Lower secondary psychopathy, long-term mating			
	B	SE	β	ΔR^2	B	SE	β	ΔR^2
Step 1								
Age	0	0	.06		0	0	.21	
Secondary psychopathy	.04	.05	.06		-.09	.05	-.12	
Sex	.02	.05	.02	.0	.04	.05	.05	.08**
Step 2								
Secondary psychopathy x Sex of rater	.07	.09	.23	.0	.05	.10	.13	.0

* $p < .05$, ** $p < .01$

Note: Lower secondary psychopathy in short-term mating model: $R^2 = .01$, F (4, 254) = .45, p = ns; Step 1: $\Delta R^2 = 0$, F (3, 255) = .37, p = ns; Step 2: $\Delta R^2 = 0$, F (1, 257) = .67, p = ns; Lower secondary psychopathy in long-term mating model: $R^2 = .08$, F (4, 254) = 5.51, $p < .001$; Step 1: $\Delta R^2 = .08$, F (3, 255) = .7.29, $p < .001$; Step 2: $\Delta R^2 = 0$, F (1, 257) = .23, p = ns.

With the addition of the interaction variable, age remained a significant predictor, $\beta = -.17$, $t = -2.80$, $p < .05$, sex became a significant predictor, $\beta = -.59$, $t = -2.12$, $p < .05$, as did the interaction variable, $\beta = .63$, $t = 2.34$, $p < .05$. Neither two models produced significant predictors for mate preference for lower secondary psychopathy for short-term mating, however for long-term mating, age was a significant positive predictor, $\beta = .21$, $t = 3.17$, $p < .05$ and remained the same with the addition of the interaction variable.

The forms of significant interactions were examined using the post-hoc probing methods suggested by Process (Hayes, 2012) and tested the association between preference for primary psychopathic partners for long-term mating and sex at high, mean and low levels of primary psychopathy. The significance of these simple slopes was calculated. We looked at un-standardised beta and standard error at 95% confidence intervals that did not include zero. The form of the interaction was plotted by computing the full regression equation at high (1SD above the mean) and low (1SD below the mean) levels of the two predictors (i.e., primary psychopathy and the interaction variable). The interaction between primary psychopathy and sex of the rater was significant in predicting preference for primary psychopathic partners for long-term mating ($\Delta R^2 = .02$, $F(1, 253) = 4.67$, $p = .03$). We also tested for the interaction between secondary psychopathy and sex of the rater, and found that it was significant in predicting preference for secondary psychoapthic partners for both short ($\Delta R^2 = .04$, $F(1, 253) = 10.53$, $p = .001$) and long-term mating ($\Delta R^2 = .02$, $F(1, 253) = 5.48$, $p = .02$). Figures 1, 2 and 3 illustrate these interactions.

There was no interaction between high primary psychopathy and sex of the rater for short-term mating, as well as low primary psychopathy and then low secondary psychopathy and sex of the rater for both short-term and long-term mating. Thus, men and women did not differ in their preferences for partners in these contexts.

Figure 2. Attractiveness ratings for primary psychopathic partners in a long-term relationship split by low, average and high primary psychopathy scores and sex.

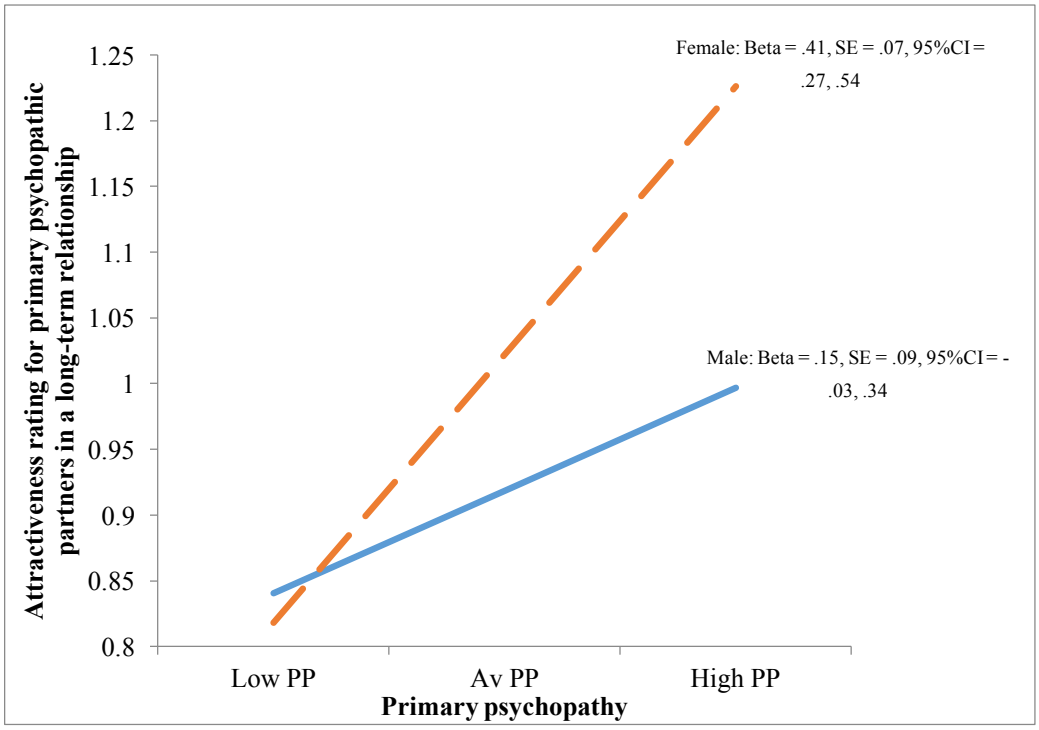


Figure 3. Attractiveness ratings for secondary psychopathic partners in a short-term relationship split by low, average and high secondary psychopathy scores and sex.

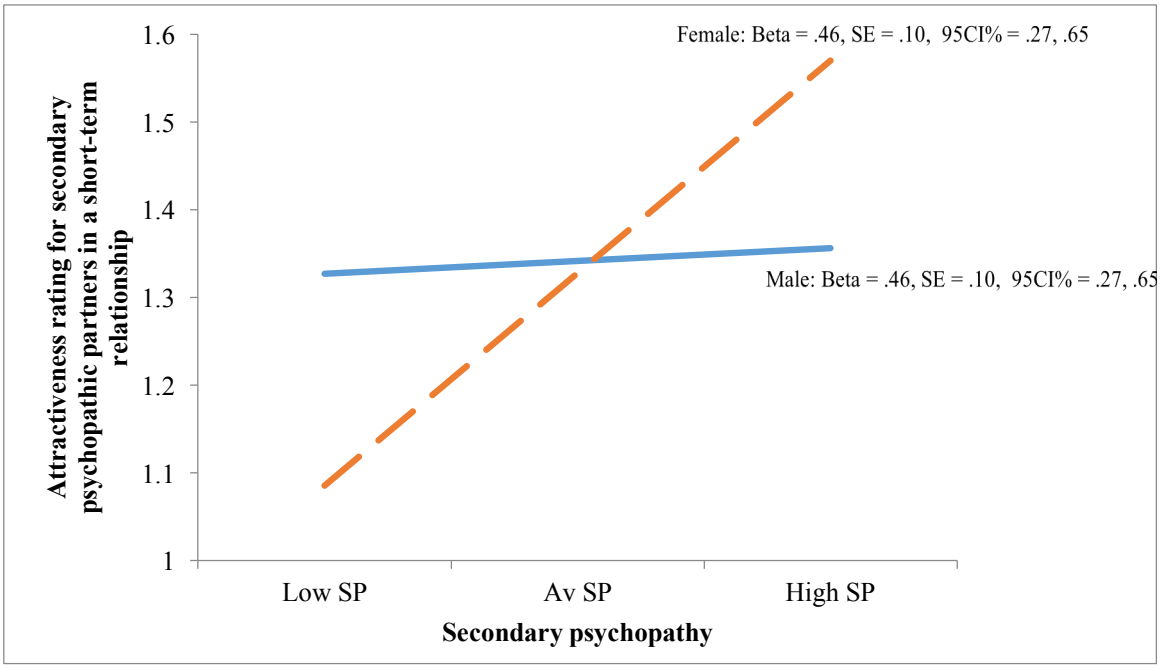
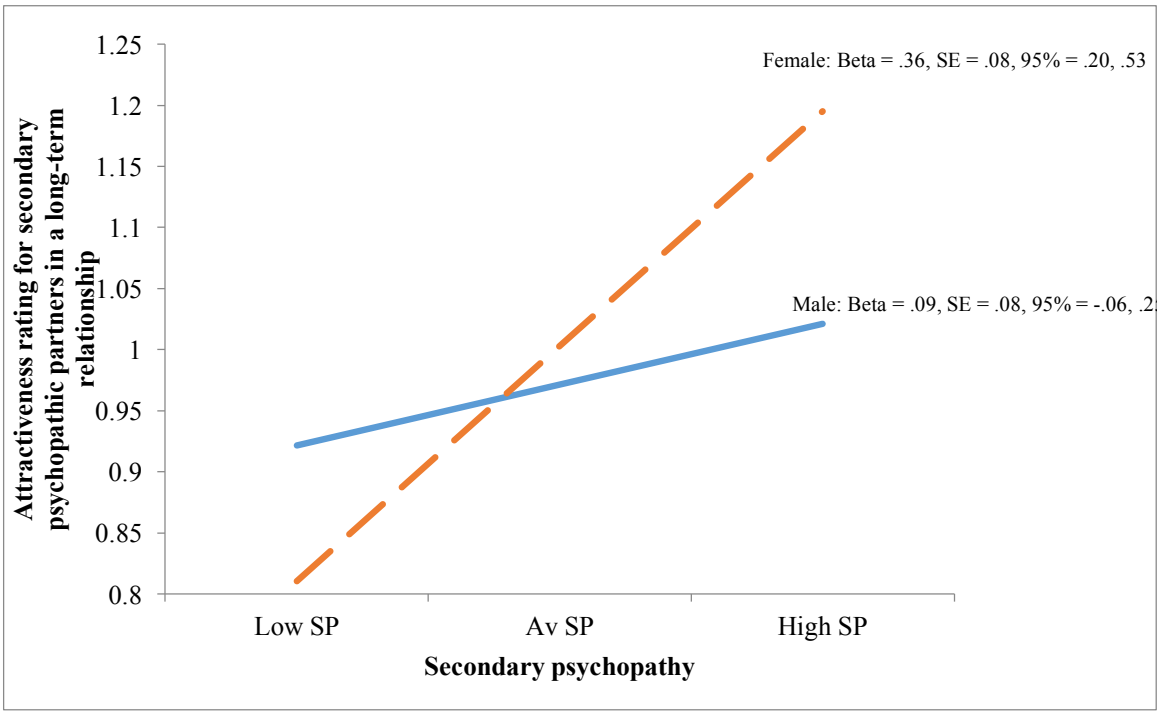


