The Role of Life History Variables in Male Competitive Behaviour

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Evolutionary psychology suggests that predispositions toward many behaviours exist because they were adaptive in the evolutionary environment. Adaptive behaviours are often sex differentiated due to biological differences in reproduction. Men are typically more competitive than women due to their innate motivation to compete for access to a greater quantity of mates which then typically decreases as reproductive resources are acquired. However, in the ancestral environment, this reproductive strategy was not adaptive for women therefore this variation in the competitiveness of women should not be evident. Research into the effect of reproductive resources on competitiveness is in its early stages and predominantly uses niche samples of highly competitive individuals. This thesis therefore aimed to explore this phenomenon using more representative samples of men and more accessible measures of competitiveness than those used in previous research. In a novel, online, behavioural measure of competitiveness, single non-fathers were shown to be more competitive than committed fathers, consistent with the evolutionary explanation of the origins of competitiveness. Furthermore, this variation in competitiveness was not evident in women. Fluctuating levels of testosterone have previously been implicated as supporting mate acquisition behaviours in men. Although this finding was not evident in the current research, testosterone levels did predict the competitive motivation of men in committed relationships consistent with self-reported interests in pursuing mates. Female mate preferences corroborated these findings showing women prefer for men to evidence a decrease in mating effort as relationship commitment increases. Finally, there was no evidence that priming cues relevant to reproductive success influenced competitiveness. Overall, the results provide some support for the evolutionary account of competitiveness in men, consistent with the suggestion that it reflects mating motivations and varies adaptively to promote reproductive success.

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Declaration

The material in this thesis has not been accepted in contribution to any other degree, and is not being submitted in candidature for any other degree.

The material in this thesis is my own independent work except where otherwise indicated.

Statement of Copyright

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Chapter 1. The Context and Theoretical Basis of the Current Research

1.1. Aims of the Research

This thesis aims to extend the understanding of competitiveness in humans by examining how it fluctuates in response to life history variables; specifically relationship and parental status. The evolutionary approach to understanding competitiveness in humans states that men have a greater inherent drive to compete than women because this was successful in securing reproductive resources. Conversely, this reproductive strategy could not increase reproductive success for women in the same way. Furthermore, ancestral women adopting this strategy faced greater risks to their reproductive success. This approach therefore predicts that men should be more motivated than women to compete, and this should reduce as they acquire reproductive resources. Conversely, there should be no effect of reproductive resources on the competitiveness of women. There is some evidence of an effect of reproductive resources on the competitiveness of men whereby single non-fathers are the most competitive, and this reduces as men become partnered and as they become fathers. However, this research has typically relied upon niche samples of highly competitive sportsmen. The current research therefore aimed to examine whether the same fluctuations in competitiveness would be evident in non-specialist samples of men using non-specialist measures of behavioural competitiveness.

This chapter will firstly define for current use the terms ‘competition’ and ‘competitiveness’ before discussing the relevant middle level evolutionary theories (parental investment theory, life history theory, costly signalling theory and the challenge hypothesis) which form the theoretical framework of this research. This will lead on to a discussion of the role of testosterone, which is important in the facilitation of competitiveness yet is heritable and therefore likely to have been selected for throughout evolutionary history. Finally, this will be brought together to provide the conclusions and the current research questions.

1.2. Understanding Competitiveness

Martens (1976) distinguishes between *competition* and *competitiveness*. He defines competition as “a process in which the comparison of an individual’s performance is made with some standard in the presence of at least one other person who is aware of the criterion for comparison and can evaluate the comparison process” (Martens, 1976, p. 14) and competitiveness as “a disposition to strive for satisfaction when making comparisons with some standard of excellence in the presence of evaluative others” (Martens, 1976, p. 3). Martens (1976) also states that *competition* can only engage an individual to the extent that their *competitive* disposition allows. Thus, these two factors interact and both must be considered when evaluating an individual’s competitiveness; *trait* competitiveness is an individual’s inherent predisposition for competitiveness and drive for excellence, and is relatively stable across contexts (Harris & Houston, 2010), and *state* competitiveness is the extent to which factors within the environment can motivate competitiveness within an individual.