Figure 4. Attractiveness ratings for secondary psychopathic partners in a long-term relationship split by low, average and high secondary psychopathy scores and sex.



5.5. Discussion

To our knowledge, this is the first study that has investigated mating preferences and primary and secondary psychopathy. Contrary to expectations, people preferred low primary and secondary psychopathic individuals in both short and long-term relationships. With regards to assortative mating, primary psychopathic women preferred similar partners for long-term relationships, and secondary psychopathic women preferred similar partners for both short and long-term relationships.

It is interesting that men and women did not consider short-term relationships with either a primary or secondary psychopathic partner attractive, despite previous evidence to the contrary (Jonason, Luevano, & Adams, 2012; Jonason et al., 2015) which therefore challenges the "good genes" hypothesis. For secondary psychopathy, the negative outcomes are perhaps more salient (e.g., Ray et al., 2009; Schmitt & Newman, 1999; Whiteside & Lynam, 2001), although primary psychopathic individuals were expected to be attractive because of their success in business (Babiak et al., 2010) and other high-ranking professions (Skeem et al., 2011). However, the average age of our female participants was significantly higher than those in a previous study that found preference for psychopathic men in short-term relationships (Jonason et al., 2015). During ovulation young women can erroneously judge "cads" for "good dads" (Durante, 2012). Furthermore, age and experience may lead older women to avoid romantic involvement with individuals who are risk-takers or seem "too good to be true". Nevertheless, this does not explain the pattern of mate choice in men, who are not subject to fertility time constraints (Easton, Confer, Goetz, & Buss, 2010). Considering the adversarial nature of primary and secondary psychopathic individuals, it would seem adaptive to be able to identify and avoid involvement with them on any level. Thus, the mating success of those individuals may rest solely on their ability to manipulate and take advantage, rather than the penchant of other people for "bad" boys or girls.

Our findings were also suggestive of assortative mating in primary and secondary psychopathy, but only in younger women. Either these women need

to ensure that they are able to move from partner to partner by engaging in problematic relationships that fail (Olderbak & Figueredo, 2012), or they are subject to the same types of parental investment issues that non-psychopathic women are in terms of their primary role in parenting (Trivers, 1972). Perhaps primary and secondary psychopathic men do in fact offer "good genes" and resource acquisition ability (Mullins-Sweatt et al., 2010), but it is only their female equivalents that can benefit from them, by being able to predict and manage the toxic nature of their personalities that non-psychopathic women usually avoid. Primary psychopathic women might be protected by their inability to become emotionally involved (Lishner, Swim, Hong, & Vitacco, 2011), and remain calculating and manipulative in achieving long-term goals. Cognitive egocentrism and deficits in Theory of Mind may also keep them in denial about the suitability of their mate choice (Ali & Charmorro-Premuzic, 2010). It should also be highlighted that the women in this study only expressed a preference rather than reported actual romantic encounters with men higher in either primary or secondary psychopathy, so it might be the case that ultimately, women higher in primary or secondary psychopathy opt for a non-psychopathic partner who is suitable for fatherhood. Clearly more research is needed to investigate what the proximate mechanisms for women's assortative preferences for primary and secondary psychopathy.

Men scoring higher in primary or secondary psychopathic traits did not show any preference for mate similarity in either mating context, suggesting a non-discriminant mating style. For men whose focus is on short-term mating, such an approach is probably strategic, as they do not have to dedicate time to pursuing one type of woman over another. Evidently, primary or secondary psychopathic women confer no fitness advantage to them over non-psychopathic women. Alternatively, the lack of differentiation also suggests that primary and secondary psychopathic men are unable to identify the adversarial characteristics of a similar mate. In primary psychopathic men, this might again be due to deficits in Theory of Mind or cognitive egocentrism (Ali & Charmorro-Premuzic, 2010). In secondary psychopathic men, anxiety, negative urgency and the inability to learn from their mistakes might pay a part in poor judgement (Levenson, Kiehl, & Fitzpatrick, 1995; Whiteside & Lynam, 2001; Wilkowski & Robinson, 2008). In all cases, further research is needed to

elucidate how primary and secondary psychopathic men and women choose their mates.

There are limitations to the current study. We did not control for ovulation, which can distort women's evaluations of potential mates (Durante et al., 2012). A future study could explore if psychopathy variant interacts with ovulation in influencing mate preference. Further, self-report measures are subject to issues including self-biasing, however for this exploratory study they are sufficient and present the opportunity for using different measures in future research. A final issue is that some of the reliability coefficients for the vignettes were less than optimal. However, for an exploratory study they are sufficient, although necessitate a replication of the study to ensure that the findings are dependable.

By investigating primary and secondary psychopathy specifically, this study has made a unique contribution to a small, but emerging research area that looks at the appeal of individuals who harbour psychopathic traits. In conclusion, men and women are adaptively able to identify and therefore avoid the pitfalls of romantic involvement with either a primary or secondary psychopathic partner. Those pitfalls seem less problematic for those that are psychopathic, and positively alluring for primary and secondary psychopathic women.

6. Summary and Discussion

6.1. Overall summary

The aim of this thesis was to investigate further the theory that primary and secondary psychopathy are similar, but evolutionary different phenomena. Principally, primary and secondary psychopathy are hypothesised to be phenotypically similar fast LH strategies that utilise a cheater approach to acquiring resources and mates but are subject to distinctive selection pressures (Mealey, 1995). Primary psychopathy is argued to have emerged as an exploitative strategy in sync with the adoption of altruism by humans, and has continued through generations through genetic inheritance (Mealey, 1995). In contrast, secondary psychopathy is an example of developmental plasticity, or a conditional adaptation to adverse and unpredictable environments (Glenn et al., 2011). Theoretically, most people have the potential to develop secondary psychopathy under circumstances where it affords fitness beyond other LH strategies.

Previous research has explored differences developmental pathways within an evolutionary framework of primary and secondary psychopathy, but this thesis is the first to specifically examine the contributions of parental bonding quality, attachment and prenatal testosterone. Furthermore, in light of previous research that demonstrated a differential effect of maternal and paternal relationship on the LH development of boys and girls (Belsky et al., 1991; Ellis et al., 2011; Ellis et al., 2009), developmental pathways between men and women, and in children were examined.

Chapters 2 and 3 demonstrated consistencies with regards to contributing developmental factors to primary and secondary psychopathy in men and women. Namely that controlling mothers were reported by men higher in primary psychopathy; uncaring mothers were reported by men higher in secondary psychopathy; uncaring parents were reported by women higher in primary psychopathy; and no particular sub-optimal bonding was reported by women higher in secondary psychopathy. Exposure to higher levels of prenatal testosterone (PT) was also found to contribute to both primary and secondary psychopathy but only in women. Chapter 4 extended this line of

investigation to children and found that high CU traits (as equivalent to primary psychopathy) moderated higher levels of PT in contribution to higher externalising behaviours.

Mate choice for and of men and women high and low in primary or secondary psychopathy was examined in Chapter 5. As fast LH strategies that afford fitness, rather than maladaptive personality types, both should be expected to appeal to the opposite sex, at least in short-term mating situations. Men and women low in primary or secondary psychopathy however did not prefer their equivalents for either short or long-term mating, indicating that they know there is no fitness advantage and even disadvantage in involvement with opposite sex partners high in primary or secondary psychopathy. However, women high in primary or secondary psychopathy preferred their equivalents in both short (primary and secondary) and long-term (secondary only) mating that suggests they either misjudge or are able to access any fitness affording attributes (i.e. resource acquisition ability) that men high in primary or secondary psychopathy may offer.

Overall, this thesis has demonstrated clear differences between primary and secondary psychopathy with regards to development and mating, between men and women, and in adults and children.

6.2. Chapter summaries

6.2.1. Chapter 2. Sex differences between primary and secondary psychopathy, parental bonding and attachment style

Chapter 2 explored whether men and women higher in primary or secondary psychopathy recalled their mother and father as uncaring and controlling during childhood, and if they exhibit current anxious or avoidant attachment styles in adulthood. Results revealed that men higher in primary psychopathy reported controlling mothers and avoidant attachment. Women higher in primary psychopathy instead recalled uncaring fathers, and were anxious *and* avoidant in attachment. Men high in secondary psychopathy recalled uncaring mothers and anxious attachment, although low-quality parental bonding and attachment style were not associated with secondary psychopathy in women.