Later definitions of competitiveness considered these distinct yet interacting components, although their labels differ among different researchers. For instance, Griffin-Pierson (1990) identified two components of competitiveness; *interpersonal*, which is the desire to do better than others, the enjoyment of competition and the desire to win; and *goal competitiveness* which emphasises striving for a goal, the desire to excel and the desire for personal development. Likewise Veldhuijzen van Zanten et al. (2002) distinguished between *interpersonal* competition, which is competing against a competitor in which success depends on the defeat of the other; and *intrapersonal* competition, the desire to compete for personal development. Both definitions appear to suggest the same distinctions between *state* competition and *trait* competitiveness, both being distinct yet inherently integrated. Similar distinctions have also been made by other authors; *structural* competitiveness (Kohn, 1992), *superiority* competitiveness (Kayhan, 2003), *competing to win* (Hibbard & Buhrmester, 2010) and *the desire to win* (Malhotra, 2010) have all been likened to state competition, the desire to dominate over others. These authors also identified the distinct component of trait competitiveness, the desire to be the best one can, labelled as *intentional* competitiveness (Kohn, 1992), *mastery* competitiveness (Kayhan, 2003), and *competing to excel* (Hibbard & Buhrmester, 2010) and *competitive motivation* (Malhotra, 2010). These distinctions are also evident in the sports literature, for instance Vallerand and Losier (1999) collate evidence discussing sports people are either *intrinsically* motivated (trait) or *extrinsically* motivated (state).

These distinctions, however, are only informed by proximate levels of explanation; for instance Vallerand and Losier (1999) suggest social factors impact on psychological processes such as perceptions of one's competency, autonomy and relatedness, which then informs motivations. Hibbard and Buhrmester (2010) discuss only gender stereotypical socialised roles, stating trait competitiveness is more aligned with a male stereotype and is at odds with a female stereotype. These explanations do not consider *why* competitiveness is more typically associated with the male role, or why social factors impact on motivations. Furthermore, some accounts of competitiveness often consider it as a personality trait (Hibbard &

Buhrmester, 2010; Kayhan, 2003) which overlooks the impact of state competitiveness and how both trait and state competitiveness interact.

In order to construct a more complete understanding of any phenomenon, both proximate and ultimate levels of explanation must be integrated (Tinbergen, 1963). It is suggested that an evolutionary perspective is more suitable in explaining sex differences in competitiveness than socialisation (Archer, 1996) as it provides vital context to understand the impact of socialisation on competitiveness, and may subsume the distinction between state and trait competitiveness. Competitiveness is suggested to have been sexually selected in humans as despite its negative impact on survival, it would have provided a reproductive advantage in terms of increased status and mating opportunities. The notion of state competitiveness can be explicitly associated with evolutionary theory due to the importance of competing for limited survival resources in the ancestral environment, however trait competitiveness may be an implicit form of status seeking which ultimately serves the same goal. Implicitly competing for self-progression and development provides an internal benchmark for social comparison rather than external opportunities that come with explicit competition. Trait competitiveness therefore allows individuals to implicitly evaluate themselves in terms of placement in the social hierarchy (Festinger, 1954), which could secure the same gains as explicit competition, discussed further later in this chapter. The current research will use the labels of *trait* competitiveness to refer to internal competitiveness in terms of self-development and progression, and *state* competitiveness to refer to overtly aiming to win at the expense of another. This chapter will now detail the relevant middle level evolutionary theories, parental investment theory, life history theory, and costly signalling theory, which inform the research questions.