Overall, the study shows that the influence of parental bonding and attachment differs between psychopathy variants and gender. Even though the argument for primary psychopathy as a genetically inherited LH strategy would stipulate an absence of parental (i.e., environmental) influence on development, the relationship between over-controlling mothers and primary psychopathy in men may actually indicate a series of passive gene x environment correlations (Beaver et al., 2011). Specifically, the same genetic disposition to primary psychopathy is expressed by the parent in the context of low quality parenting, and primary psychopathy behaviour in the child. Indeed, attachment was originally thought to be driven solely by parent behaviour, but recent evidence shows that genes are another contributing factor (Bakermans-Kranenburg, van IJzendoorn, Bokhurst, & Schuengel, 2004; Crawford et al., 2006; Torgersen, Grova, & Sommerstad, 2007). Thus, maternal control might stem from a genetic disposition to primary psychopathy in the mother (Barber, 1996). Indeed, parental authoritarianism, harshness and power assertion are forms of controlling behaviour (Baumrind, 2012). Maternal sensitivity can be compromised by genes (van IJzendoorn, Bakermans-Kranenburg, & Mesman, 2008; Cents et al., 2014), and low agreeableness is associated both with psychopathy (Jakobwitz & Egan, 2006) and avoidant attachment (Blanchard et al., 2016). Alternatively, a controlling mother may restrict her child's behaviour in ways that are detrimental to emotional and social development. Avoiding close relationships is optimal for actualising multiple romantic encounters with low commitment, and could also be driven genetically as part of primary psychopathy.

In contrast, in this study, mother's controlling parenting style appears not to have fostered anxious attachment in men higher in primary psychopathy, which indicates that suboptimal parenting overall is not a contributing factor to primary psychopathy in men. In fact, CU traits and primary psychopathy may even buffer against the effects of low-care parenting (Hicks et al., 2012). Thus, for men higher in primary psychopathy at least, controlling mothers and avoidant attachment can support to a degree, the argument that primary psychopathy is an inherited fast LH strategy.

The relationship between uncaring fathers and higher primary psychopathy in women may also signal a passive gene x environment

correlation if low care pertains to low empathy. Furthermore, the quality of relationship that a girl has with her father is of particular importance to the shaping of her LH strategy (Belsky et al., 1991; Ellis et al., 2011; Ellis et al., 2009), therefore paternal practices, as well as father absence would be expected to have more relevance than maternal practices, although in this case it reinforces the genetic relationship.

It seems anomalous that women high in primary psychopathy would be anxiously attached in close relationships considering that anxiety is symptomatic of secondary psychopathy (Levenson et al., 1995; Lykken, 1957; Skeem et al., 2007). However, anxious attachment may result from an evocative gene x environment correlation, whereby a father who is disposed to primary psychopathy type behaviour deals harshly with behavioural outcomes of primary psychopathy in his daughter. Indeed, quality of parenting can modify a child's genotype that predisposes them to insecure and adverse behaviour (Barry, Kockanska, & Philibert, 2008). Forty percent of the variance in anxious attachment has been shown to be heritable (Crawford et al., 2007), so again, the genes that predispose parents to primary psychopathy type behaviour, may also shape their parenting style, the child's genotype, and then the interaction there of. It should also be highlighted that psychopathy is less well understood in women (Verona et al., 2013), therefore the relationship between anxiety and psychopathy in women is perhaps less predictable.

Nevertheless, women are in general, more anxious than men (Hankin, 2009). From an evolutionary perspective this might form part of an adaptive surveillance strategy for avoiding harm. Indeed, women are more anxious about the prospect of physical harms than men (Stewart, Taylor, & Baker, 1997). Anxiety might also stem from increased sensitivity to rejection and criticism developed from social understanding and empathy (Altemus, Sarvaiya, & Epperson, 2014) which is needed for the development of their child's social cognition. Women who are anxious in partner relationships may be more successful in anticipating and preventing their partner deserting them, especially in adverse environments. Such are the fitness outcomes for high levels of anxiety in these domains that, despite their psychopathy, women high in primary psychopathy could express high levels of anxious attachment for the same reasons. Indeed, even though high primary psychopathy women are

lower in neuroticism than secondary psychopathy women, they are still more neurotic than their male equivalents (Lee & Salekin, 2010). Furthermore, women high in neuroticism produce more children than emotionally stable women; in contrast, men who are high in neuroticism produce less children than emotionally stable men (Alvergne, Jokela, & Lummaa, 2010). Thus, fitness payoffs for neurotic behaviour suggests that neuroticism is another fast LH trait (Richardson, Chen, Dai, & Swoboda, 2014) and could potentially form part of a female typical, primary psychopathy LH strategy. The finding that women high in primary psychopathy also avoid emotional involvement in close relationships is expected as indicated by previous research (Mack et al., 2011) and likely supports a fast LH strategy in pursuing multiple partners. Thus both anxious and avoidant attachment may form a cohesive, female typical fast LH strategy.

However, that neither anxious or avoidant attachment were associated with secondary psychopathy in women questions how they address maternal challenges. Women high in secondary psychopathy are higher in anxiety (Lee & Salekin, 2010), but perhaps anxiety is not affected by bonding or attachment experiences. It could be case that women high in secondary psychopathy are more sensitive to multiple environmental factors or that a suite of influences may contribute to general anxiety rather than in relationships specifically. These women might have an adequate relationship with either parent, but parental conflict, father absence, abuse experienced outside of the home, peer influence and socioeconomic background potentially combine to encourage the development of secondary psychopathy. Evidently, more research is needed to clarify the dynamics involved, although the input of multiple factors indicates a stronger role for the environment in secondary psychopathy as theory suggests (Mealey, 1995).

That uncaring mothers and anxious attachment were reported by men high in secondary psychopathy dovetails with current literature that demonstrates a crucial role for adverse childhood experience in secondary psychopathy (Bailey & Shelton, 2014; Frodi et al., 2001; van IJzendoorn, 1997; Krisher & Sevecke, 2008; Weiler & Widom, 1996; Schimmenti et al., 2014; Craig et al., 2013; Jonason et al., 2014). Mother influence is likewise expected as girls LH strategies are more sensitive to father behaviour, as a signal of

current and future resource availability for them and their child (Belsky et al., 1991; Ellis et al., 2011; Ellis et al., 2009). As the sex with lower parental investment, especially for those men who are following a fast LH strategy, resource information is less important or even irrelevant. Instead, men high in secondary psychopathy are perhaps more sensitive to the relationship with their mother because of father absence and the greater burden of responsibility the mother has in providing for her children. This responsibility could result in high stress and a lack of emotional support (i.e., low care) for the children. Father absence is associated with an extensive range of secondary psychopathy related behaviours (Allen & Daly, 2007), therefore in this case, father absence is an indirect rather than a direct factor acting on behavioural development. Overall, it is plausible that contributing factors to secondary psychopathy in men may reflect a more influential role for environmental forces, with the implication that secondary psychopathy in men is also a conditional adaptation.

Chapter 2 has presented a study that shows differential influence of maternal and paternal bonding, and anxious and avoidant attachment in primary and secondary psychopathy according to sex. These results support the notion that primary and secondary psychopathy are subject to different evolutionary forces that function according to sex typical fast LH strategies.

6.2.2. Chapter 3. Baby was a black sheep: Digit ratio (2D:4D), maternal bonding and primary and secondary psychopathy

Chapter 3 examined whether exposure to higher levels of prenatal testosterone (PT) and low quality maternal bonding, influences the development of either primary or secondary psychopathic traits in men and women. Investigating the influence of PT also provided the opportunity to consider whether "fetal programming" (whereby the environment increases, via maternal stress elevating cortisol levels, PT, which consequently masculinises neural organisation such as to prepare the unborn child for a more hostile outside world; Del Giudice, 2012) contributes to the development of psychopathy. In women, exposure to higher levels of PT predicted primary and secondary psychopathy. Interestingly, as in Chapter 2, in men, controlling mothers predicted primary psychopathy and uncaring mothers predicted

secondary psychopathy; and in women, secondary psychopathy was not associated with maternal bonding. This time, uncaring mothers (rather than uncaring fathers) were reported by women high in primary psychopathy. Taking the overall sample, uncaring and controlling mothers contributed to primary psychopathy above and beyond that of exposure to higher levels of PT. Uncaring mothers also contributed to secondary psychopathy above and beyond high PT, although controlling mothers did not.

Psychopathy is sexually dimorphic. It is associated with male-typical behaviours that are also associated with PT and freely circulating levels of testosterone (Stalenheim et al, 1998) and is therefore considered as a male fast LH strategy (Jonason et al., 2009). In the current study however, a relationship between exposure to higher levels of PT and primary and secondary psychopathy was revealed for women only. Thus, women rather than men appear to be susceptible to fetal programming for psychopathy. Perhaps it is necessary for females to be more sensitive to environmental influences before birth in establishing their LH strategy. Indeed, the sex of the fetus changes the expression of the gene that is subject to maternal stress (Grundwald & Brunton, 2015) which has a greater impact on, and raises PT in female fetuses only (Barrett and Swan, 2015; Barrett et al., 2014; Sarkar et al., 2008). Prenatal stress appears to have only negative outcomes for fitness in men. For example, men subject to higher maternal stress are at greater risk for anxiety and depression (Machòn et al., 1997). Elevated levels of cortisol appear to cause the feminisation rather than masculinsation of male fetuses, with adverse outcomes for fitness (Barrett et al., 2014). A further point to consider is that male fetuses are inevitably exposed to higher concentrations of PT so elevations in PT levels caused by maternal stress may not be sufficient to cause an effect on neural organisation that is already masculinised. Indeed, personality traits in relation to PT are more evidenced in women (Fink, Manning, & Neave, 2004). More research of female sensitivity to prenatal experience is clearly needed to provide a more thorough answer to this finding.

Nevertheless, if PT is considered an environmental factor, then why was an association found between PT in both primary and secondary psychopathy in women? PT levels are both genetically and environmentally determined (Voracek & Dressler, 2009), so perhaps the same genes are

implicated in primary psychopathy and PT, while PT levels in secondary psychopathy are driven by maternal stress. In any case, the interplay between genes and environment, and resultant phenotype is extremely complex, therefore at the current time it is only possible to speculate as to the answer of this particular question. A further point to consider is that for the overall sample, maternal bonding, either low care and/or high control, had the greatest effect on primary and secondary beyond that of PT. Therefore, it is important to bear in mind that PT plays a limited role and should not be over-stated in its contribution to primary and secondary psychopathy.

The outcome of suboptimal maternal bonding affected men and women differently. Women high in primary psychopathy reported uncaring mothers and may, as in the case of uncaring fathers in Chapter 2, reflect a passive gene x environment correlation, if low care is taken as low empathy. However, as in Chapter 2, another possible passive x gene correlation was indicated by the report of controlling mothers by men higher in primary psychopathy, if controlling is taken as primary psychopathic (i.e., manipulative) behaviour. The results in this case lead to the question as to why men and women high in primary psychopathy should report differences in maternal practices. It is possible to suggest that different outcomes for men and women are indicative of an evocative gene x environment correlation whereby primary psychopathy in girls and boys elicit different behavioural responses from their mother. Indeed, evidence consistently demonstrates how parents support (inadvertently or not) gender specific behaviour (Tenenbaum & Leaper, 2002). Thus, a mother may be harsher on her daughter in playing out "male-typical" primary psychopathy behaviours (e.g., Kingsbury & Coplan, 2012). Alternatively, the son or daughter high in primary psychopathy might be more sensitive to or interpret differently the style of suboptimal parenting that they receive.

As in Chapter 2, women high in secondary psychopathy did not report suboptimal parental bonding, which suggests again that a constellation of environmental factors beyond maternal bonding are needed for secondary psychopathy in women. Low maternal care (as a proxy for an adverse home environment) was associated with secondary psychopathy in men. Again, low maternal care might result from the mother's stress of having to look after a

family without the children's father. Maternal care is evidently a crucial contributing factor for secondary psychopathy in men.

Overall, Chapter 3 has, as in Chapter 2, shown that contributing factors to primary and secondary psychopathy differ according to sex, but that this also extends to pre-birth experience. Again, differences in the contributions of developmental factors indicate that primary and secondary psychopathy follow alternate developmental trajectories as a function of different evolutionary circumstances and inequity in parental investment.

6.3.3. Chapter 4. Callous-unemotional traits moderate the relation between prenatal testosterone (2D:4D) and externalising behaviours in children

Chapter 4 extended the investigation of Chapter 3 by examining exposure to prenatal testosterone, callous-unemotional (CU) traits and externalising behaviour in children aged 5-6 years. Results showed that CU traits moderate the relationship between exposure to higher levels of PT and externalising behaviour. Thus, children who had been exposed to high PT and were higher in CU traits demonstrated more externalising behaviours. Conversely, children exposed to higher levels of prenatal estrogen (PE) and were higher in CU traits expressed less externalising behaviours. These findings suggest an interplay between genetics (i.e., those that lead to CU traits) and the prenatal environment (i.e. maternal stress leading to higher levels of PT) in the development of externalising behaviours.

CU traits are highly heritable compared to externalising behaviour, for which environmental factors play a greater role in development (Viding et al., 2005; Viding et al., 2008, Viding & McCrory, 2012; Edens et al., 2008; Oxford et al., 2003). It is thought that genes in some way contribute to the development of abnormal amygdala that cause deficits in fear recognition and empathic responding (Blair, 2006). Children who are born with a genetic predisposition to CU traits can be thought of as having a biological vulnerability to developing serious externalising behaviour. For example, some individuals are born with a "risk allele" that predisposes them to adverse behaviour, although only manifests in interaction with a negative rearing

environment (Glenn, 2011; Sadeh et al., 2010; Beaver, Delisi, Vaughn, & Barnes, 2010). CU traits are also shown to manifest in children as young as two-years old (Waller, et al, 2012), so they are unable to learn from discipline and "feeling bad" about upsetting people (Frick et al., 2014). By contrast, externalising behaviour without the presence of CU traits, emerges later on in childhood and responds to intervention, thereby demonstrating that the child is able understand the negative outcomes of, and be able to improve upon their behaviour. What this study has perhaps shown is that the particular vulnerability children with CU traits have to situations that further escalate poor behaviour may operate even before birth.

From a fetal programming perspective, prenatal engagement of developmental plasticity is adaptive as the child is already prepared for the outside environment. Although it is not unexpected that a wide variety of adverse behaviours are related to higher levels of PT exposure, this study shows that a third factor (i.e., CU traits) exacerbates these behaviours. Perhaps the "double dose", and interaction of genetic predisposition and fetal programming leading to serious externalising behaviour is necessary for the survival of a CU child entering into a particularly hostile environment. It is possible that this interaction indicates an evocative gene x environment correlation whereby an expectant mother who is higher in primary psychopathy, by their "nature", elicits stressful situations that prompt cortisol production. Although primary psychopathy is associated with low anxiety and therefore low cortisol, generally, this association has been limited to men (Loney et al., 2006; O'Leary et al., 2007, although c.f., Vallaincourt & Sundarani, 2011). Thus, women high in primary psychopathy might be susceptible to stress on occasion rather than chronically, which is more characteristic of secondary psychopathy. Sensitivity to stress might be an adaptation in guaranteeing optimal preparation for their child in the outside environment. Alternatively, the child may be subject to an unfortunate mix of genes and environmental factors, with negative outcomes for fitness.

The apparent interplay between CU traits and higher levels of prenatal estrogen (PE) in externalising behaviours is interesting. Primary psychopathy is associated with public prosocial behaviour (White, 2014), which could serve as a manipulative social desirability strategy. Furthermore, even though earlier

research indicated that psychopathy was not associated with deficits in Theory of Mind (e.g., Richell et al., 2003; Blair, 2006), more recent research indicates that excessive Theory of Mind, whereby there is an over-attribution of others' mental states, which is perhaps useful in manipulating others, is associated with primary psychopathy (Ali & Chamorro-Premuzic, 2010; Sharp & Vanwoerden, 2014). Evidently, those that are high in primary psychopathy are to a degree, proficient in understanding emotions. It is possible then that, without the adverse effects of PT but with the prosocial behaviours associated with PE (Kempe & Heffernan, 2011), children with CU traits can give the impression that they care and show remorse. Consequently, displays of contrition might limit the extent of negative response or discipline from parents, peers and other authority figures that otherwise exacerbate negative behaviour. How maternal experience might elevate levels of PE or reduce PT is as yet investigated so it is difficult to say whether this relationship is an indication of fetal programming. Why unborn children with high CU traits are sensitive to prenatal androgens compared to children who are either average or low on CU traits also requires further investigation, although may be informed by the fact that some children are born with genotypes that predispose them to antisocial behaviour if nurtured within adverse environments. Perhaps a higher degree of developmental plasticity is necessary for children high in CU traits in optimising their LH strategy.

Chapter 4 has presented an innovative examination of the influence of PT in CU traits and externalising behaviours in children. Evidently, the effect of PT in primary and secondary psychopathy is manifest even at ages 5-6 years old, which suggests that prenatal programming prepares an individual early on for the environment and continues into adulthood, as demonstrated in Chapter 5. If CU traits and externalising behaviours are taken as primary and secondary psychopathy, then the moderation of externalising behaviours by CU traits further supports the argument for distinctive developmental pathways for psychopathy variants.

6.3.4. Chapter 5. An effective way to deal with predators is to taste terrible: Primary and secondary psychopathy and mate preference

Chapter 5 investigated mating preferences of men and women either high or low in primary or secondary psychopathy for partners who are also high or low in primary or secondary psychopathy. Men and women low in primary or secondary psychopathy preferred likewise individuals for both short and long-term mating. However, a pattern for assortative mating was revealed for women high in primary psychopathy in long-term relationships and women high in secondary psychopathy for short and long-term relationships.

The appeal of "cads" has become a topic for discussion within the evolutionary psychology literature. Some studies show that women find men high in psychopathy and Machiavellianism desirable for short-term mating (Jonason et al., 2015; Aitken, Lyons, & Jonason, 2013). These findings are thought to demonstrate that men high in these traits offer "good genes" which are fitness optimising in environments that are harsh and unpredictable. Primary psychopathy is perhaps more fitness affording in a partner because of the various positive outcomes associated with the variant (i.e., "successful" psychopathy) compared to secondary psychopathy (i.e., "unsuccessful psychopathy"). Nevertheless, sensation seeking and related behaviours in secondary psychopathy are potentially advantageous in intrasexual competition (Weiss et al., 2002). However, this study shows that neither men nor women desired prospective partners higher in either psychopathy variant for short or long term mating. It seems that the putative "good genes" offered by men higher in either type of psychopathy are not detected or are absent. There is currently a gap in the literature regarding whether "cadettes" (i.e., women higher in "dark" personality traits) also embody "good genes" or some other quality. However, findings from the current study suggest not. Considering that men and women both demonstrated a preference against high psychopathy individuals shows that detecting and rejecting individuals who serve to exploit and manipulate in both short and long-term relationships is adaptive for both sexes. The "good genes" hypothesis of "cads" and potentially "cadettes" evidently needs further investigation.