1.3. Parental Investment Theory

Parental investment is considered to be any investment in a child at the expense of investing in another child or at the expense of pursuing further mating opportunities (Trivers, 1972). In sexually reproducing species such as humans there is a fundamental *asymmetry* in parental investment due to a sex difference in gamete size (anisogamy) with women having significantly larger gametes than men. These larger gametes require a much larger energetic input than the smaller gametes of men as they provide the nutrients and sustenance for embryos until the placenta is formed. Women's gametes are finite; they are born with an average of two million gametes with only approximately 450 ever being accessible for fertilisation. In comparison, the relatively inexpensive sexual gametes of men are replenished constantly and the average ejaculate contains 350,000,000 pound (Baker & Bellis, 1995). Genes promote behaviours that maximise the likelihood of being propagated into the next generation and increase reproductive success (Dawkins, 1976). This translates into having healthy offspring and rearing them to reproductive age to ensure their own chance of reproduction. A consequence of anisogamy is therefore sex differences in mating behaviours due to sex differences in how reproductive success is maximised. As men's gametes are relatively inexpensive, abundant and replaceable in comparison to the limited and costly gametes of women, they have a *higher fitness variance* than women. This means women have evolved the tendency to be much more cautious in their mating behaviours in order to protect their limited reproductive resources. Women are particularly sensitive to indicators of the potential and willingness for a mate to provide *investment* in her and her offspring. However, women are also sensitive to indicators of *genetic fitness* as they are more likely to provide a strong contribution to their offspring. Both of these factors would have a positive impact on offspring *quality*, maximising their survival prospects and therefore maximising the efficiency of women's lower fitness variance (discussed further in Chapter 8). Conversely, the higher reproductive variance of men means they need not demonstrate such cautiousness in their reproductive choices because they can afford to waste gametes on non-viable offspring as they are inexpensive and replaceable. Investing in offspring *quantity* is often a more efficient way for men to maximise their reproductive success.

A further sex difference in reproduction that impacts on the sex-differentiation of parental investment concerns conception and gestation. Women are biologically bound by a lengthy gestation period, whereas men are only obliged by copulation time. This further increases the need for women to be selective with regards to mate choice. Internal gestation diverts energy away from further increasing reproductive success as mating cannot increase the number of offspring pregnant woman can have. Following a successful pregnancy, ancestral women were required to breastfeed for potentially up to five years (Hrdy, 1999). Regular lactation prevents ovulation which serves the purpose of increasing birth intervals to avoid overwhelming a woman's biological resources by investing in multiple offspring simultaneously. Lactation requires up to an additional 500 calories a day, a substantial increase in the ancestral environment. To breastfeed multiple children, or to gestate one and breastfeed another would pose a substantial energetic cost which ancestral women may not have been able to withstand. Therefore, female biology adapted to the environment to focus a woman's resources on (usually) a single offspring at a time, but this resulted in yet another decrease to her reproductive potential by delaying ovulation for longer. The biological obligations imposed on women have selected them to be predominantly *parenting* oriented in regards to reproduction rather than *mating* oriented. Conversely, the energetically inexpensive, abundant gametes and lack of biological constraints mean men can pursue mating opportunities with the potential to increase their fitness variance much more often than women can, potentially having hundreds of offspring in the time it takes a woman to have one. This is further compounded by the greater parental certainty women have compared to men, providing greater assurances that women's offspring provisioning is increasing their reproductive success. As men are never this certain of parental certainty, provisioning offspring incurs a larger potential risk to their reproductive success.

The application of an evolutionary framework to the behaviours that may have been sexually selected for due to the asymmetry in parental investment, such as competitiveness, allows us to make certain predictions about sex differences in these behaviours in modern humans. The lower minimal obligation toward offspring provisioning in men means they have a higher fitness variance than women; that is men have greater potential to increase their reproductive success by pursuing more mating opportunities whereas women do not. Conversely, women's lower fitness variance means they are choosier in their mate choices in comparison to men (Buss, 2007; Todd, Penke, Fasolo, & Lenton, 2007). Thus the asymmetry in parental investment has led to sex differences in mating *strategies*, with men prioritising *quantity of mates* compared to women who prioritise *quality of mates*. Competitiveness may be a mutually beneficial way for men to compete for access to mates and for women to assess the quality of potential mates. This sex difference in the prioritising of quality versus quantity of mating opportunities is discussed further in the following section with reference to Life History theory.