It is interesting that a pattern of positive assortative mating was observed in women higher in primary psychopathy who desired their

equivalents for short-term mating, and women higher in secondary psychopathy who also desired similar partners but for both short *and* long term mating. Similar findings for psychopathy have been demonstrated previously (Jonason et al., 2015). In this case, it is possible that higher primary and secondary psychopathy men do actually offer "good genes" or the ability to acquire resources, but only women who are likewise high in psychopathy can detect this, and be able to successfully manage their partner's behaviour in terms of getting what they want out of the relationship and remaining unharmed in the process. A further possibility is that higher primary and secondary psychopathy women are over-confident in their assessment of a similar partner. It is interesting that women high in primary psychopathy did not desire their equivalents for long-term mating perhaps because they recognise that either higher primary psychopathy men do not practice long-term mating, that involvement beyond the short-term will be harmful to them, or because they themselves are not interested in long-term relationships. Evidently, matching themselves to similar fast LH strategists is adaptive.

Women high in secondary psychopathy however are desirable of a long-term relationship perhaps because, despite being anxious in relationships, they are not avoidant. Consequently, they are emotionally in a position to foster a situation in which they can benefit from the positive outcomes associated with assortative mating (Thiessen & Gregg, 1980). Perhaps long-term commitment is achievable with the acceptance that either party is likely to pursue other mating opportunities outside of the relationship. Alternatively, secondary psychopathy women might find non-secondary psychopathy men boring (Jonason et al., 2015) or know that they do not have the same exploitative and manipulative skills that women higher in primary psychopathy could use for ensnaring a hapless non-psychopathic male.

In contrast, men higher in primary or secondary psychopathy are either able to detect and avoid women high in primary or secondary psychopathy whose maternal skills will be questionable, or that preference does not increase fitness. Essentially, this lack of discrimination shows that, as expected, in committing to minimal parental investment, any woman will do for the man high in primary or secondary psychopathy. It is not the same for women high in primary or secondary psychopathy whose choice is more critical. A man

high in primary or secondary psychopathy apparently confers some fitness advantage for them beyond other men.

Chapter 5 has investigated for the first time, mating preferences for and of men and women high in primary or secondary psychopathy. As the sex committed to considerably more parental investment, women's mate choice is more crucial to their fitness, and this extends also to women high in primary or secondary psychopathy. Furthermore, few studies have also considered the mating preferences of men in this context. This chapter has shown that for fast LH strategy men, because all women are inevitably committed to high parental investment, they are indiscriminate in mate choice. This stands in contrast to mate choice choosiness of low primary and secondary psychopathy men.

6.3. Overall discussion

The theory that primary and secondary psychopathy are phenotypically similar, but evolutionary different fast LH strategies has been researched for over thirty years. This thesis set out to make a new and innovative contribution to the literature by examining, from a life-history theoretical perspective whether parental bonding, attachment, prenatal testosterone are differentially associated with primary and secondary psychopathy in men and women. It also looked at CU traits, externalising behaviours and PT in children. Finally, mating preferences for and in men and women high in primary or secondary psychopathy were investigated in short and long-term mating contexts. It is confirmed from the thesis that primary and secondary psychopathy function differently in development and mating scenarios, which varies potentially according to sex as a reflection of maternal and paternal investment.

Primary psychopathy is a putative genetically inherited LH strategy that emerged during the evolution and uptake of altruism, as a way of exploiting the trust of conspecifics. From this perspective, a larger contributing factor for genetics compared to environmental factors should be expected in primary psychopathy. Both Chapter 2 and Chapter 3 showed that men high in primary psychopathy reported that they experienced their mother as controlling during their childhood. Even though mothers' behaviour could be regarded as an environmental factor, it is recognised that environmental effects can be over-

emphasised when gene x environment correlations are not taken into account (Beaver et al., 2011). Therefore, in this case (i.e., when there is a genetic influence for primary psychopathy), the presence of controlling behaviour in the mother and primary psychopathy in the son could reflect a passive gene x environment correlation, whereby controlling behaviour stems from a disposition for primary psychopathy behaviour in the mother.

In Chapter 2 and 3 women high in primary psychopathy reported uncaring fathers and mothers, respectively, and again may indicate a passive gene x environment correlation, if low care is considered as an aspect of un-empathetic behaviour. Furthermore, a woman's LH strategy is particularly sensitive to the quality of relationship that she has with her father, as a signal of resource availability that is imperative to the survival of her child. Therefore, if a relationship had been found only for uncaring fathers, this might have been more suggestive of an environmental effect. Yet, paternal bonding was no more important than maternal bonding for women high in primary psychopathy.

Findings for secondary psychopathy in men and women present a different picture. In Chapter 2 and 3, men high in secondary psychopathy reported uncaring mothers. However, uncaring behaviour in this case (as an outcome of primary psychopathy-type behavioural disposition in the parent) is not reflected in the child; rather, uncaring behaviour, perhaps stemming from stresses encountered in the environment appears to have a direct effect in driving secondary psychopathy behaviour in the child. Adverse home environments are key determinants in secondary psychopathy, so an effect of uncaring behaviour would be expected. As the quality of relationship with the father is more important for girls, that inadequate paternal bonding was not implicated in men is also to be expected.

Women high in secondary psychopathy did not report any aspect of inadequate parental bonding in both Chapter 2 and 3. Even though relationship quality with the father would have been predicted as relevant, it is possible that a wider number of factors, unaccounted for in this thesis, play an important role in developing secondary psychopathy in women. It might be the case that all women need to be sensitive to a wide range of environmental factors to ensure that the most comprehensive information about environmental conditions is

used to shape their LH strategy. Considering the outcomes for fitness, it seems adaptive to take such an approach. If anyone has the potential to develop secondary psychopathy as a conditional adaptation to an environment, then women high in secondary psychopathy should effectively function the same as "typically" developing women in this context. The finding also suggests an absence of a gene x environment correlation which further highlights the relevance of environmental factors.

As part of a fast LH strategy, it is expected that men and women high in primary psychopathy are avoidant in relationships so that they can pursue multiple relationships. Avoidance stems from an emotional deficit rather than a consequence of a dysfunctional upbringing. Indeed, men high in secondary psychopathy reported anxiety in close relationships, which potentially stems from an uncaring mother (as is demonstrated in this thesis). Women high in either primary or secondary psychopathy were also anxious in attachment, however, this might partly result from a general disposition that all women have for higher levels of anxiety, as part of an adaptive harm reduction strategy as the primary caregiver. Furthermore, anxiety levels are not as much of a key differentiating factor between primary and secondary psychopathy in women as they are in men (Lee & Salekin, 2010), therefore, higher levels of anxiety perhaps as expressed in relationships are not necessarily surprising. A final consideration is that a woman high in primary psychopathy might develop anxious attachment through evocative gene x environment correlation. Her parents may have been less caring towards a child who is callous and unemotional. Even though a cold and callous temperament should deflect the effects of uncaring parenting (Hicks et al., 2012), negative outcomes may still arise. Again, this may result from a generalised increased sensitivity to environmental conditions that women need for developing an effective LH strategy.

It is interesting that exposure to higher levels of prenatal testosterone (PT) were expressed in women high in primary or secondary psychopathy but not men. In primary psychopathy, the same genes might contribute to both primary psychopathy behaviour and levels of PT. A mother who is dispositional to behaviours associated with primary psychopathy might further elicit stressful situations and increase PT in that way. In comparison, the

mothers of women who go on to develop higher levels of secondary psychopathy may happen to be encountering adverse environments because of external circumstances that are not provoked by her behaviour. Then in developing secondary psychopathy they also start to seek out and evoke aggravating circumstances. Again, greater developmental plasticity and sensitivity to the environment might be crucial to the development of an effective LH strategy in women. As men inevitably commit to less parental investment than women, perhaps it is not necessary to be so sensitive to the environment in terms of evaluating the availability of resources for them *and* their child. It could be that only postnatal experience is necessary in defining LH strategy in men. Furthermore, considering that PT levels are already higher during the development of a male fetus, elevated levels of PT may not affect neural organisation sufficiently to contribute to psychopathy in men.

Chapter 4 showed that children high in CU traits and exposed to higher levels of PT expressed more externalising behaviour, thereby demonstrating a potential interplay between genetically driven CU traits and fetal programming. This might be another example of evocative gene x environment correlation whereby the mother, who demonstrates some aspects of primary psychopathy behaviour encounters stressful environments by virtue of her own behaviour. A double dose of genes and environment to externalising behaviour might be adaptive in preparation for a particularly harsh environment. Decreased externalising behaviour was reported in high CU children who were exposed to less PT and more PE. Perhaps a shift in circumstances that stops the mother from eliciting stress from the environment prevents the double dose effect; only CU traits are developed instead thereby limiting the extent of adverse behaviour.

Finally, women high in primary and secondary psychopathy showed that, even if misjudged, they do discriminate in mate choice, in favour of their opposite sex equivalents. This suggests that they evaluate men high in either primary or secondary psychopathy as offering fitness affording advantages beyond those of low primary and secondary psychopathy men. Even though this preference could be misjudged, like low primary and secondary psychopathy women, as the primary caregiver, high primary and secondary psychopathy women should still remain astute about their mate choice. The

lack of any discernible mate choice in men high in primary or secondary psychopathy shows that they are the sex with considerably less parental investment (especially as part of a fast LH strategy). Low primary or secondary psychopathy men and women were not attracted to their high primary and secondary psychopathy equivalents even in short-term mating scenarios when there may have been genetic or resource acquisition advantages. Evidently. low psychopathy individuals are able to detect the adversarial consequences of involvement with high primary and secondary psychopathy individuals.