1.4. Life History Theory

Sex differences in parental investment result in sex differences in adaptive *life history strategy,* which is how an individual adaptively allocates their lifetime energy into life history components over the lifespan. Reproduction is an essential component for maximising reproductive success, but survival following reproduction less so. Prioritising reproduction over survival is sometimes logical, as is the case with sexually selected traits. As energy is a finite resource which cannot be allocated maximally into multiple components, trade-offs must be made in order to adaptively allocate energy (Kaplan & Gangestad, 2005). Life history theory (Figure 1.1) states that adaptive life history components comprise a spectrum with s*omatic* effort anchoring one end, reflecting a focus on survival and self-development; and r*eproductive* effort at the opposite, which is energy directed towards offspring production and provisioning. Prioritising reproductive over somatic effort results in a *faster* life history strategy which involves an earlier age of reproduction at the expense of future investment, whereas prioritising somatic over reproductive effort results in a *slower* life history strategy and involves greater investment in oneself in order to provide better investment for future offspring.

Reproductive effort is further comprised of a spectrum, anchored by *mating* effort (pursuing reproductive opportunities) and *parenting* effort (offspring development) (Chisholm, 1993; Figueredo et al., 2006). Prioritising mating effort at the expense of parenting effort represents a *faster* mating strategy with a focus on offspring *quantity*, whereas prioritising parenting effort represents a *slower* mating strategy with a focus on offspring *quality*. Energy allocation into these life history components has been selected for throughout evolutionary history, resulting in a “co-ordinated suite of traits at all stages of the lifespan” (Macdonald, 1997, p.3). This thesis refers to this as *an adaptive baseline of energy allocation* into fitness enhancing components, which has been selected to fluctuate at appropriate times across the human lifespan (Parker & Maynard Smith, 1990). This provides an adaptive template of energy allocation which is then personalised upon unconscious calibration with internal cues (such as senescence and mate value) and external cues (such as relationship and parental status, the presence and availability of alternative mates).