6.4. Limitations, Future Directions and Implications

The use of psychometrics is always problematic due to impression management, and self-deception. Saliently, one key feature of psychopathy is the ability to lie and deceive others (Seto et al., 1996), thus individuals who score higher in psychopathy are perhaps more likely to lie in their answers. Accuracy is a particular issue for individuals when trying to recall childhood experiences. Memories are subject to distortion and might not be accessed when an individual is trying to remember a specific event. Parents are likely to report their children as being less callous or behavioural challenging than they are. Jointly using the teacher-report versions of the the Inventory of Callous Unemotional Traits (ICU; Frick, 2004) and Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) would be more informative of the child's temperament. Participants' ratings of the personality profiles in Chapter 5 could likewise be affected by these issues associated with self-report measures. Nevertheless, the studies featured in this thesis are exploratory, and present the opportunity for longitudinal research in the future whereby the development of primary and secondary psychopathy could be observed in more detail. Longitudinal studies would also address issues associated with cross-sectional data from which cause and effect cannot be inferred.

The 2D:4D ratio is not an undisputed proxy measure for prental testosterone (Berenbaum et al., 2009). The ease at which the 2D:4D ratio can be measured has generated hundreds of studies that have demonstrated significant relationships with a variety of cognitive abilities, as well as physical

and psychological traits. However, meta-analyses show that there are now a series of contradictions within the literature thereby questioning the credibility of 2D:4D ratio (Millet & Dewitte, 2009). Studies also show that differences in 2D:4D ratio can differ more between countries than between sex (Manning et al., 2007). Thus, the findings from the 2D:4D ratio studies featured in this thesis should be considered appropriately in light of this. The optimal method for measuring the fingers is also debatable, ranging from manual measurement with a ruler or callipers to electronic measurement where the fingers are measured from photocopies, or (as in this thesis) from hand-scans, which are shown to be more reliable (Voracek et al., 2007). It should be noted though, that some inter-rater reliability values for finger measurements in Chapters 3 and 4 were low, and therefore these studies should be replicated to ensure credibility of the findings. A further issue is that finger bone immaturity can vary considerably in children aged 4 to 8 years of age, and thus any interpretation of data taken from a cohort of this age should taken with caution (Bloom, Houston, Mills, Molloy, & Hediger, 2010). Considering that 2D:4D ratio is sexually dimorphic, it would be useful to repeat the study in Chapter 4 with enough participants to be able to compare boys and girls. One alternative to using the 2D:4D ratio would be to access pregnant women undergoing routine amniocentesis through which prenatal testosterone could be measured (Chapman et al., 2006). Similarly, working with pregnant women who may or may not be taking some form of hormonal treatment or experiencing stressful conditions could also offer valuable data for future research.

Findings from this thesis cannot be generalised beyond WEIRD (i.e., Western, Educated, Industrialised, and Democratic; Henrich, Heine, & Norenzayanm, 2010) populations. Cross cultural studies are especially important in validating claims made about the evolution of psychological traits, and thus repeating the studies featured in this thesis in different cultures would be both valuable and necessary. Relatedly, the prevalence of primary psychopathy is supposedly low (estimated at 1% of the population, Hare, 2003), and so whether these studies actually access individuals who are truly high in primary psychopathy is debatable. It should be borne in mind however, that if the personality components of psychopathy (i.e., primary psychopathy) arise through non-additive genetic effects (Blonigen et al., 2003) and

psychopathy is dimensional, then the prevalence of primary psychopathy could be higher. Furthermore, considering that Hare's work is in forensic populations, then the 1% that he estimates may be only relevant in that context. Indeed, some have argued that the construct has become too forensic, and beyond what Cleckley originally described as psychopathy (Skeem & Cooke, 2010).

Building upon the work in the thesis, there are a number of new areas of research that should be pursued. In terms of contributing environmental factors, it would be interesting to examine CU traits and EB in siblings. Perhaps siblings would report similar quality parent-child relationships and score likewise in EB rather than CU traits. Or perhaps they could both be higher in CU traits and report emotionally cold mothers. Furthermore, sex of siblings as well as parents should be examined for differential effects. Having established prenatal testosterone as a potential influence in the development of increased EB, replicating the study in children of younger and older ages would establish whether social and physical development affects this relationship. For example, puberty may interact with higher CU traits or PT in exacerbating EB. The role of higher levels of prenatal estrogen (PE) in potentially reducing the influence that CU traits has on EB should be examined. For example, pinpointing external factors that encourage levels of PE would be valuable in potentially counterbalancing genetic influences in adverse behaviours. Furthermore, how feminising environments in general (i.e., post-natal) can reduce adverse behaviour should be reviewed. Potentially, "high-empathy" environments could form part of a therapeutic regime for children who are high in CU traits. That parental bonding nor attachment were implicated in secondary psychopathy in women suggests that perhaps peer influence or some other family environment are important. In any case, more investigation is needed in this area. Lastly, it would be possible to use other stimuli in the mating study such as facial morphs (high and low in primary or secondary psychopathy), or change the context from mate preference to mate choice. This is an important difference because what someone says they prefer in a mate may not reflect what they would actually choose in "real-life".

There a number of prevention and treatment implications. For example, mothers to be and healthcare practitioners should prioritise the reduction of

maternal stress considering that it could have an exponential affect on the development and outcome of callous-unemotional traits. In addition, parents, health care professionals, teachers and other agencies that are involved with child care should be aware of the difference of callous unemotional traits and externalising behaviours and how they interact differently with mother-child and father-child relationships so that the type and timing of interventions are most effective. More focus should be given to developing and improving the quality of father-daughter relationships to prevent early pregnancy as well as treat delinquent behaviour. For boys, it would be necessary to focus on both parents. Training could be given to parents who seem emotionally cold and dismissive to their children to limit the influence of environmental factors in reinforcing the primary psychopathy phenotype. For girls who exhibit antisocial behaviour, a more holistic analysis of causal factors should be considered beyond that of parental influence. Therapeutic treatment in adolescence and adulthood should similarly focus on the most influential parent relationship in addressing problematic behaviour. On a broader level, an approach whereby it is recognised that a child or adult behaves antisocially because it is the best strategy available for surviving a hostile environment may remove some of the stigma associated with that behaviour, allowing for that individual to feel more accepted and invested in society. Interventions may subsequently be more successful.

In view of the findings from Chapter 5, the effectiveness of ongoing treatment for women with Antisocial Personality Disorder or Borderline Personality Disorder (comparable to primary psychopathy and secondary psychopathy respectively) could be hindered by their choosing of romantic partners who are behaviourally similar to them. It would be important to implement strategies that encourage the avoidance or dissolution of close relationships with partners who reinforce or encourage destructive (either to self or others) behaviour, especially more so when children are involved.

In conclusion, this thesis has made a valuable and unique contribution to the debate that continues to surround the theory that primary and secondary psychopathy are similar, but evolutionary different phenomena. Important hitherto unexamined differences in terms of development (specifically maternal and paternal bonding, attachment and prenatal testosterone) and mating in

primary and secondary psychopathy have been revealed. Furthermore, a crucial role for inequity in parental investment between men and women has been highlighted as the potential driving force in these differences. The thesis has been particularly creative and unique in taking the investigation to children aged 5-6 years old, a previously uninvestigated age group for CU traits, and, to the authors knowledge, PT from a fetal programming perspective. All four studies were accepted for publication in international journals, thereby demonstrating the quality and rigor of the rationale, design and discussion of each study. New avenues for research have been revealed, providing the opportunity to deepen our understanding of primary and secondary psychopathy, two personality types that, in light of their destructive nature, continue to warrant further investigation.

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8. Appendices

Appendix A: Self-Report Psychopathy Scale (SRP-III) (Paulhus, Neumann, & Hare, 2009)

Please rate the degree to which you agree with the following statements about you. You can be honest because your name will be detached from the answers as soon as they are submitted.

1	2	3	4	5
Disagree Strongly	Disagree	Neutral	Agree	Agree Strongly

1. I'm a rebellious person.
2. I'm more tough-minded than other people.
3. I think I could "beat" a lie detector.
4. I have taken illegal drugs (e.g., marijuana, ecstasy).
5. I have never been involved in delinquent gang activity.
6. I have never stolen a truck, car or motorcycle.
7. Most people are wimps.
8. I purposely flatter people to get them on my side.
9. I've often done something dangerous just for the thrill of it.
10. I have tricked someone into giving me money.
11. It tortures me to see an injured animal.
12. I have assaulted a law enforcement official or social worker.
13. I have pretended to be someone else in order to get something.
14. I always plan out my weekly activities.
15. I like to see fist-fights.
16. I'm not tricky or sly.
17. I'd be good at a dangerous job because I make fast decisions.
18. I have never tried to force someone to have sex.
19. My friends would say that I am a warm person.
20. I would get a kick out of 'scamming' someone.
21. I have never attacked someone with the idea of injuring them.
22. I never miss appointments.
23. I avoid horror movies.

24. I trust other people to be honest.
25. I hate high speed driving.
26. I feel so sorry when I see a homeless person.
27. It's fun to see how far you can push people before they get upset.
28. I enjoy doing wild things.
29. I have broken into a building or vehicle in order to steal something or vandalize.
30. I don't bother to keep in touch with my family any more.
31. I find it difficult to manipulate people.
32. I rarely follow the rules.
33. I never cry at movies.
34. I have never been arrested.
35. You should take advantage of other people before they do it to you.
36. I don't enjoy gambling for real money.
37. People sometimes say that I'm cold-hearted.
38. People can usually tell if I am lying.
39. I like to have sex with people I barely know.
40. I love violent sports and movies.
41. Sometimes you have to pretend you like people to get something out of them.
42. I am an impulsive person.
43. I have taken hard drugs (e.g., heroin, cocaine).
44. I'm a soft-hearted person.
45. I can talk people into anything.
46. I never shoplifted from a store.
47. I don't enjoy taking risks.
48. People are too sensitive when I tell them the truth about themselves.
49. I was convicted of a serious crime.
50. Most people tell lies everyday.
51. I keep getting in trouble for the same things over and over.
52. Every now and then I carry a weapon (knife or gun) for protection.
53. People cry way too much at funerals.
54. You can get what you want by telling people what they want to hear.
55. I easily get bored.
56. I never feel guilty over hurting others.
57. I have threatened people into giving me money, clothes, or makeup.

58. A lot of people are “suckers” and can easily be fooled.

59. I admit that I often “mouth off” without thinking.

60. I sometimes dump friends that I don’t need any more.

61. I would never step on others to get what I want.

62. I have close friends who served time in prison.

63. I purposely tried to hit someone with the vehicle I was driving.

64. I have violated my parole from prison.

KEY TO SRP-III.13 SUBSCALES

Interpersonal Manipulation (IPM)
3, 8, 13, 16R, 20, 24R, 27, 31R, 35, 38R, 41, 45, 50, 54, 58, 61R

Callous Affect (CA)
2, 7, 11R, 15, 19R, 23R, 26R, 30, 33, 37, 40, 44R, 48, 53, 56, 60

Erratic Life Style (ELS)
1, 4, 9, 14R, 17, 22R, 25R, 28, 32, 36R, 39, 42, 47R, 51, 55, 59

Anti-Social Behavior (ASB)
5R, 6R, 10, 12, 18R, 21R, 29, 34R, 43, 46R, 49, 52, 57, 62, 63, 64

SCORING

Reverse the scoring on the items marked ‘R’ above (1=5)(2=4)(3=3)(4=2)(5=1).

Average the 16 items in each subscale to get their means.

The overall SRP-III score is simply the mean of the four subscales on a 5-point scale.

Appendix B: Parental Bonding Instrument (Parker, Tupling, & Brown, 1979)

This questionnaire lists various attitudes and behaviours of parents. As you remember your mother/father in your first 16 years would you place a tick in the most appropriate box next to each question.

	Very like	Moderately like	Moderately unlike	Very unlike
1. Spoke to me in a warm and friendly voice				
2. Did not help me as much as I needed				
3. Let me do those things I liked doing				
4. Seemed emotionally cold to me				
5. Appeared to understand my problems and worries				
6. Was affectionate to me				
7. Liked me to make my own decisions				
8. Did not want me to grow up				
9. Tried to control everything I did				
10. Invaded my privacy				
11. Enjoyed talking things over with me				
12. Frequently smiled at me				
13. Tended to baby me				
14. Did not understand what I needed or wanted				
15. Let me decide things for myself				
16. Made me feel like I wasn't wanted				
17. Could make me feel better when I was upset				
18. Did not talk with me very much				
19. Tried to make me feel dependent on him/her				
20. Felt I could not look after myself unless she/he was around				
21. Gave me as much freedom as I wanted				
22. Let me go out as often as I wanted				

23. Was over-protective of me				
24. Did not praise me				
25. Let me dress in any way I pleased.				

Variables measured:

Two scales termed ‘care’ and ‘overprotection’ or ‘control’, measure fundamental parental styles as perceived by the child. The measure is ‘retrospective’, meaning that adults (over 16 years) complete the measure for how they remember their parents during their first 16 years. The measure is to be completed for both mothers and fathers separately. There are 25 item questions, including 12 ‘care’ items and 13 ‘overprotection’ items.

Care
Items: 1, 5, 6, 11, 12, 17: Very like = 3
Moderately like = 2
Moderately unlike = 1
Very unlike = 0
Items: 2, 4, 14, 16, 18, 24 Very unlike = 3
Moderately unlike = 2
Moderately like = 1
Very like = 0

Overprotection
Items: 8, 9, 10, 13, 19, 20, 23 Very like = 3
Moderately like = 2
Moderately unlike = 1
Very unlike = 0
Items: 3, 7, 15, 21, 22, 25 Very unlike = 3
Moderately unlike = 2
Moderately like = 1
Very like = 0

Appendix C: Relationship Scales Questionnaire (Griffin & Bartholomew, 1994)

Please read each of the following statements and rate the extent to which you believe each statement best describes your feelings about close relationships.

	Not at all like me	A bit like me	Somewhat like me	Quite like me	Very much like me
1. I will worry that I will be hurt if I allow myself to become close to others					
2. I worry about being alone					
3. I worry that romantic partners don't really love me					
4. I find it difficult to trust others' completely					
5. I worry that others' don't value me as much as I value them					
6. People are never there when you need them					
7. My desire to merge completely sometimes scares other people away					
8. I often worry that romantic partners won't stay with me					
9. I worry about being abandoned					
10. I find that others are reluctant to get as close as I would like					
11. I worry about having others not accept me					
12. It is very important for me to feel independent					
13. I find it easy to get emotionally close to others					
14. I want to merge completely with another person					
15. I want to be completely emotionally intimate with others					

16. I am comfortable depending on other people					
17. I want emotionally close relationships					
18. Romantic partners often want me to be closer than I feel comfortable with					
19. I find it relatively easy to get close to others					

SCORING THE RSQ - Anxious and Avoidant scales (taken from Creasy & Ladd, 2005)

Anxious scale is the average of 1, 2, 3, 4, 5, 6 (Reverse), 7, 8, 9 (Reverse), 10, 11.
Avoidant scales is the average of 12, 13, 14, 15, 16, 17, 18, 19.

Appendix D: Strengths and Difficulties Questionnaire (Goodman, 1997)

SDQ: Parent version

Please complete the background information above. Then read each statement and decide how well it describes your child. Mark your answer by ticking the appropriate box for each statement. Do not leave any statement unrated.

	Not true	*Somewhat True*	*Certainly True*
1. Often complains of headaches	*0*	*1*	*2*
2. Many worries	*0*	*1*	*2*
3. Often unhappy, downhearted	*0*	*1*	*2*
4. Nervous or clingy in new situations	*0*	*1*	*2*
5. Many fears, easily scared	*0*	*1*	*2*
6. Often has temper tantrums or hot tempers	*0*	*1*	*2*
7. Generally obedient (R)	*2*	*1*	*0*
8. Often fights with other children	*0*	*1*	*2*
9. Often lies or cheats	*0*	*1*	*2*
10. Steals from home, school or elsewhere	*0*	*1*	*2*
11. Restless, overactive	*0*	*1*	*2*
12. Constantly fidgeting or squirming	*0*	*1*	*2*
13. Easily distracted, concentration wanders	*0*	*1*	*2*
14. Thinks things out before acting (R)	*2*	*1*	*0*
15. Sees tasks through to the end (R)	*2*	*1*	*0*
16. Rather solitary, tends to play alone	*0*	*1*	*2*
17. Has at least one good friend (R)	*2*	*1*	*0*
18. Generally liked by other children (R)	*2*	*1*	*0*
19. Picked on or bullied	*0*	*1*	*2*
20. Gets on better with adults than with other children	*0*	*1*	*2*
21. Considerate of other people's feelings	*0*	*1*	*2*

22. Shares readily with other children	*0*	*1*	*2*
23. Helpful if someone is hurt	*0*	*1*	*2*
24. Kind to younger children	*0*	*1*	*2*
25. Often volunteers to help others	*0*	*1*	*2*

Note: R = Reverse scored

Scoring the SDQ:
The 25 items in the SDQ comprise 5 scales of 5 items each. It is usually easiest to score all 5 scales first before working out the total difficulties score. 'Somewhat True' is always scored as 1, but the scoring of 'Not True' and 'Certainly True' varies with the item, as shown below scale by scale. For each of the 5 scales the score can range from 0 to 10 if all items were completed. These scores can be scaled up pro-rata if at least 3 items were completed, e.g. a score of 4 based on 3 completed items can be scaled up to a score of 7 (6.67 rounded up) for 5 items.

Appendix E: Inventory of Callous Unemotional Traits (ICU) (Frick, 2004)

ICU: Parent version

Completed by (please circle): Mother Father Other

Instructions: *Please complete the background information above. Then read every statement and decide how well it describes your child. Mark your answer by circling the appropriate number (0-3) for each statement. Do not leave any statement unrated.*

	Not at all true	*Somewhat true*	*Very true*	*Definitely true*
1. Expresses his/her feelings openly. (R)	0	1	2	3
2. Does not seem to know "right" from "wrong".	0	1	2	3
3. Is concerned about schoolwork. (R)	0	1	2	3
4. Does not care who he/she hurts to get what he/she wants.	0	1	2	3
5. Feels bad or guilty when he/she has done something wrong. (R)	0	1	2	3
6. Does not show emotions.	0	1	2	3
7. Does not care about being on time.	0	1	2	3
8. Is concerned about the feelings of others. (R)	0	1	2	3
9. Does not care if he/she is in trouble.	0	1	2	3
10. Does not let feelings control him/her.	0	1	2	3
11. Does not care about doing things well.	0	1	2	3
12. Seems very cold and uncaring.	0	1	2	3
13. Easily admits to being wrong. (R)	0	1	2	3
14. It is easy to tell how he/she is feeling. (R)	0	1	2	3
15. Always tries his/her best. (R)	0	1	2	3
16. Apologizes ("says he/she is sorry") to persons he/she has hurt. (R)	0	1	2	3
17. Tries not to hurt others' feelings. (R)	0	1	2	3
18. Shows no remorse when he/she has done something wrong.	0	1	2	3
19. Is very expressive and emotional. (R)	0	1	2	3

20. Does not like to put the time into doing things well.	0	1	2	3
21. The feelings of others are unimportant to him/her.	0	1	2	3
22. Hides his/her feelings from others.	0	1	2	3
23. Works hard on everything. (R)	0	1	2	3
24. Does things to make others feel good. (R)	0	1	2	3

Note: R = Reverse scored

Scoring the ICU: Ratings are summed to produce an overall score.