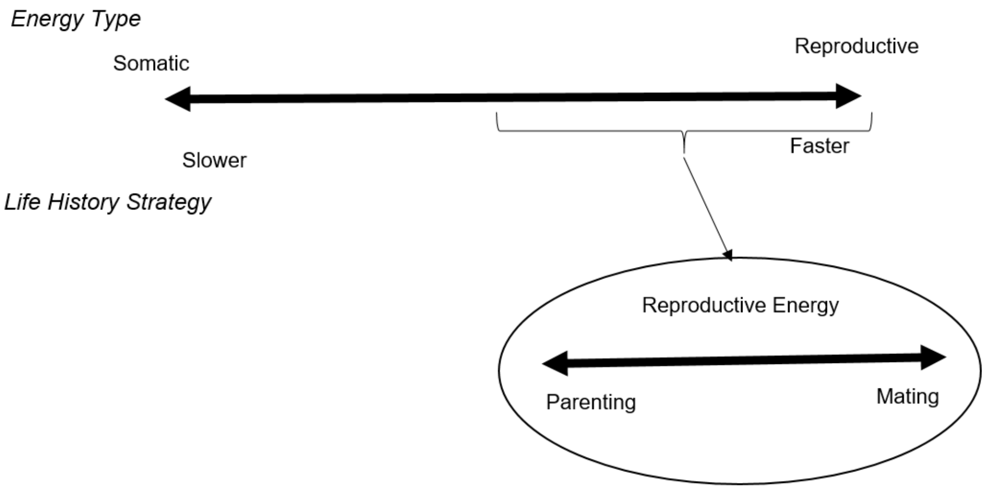


Figure 1.1. Schematic representation of Life History Theory

A number of variables have been highlighted as affecting and being affected by adaptive energy allocation into life history components including mortality schedules, age at first reproduction, fecundity, degree of paternal care and reproductive effort (Wilbur, Tinkle, & Collins, 1974). Species-typical adaptive baselines of reproductive energy allocation has been selected for, falling along a continuum of ‘fast’ to ‘slow’. A fast life history strategy involves reaching reproductive maturity earlier, reproducing at an earlier age, seeking a higher quantity of mating opportunities, having a higher number of offspring per gestation, less paternal investment and ultimately aging and dying earlier. An example of a fast life history strategist species is the rabbit (Figuerado, de Baca & Woodley, 2012). Rabbits typically reach sexual maturity at three months old, produce offspring from six months old with a short gestation period of thirty days, they feed their young for approximately five minutes a day and they are weaned at 6-8 weeks after which they can reproduce again, and they can produce 20-40 babies per year throughout their 8-10-year lifespan. This shows rabbits have been selected to prioritise mating over parenting effort resulting in a focus on *quantity* over *quality* of offspring. A fast life history strategy can be adaptive, particularly in unpredictable environments when there is greater uncertainty about the future. In these cases, delaying reproduction increases the likelihood of not reproducing at all. In more predictable environments, slower life history strategies can be adaptive. This is where somatic effort is prioritised for longer, then once energy is invested into reproductive effort, parenting effort is prioritised over mating effort. This strategy results in reaching sexual maturity later than fast life history strategists, longer gestational periods resulting in fewer offspring, prioritising offspring *quality* over offspring *quantity*. Elephants demonstrate a slow life history strategy (Figuerado et al., 2012); they do not reach sexual maturity until 12-16 years old, with a gestational period of 22 months they usually have approximately four offspring throughout their 70 plus year lifespan. These examples demonstrate stark contrasts between the optimal adaptive baseline of lifetime energy allocation dependent upon the species and their ecology.

Humans have evolved a relatively slow life history strategy, with a lifespan of approximately 70 years, reaching sexual maturity in adolescence, a high degree of parental investment, lengthy gestation periods and dependent infants; however there is extensive variation *within* humans. The first important difference is a sex difference in the baseline of optimal energy allocation due to the different reproductive challenges faced by ancestral men and women. Allocation of energy into *somatic* versus *reproductive* effort is not sex differentiated because survival related adaptive problems were similar for ancestral men and women (Davies & Shackelford, 2006). However, there is a sex difference in the baseline of energy allocation into *mating* and *parenting* components, consistent with parental investment theory, resulting in a sexually selected, sex-differentiated optimal baseline of reproductive energy allocation (Buss & Schmitt, 1993). Women by default have a relatively *slower* mating strategy than men because their greater obligation to offspring development means they prioritise *parenting* effort at the expense of *mating* effort. This means women are usually more cautious in their mating behaviours, prioritising quality rather than quantity of mates. As the mating strategy of men is not constrained in the same way, there is more variance in the available mating strategies *within* men, which is the second major difference in human mating strategies.

The reduced requirements of men in offspring development means they are less restricted in whether they follow a relatively faster or slower mating strategy. Men are able to increase their reproductive success by prioritising mating over parenting effort if the appropriate opportunities present due to the offspring provisioning that women provide. Men following faster life history strategies, tend to prioritise *quantity* over *quality* of sexual relationships and offspring, provide less parental investment and tend to be more impulsive, less cooperative and engage in risk taking behaviours (Olderbak & Figueredo, 2012). Conversely, men following slower life history strategies prioritise the *quality* of sexual partner and offspring over quantity, demonstrating greater commitment to, and provisioning of, a partner and offspring, as well being more cooperative (Olderbak & Figueredo, 2012). Accurate calibration of internal and external cues is essential to informing a successful mating strategy and maximising reproductive success. Individuals who did not successfully calibrate their reproductive strategy were less likely to reproduce.