Appendix F: Personality profile vignettes

Male Vignettes

High primary psychopathy male 1:

He gets what he wants and is happy to flatter people along the way to get there. He thinks that people are untrustworthy and thinks that it is fair enough to be dishonest to avoid being taken advantage of. He admires businessmen like Donald Trump for their ruthless attitude to success. He is unaffected by causes like homeless and animal charities. Recreationally, he enjoys horror movies and boxing. Women find his flattering demeanour attractive.

Low primary psychopathy male 1:

Enjoys his nine to five job and has no ambition to climb the career ladder. He is honest and down to earth. He relaxes at the weekend by playing football and watching television. He doesn't like the idea of "chatting up" a woman on a night out and would rather meet a partner through a friend.

High primary psychopathy male 2:

Believes he tells it how it is, thinks that most people's problems are down to them being over-sensitive, and is confident in telling them this. He thinks we live in a dog-eat-dog world, and therefore it is necessary to plan ways of manipulating other people to climb the career ladder. He is charming and is popular because of it. He is not a family man as he feels that emotional connections can hold you back in life.

Low primary psychopathy male 2:

Is well liked within his social group. His female friends find he is good to talk to as he understands their problems and gives good advice. He is vegetarian and fund raises for various charities. He hopes to settle down and have children someday. He enjoys spending time with his family.

High primary psychopathy male 3:

Thinks he would be a good participant on The Apprentice as he is good at persuading other people to do things for him, partly because of his charisma. However, he has a reputation of being harsh when he thinks that someone should hear the truth about themselves, and doesn't feel guilty about doing this. He is good at telling a story in social situations, but is known for making things up about himself or the story to make it sound better. He finds horror films funny and enjoys winding people up when they get scared by them.

Low primary psychopathy male 3:

Works in the care industry, as he likes helping people less fortunate than himself - although this means that he is on a low wage. Has no desire to reach management level. He still has his best friends from when he was growing up and has close female friends. He likes

watching documentaries and is concerned about climate change. He dislikes politicians as he thinks that they are dishonest and self-serving.

High secondary psychopathy male 1:

Has a "live fast, die young" approach to life. He loves being the centre of attention at parties, usually by doing something outrageous and risky. He enjoys watching Sons of Anarchy and has thought about joining a biker gang. As he can't hold a job down for long, he deals cannabis with his mates, but this has made him a popular member of his peer group. His friends think he's a good "laugh" because he's good at avoiding getting into trouble with the police.

Low secondary psychopathy male 1:

Leads a stable life. He has a regular job and his boss thinks that he is reliable and conscientious about his work. Even though he likes to go out on the weekend with his friends and get drunk, he doesn't take drugs. Every Wednesday he plays football with his colleagues after work. He is good with money so that he can save for nice meals out and holidays.

High secondary psychopathy male 2:

Has a reputation for being "wild". This means that he is exciting to be around, but can be unreliable as he forgets appointments etc. He can be empathetic but also gets frustrated and aggressive when something goes wrong or when he can't get his own way, and often "mouths off" at people without thinking. He likes to gamble and when he does win, he'll spend the money on a night out getting drunk with his mates and is happy to buy the drinks for everyone.

Low secondary psychopathy male 2:

Is a teacher in secondary school and enjoys his job, even though it means that he has to bring work home with him in order to get it done. He has an economic car and drives it sensibly so that he can save money on fuel. He has had long-term relationships before and is currently internet dating, although he finds it difficult as he hates to show off on his profile in order to catch the attention of women and wants to avoid casual encounters.

High secondary psychopathy male 3:

Is a good person to have around if a confrontation happens on a night out, as he is good in a fight. However, his friends also know not to wind him up as he can take it personally and get aggressive. He has a criminal record, as do most of his friends - mainly for low-level crimes such stealing and vandalism. He tries to avoid getting arrested nowadays as he has a job, although he's almost lost it on a number of occasions from not bothering to turn up. He is good fun to be around sometimes as he'll do things on the spur of the moment and is up for partying all night into the next day.

Low secondary psychopathy male 3:

Owns his own home and worked hard to save money to buy it. His friends are similar to him and they enjoy going every year on a beach holiday somewhere. He's careful to avoid any

sort of negative encounter when he is out as he hates fighting. He is also good at staying calm in high-pressured situations and getting people to see reason in the heat of the moment. He thinks that it is cliché to have a bad attitude to authority and therefore stayed out of trouble during school and beyond.

Female Vignettes

High primary psychopathy female 1:

Gets what she wants and is happy to flatter people along the way to get there. She thinks that people are untrustworthy and thinks that it is fair enough to be dishonest to avoid being taken advantage of. She admires celebrities like Kim Kardashian for exploiting the press. She is unaffected by causes like homeless and animal charities. A lot of men find her attractive as she spends time and money (including cosmetic surgery) on her appearance and looks very glamorous although she is yet to find anyone that she thinks is good enough for her.

Low primary psychopathy female 1:

Enjoys her nine to five job and has no ambition to climb the career ladder. She is honest and down to earth. She relaxes at the weekend by enjoying a glass of wine with friends, watching a film and taking her dogs out for longs walks. She doesn't like being "chatted up" in the pub and would rather meet a partner through a friend.

High primary psychopathy female 2:

Believes she tells it how it is, thinks that most people's problems are down to them being over-sensitive, and is confident in telling them this. She thinks we live in a dog-eat-dog world, and therefore it is necessary to plan ways of flattering other people to climb the career ladder. She is charming and always has a number of men who fancy her. She is not interested in having children as she feels that they would hold her back in life.

Low primary psychopathy female 2:

Is well-liked within her social group. She is vegetarian and fund raises for various charities. She hopes to settle down and have children someday. She enjoys spending time with her family. Sometimes her empathetic nature prevents her from gaining the success that she deserves.

High primary psychopathy female 3:

Thinks she would be a good participant on The Apprentice as she is good at persuading other people to do things for her, partly because of her charisma. However, she does have a reputation of being harsh when she thinks that someone should hear the truth about themselves, and doesn't feel guilty about doing so either. She is good at telling a story in social situations, but is known for making things up about herself or the story to make it sounds better. She hates "Chick Lit" films such as Bridget Jones Diary and Love Actually, and would rather watch a horror movie instead (just for a laugh rather than to be scared).

Low primary psychopathy female 3:

Works in the care-industry as she likes helping people less fortunate than her, although this means that she is on a low wage. She has no desire to reach management level. She still has her best friends from childhood and has close male friends. She likes watching documentaries and is concerned about climate change. She dislikes politicians as she thinks that they are dishonest and self-serving.

High secondary psychopathy female 1:

Has a "live fast, die young" approach to life. She loves being the centre of attention at parties, usually by doing something outrageous and risky. She loves to get drunk and have a good time, although she can end up a mess in the process. The Police have on more than one occasion reprimanded her on a night out for drunk and disorderly behaviour. She has had a variety of jobs, but can't keep them for long as she invariably gets annoyed with her boss or customers and either gets sacked or walks out. Her friends find her entertaining because of the situations she gets herself into.

Low secondary psychopathy female 1:

Leads a stable life. She has a regular job and her boss thinks that she is reliable and conscientious about her work. Even though she likes to go out on the weekend with his friends and get drunk, she generally looks after herself by eating well and keeping fit. Every Wednesday she visits her mum for a catch up. She is good with money so that she can save for nice meals out and holidays.

High secondary psychopathy female 2:

Has a reputation for being "wild". This means that she is exciting to be around, but can be unreliable as she forgets appointments, etc. She can be empathetic but also gets frustrated and aggressive when something goes wrong or when she can't get her own way, and often "mouths off" at people without thinking. She spends too much money on clothes and make-up, but gives away anything she doesn't wear to her friends for free.

Low secondary psychopathy female 2:
Is a teacher in secondary school and enjoys her job even though it means that she has to bring work home with her in order to get it done. She has an economic car, and drives it sensibly so that she can save money on fuel. She has had long-term relationships before and is currently internet dating, although she finds it difficult as she hates to show off on her profile in order to catch the attention of men and wants to avoid casual encounters.

High secondary psychopathy female 3:

Stands up for her friends no matter what, even if it leads to a fight on a night out. Even so, her friends know her to be unpredictable in her moods and she doesn't react well to being wound up. She used to go shoplifting but stopped after she got caught by the police, mainly because she needs to be at home to look after her mum. She is good fun to be around, as she'll do things on the spur of the moment and is up for partying all night into the next day.

Low secondary psychopathy female 3:

Owns her own home and worked hard to save money to buy it. Her friends are similar to her and they enjoy going on a beach holiday somewhere every year. She likes to keep her life as simple as possible and avoids anything too exciting - so she doesn't get drunk and prefers hiking and meditation. She is also good at staying calm in high-pressured situations and getting people to see