The asymmetry in parental investment produces a male biased operational sex ratio, meaning there is a greater number of sexually available men than women at any one time. In the ancestral environment, men engaged in mating effort were required to *compete* with each other in order to access scarce survival and mating resources (Davies & Shackelford, 2006; Geary, 1998). Male intrasexual competition in the ancestral environment was primarily physical (Kanazawa, 2003) which carried an elevated risk of injury or death. Successful competitors were those who were strong and dominant, successfully outcompeting their rivals. In a modern environment, this competitive motivation appears evident in many domains (discussed later). Therefore, pursuing a faster mating strategy was risky due to prolonged engagement in physical competition. Maintaining this mating strategy diverts energy away from parenting effort, reducing offspring survival prospects (Gray & Anderson, 2010; Hill & Hurtado, 1996). Aging increases this risk further; men may be less able to successfully compete physically with younger rivals. A man who could successfully pursue this strategy must have a strong genotype to support the level of physical fitness required; it would not be adaptive for a less fit man to attempt to follow this strategy as his chances of success are much reduced.

A less risky strategy would be for men to *gradually* redistribute their reproductive energy from mating-oriented to parenting-oriented as reproductive resources are secured. For instance, it would make sense for men to begin reducing their mating effort when they secured a partner, and for this to decrease further once they had offspring. This would be adaptive as it would reduce the risk associated with maintained mating effort and encourage investment in reproductive resources via increased parenting effort, promoting offspring *quality* rather than *quantity*. The disadvantage of this strategy for men is that it reduces their fitness variance to the level of their mate. As men could potentially increase their fitness variance by maintaining mating effort, it may seem counterintuitive to reduce this. However, the associated risks of maintaining mating effort when partnered tend to outweigh the potential gains for all but a small minority of men. Forming long-term pair bonds and providing exclusive sexual access to one man was therefore mutually beneficial for ancestral men and women. By reducing mating effort, men were able to provision and guard his partner and offspring, increasing their survival rates (Gray & Anderson, 2010; Hill & Hurtado, 1996) and also reducing the risks which accompany physical competition, ultimately increasing offspring viability, quality and reproductive success.

The importance of negotiating a successful life history strategy is central to promoting reproductive success and therefore it is likely to have been subject to sexual selection. The increased motivation to engage in mating effort during adolescence is evident in modern men, accompanied by the hypothesised decrease in mating effort as reproductive resources are gained (discussed later). However, as discussed there is still substantial variation in mating strategies within men due to the effect of cognitive calibration of internal and external cues. This calibration involves cost-benefit analyses resulting in *adaptive individual differences* to the baseline of reproductive energy allocation, leading to variation in the mating strategies of men (Buss & Greiling, 1999; Davies & Shackelford, 2006). Chisholm (1996) suggests humans have developed “suites of functionally integrated anatomical, physiological, psychological and developmental mechanisms for optimising the trade-offs among the components of fitness through the life cycle" (Chisholm, 1996; p. 10). An example of a factor influencing this calibration is unpredictability in the early childhood environment; this encourages a faster life history strategy as a rapidly changing environment indicates future uncertainty. Empirical research supports this, suggesting the developmental environment acts as a sensitive period for setting a life history strategy (Griskevicius, Delton, Robertson, & Tybur, 2011; Simpson, Griskevicius, Kuo, Sung, & Collins, 2012). Conversely, a stable developmental environment indicates a stable future environment, therefore calibration of these relevant cues encourage a slower life history strategy.

While it is adaptive for men to increase mating effort in adolescence, it is *not* adaptive for this to intensify *prior* to being able to reproduce. In younger men who have not yet secured any reproductive resources or mating opportunities, there are few costs associated with following a faster mating strategy but the potential benefits to this are high (Frankenhuis & Karremans, 2012). Therefore, younger, sexually mature men with few reproductive resources secured should be *more* motivated to compete for reproductive resources than older men who have secured resources, for whom additional competition puts these resources at risk. Likewise, men who perceive a shorter lifespan available to increase reproductive success should be more inclined to follow a faster mating strategy (Piquero, 2014). As men age and accrue resources, cost-benefit analyses calibrate their mating strategy, typically reduce mating effort in favour of parenting effort. Failure to adjust the allocation of reproductive effort increases the risk to the primary partner and offspring, wasting reproductive resources and reducing reproductive success. However, this reallocation of mating-to-parenting effort is *not* adaptive in older men who have *not* acquired appropriate reproductive resources. As ancestral men aged, the potential costs associated with competing increased, however so did the risk of *not* reproducing. Older men who have not yet secured appropriate reproductive resources should therefore maintain mating effort by being motivated to compete in order to gain reproductive resources. As discussed, reproduction is more important to increasing reproductive success than survival, therefore an aging man without reproductive resources should be more focused on mating effort than survival. This further highlights the importance of adaptive individual variation in life history strategy.

The argument developed here concerns individual calibration of mating effort. It is suggested that this is evidenced by variation in the motivation to compete. Specifically, men who prioritise mating effort (following a faster mating strategy) will be more motivated to compete. Conversely men who prioritise parenting effort (following a slower mating strategy) will be less motivated to compete. The ongoing calibration of cues that inform mating strategy personalisation is dynamic and varies within individuals throughout their lifetime. An important aspect to consider is what processes inform this cognitive calibration and what motivates mating strategy adjustment. The mating effort bias evident in adolescence reflects a ‘nothing to lose’ mentality of prioritising competing for reproductive resources. There are two methods of achieving this; *intrasexual* competition is direct male-male competition, and *intersexual* displays are those that directly provide information about genetic quality to potential mates. Although distinct, there is considerable overlap between these and both ultimately serve to accumulate resources and maximise reproductive success (Andersson, 1994). For example, intrasexual competition *directly* informs the status hierarchy of men, which informs priority access to reproductive resources, yet this *indirectly* provides information to women about potential mate quality and therefore simultaneously serves as an intersexual display. In order to be successful in the attainment of resources and mating opportunities however, men must *outcompete* their rivals and be selected as a mate. This will be discussed further in the following section.

1.5. Costly Signalling Theory

Parental investment theory suggests that the reduced fitness variance of women resulted in a selection pressure leading women to be more selective in their mate choices (Buss & Schmitt, 1993). Life history theory suggests the higher fitness variance of men means there is greater potential for them to successfully follow a faster mating strategy. Maintaining mating effort at the expense of parenting effort is risky, but this is lower for men than for women. Women primarily seek mates for long term relationships who signal that they would slow their mating strategy and provision her and their offspring, reducing the likelihood of abandonment and increasing their survival prospects (Buss & Schmitt, 1993; Scheib, 2001). This may reduce the risk of abandonment but does not guarantee it. Abandonment would have dire consequences on the reproductive success of ancestral women, therefore women needed to ensure the quality of a partner's genetic contribution, as his minimal obligation to offspring. This would mean her offspring were physically strong, increasing their survival prospects if they were abandoned (Gangestad & Simpson, 2000). As genetically fit men were more successful in outcompeting rivals, securing more reproductive resources and following a fast mating strategy, indicators of genetic fitness indicate the propensity to follow a fast mating strategy and greater likelihood of partner abandonment. This highlights a fundamental trade-off faced by ancestral women in attempting to maximise their reproductive success; seeking indicators of genetic fitness via increased mating effort or indicators of investment potential via increased parenting effort (discussed in Chapter 8). Only more recently has research paid sufficient attention to the need for women to seek and accurately differentiate indicators of genetic quality in potential mates (Buss & Schmitt, 1993; Gangestad & Simpson, 2000), and this is the focus of costly signalling theory.

The principles of costly signalling theory are concerned with the sex-differentiated development of *ornaments* across species which appear counterintuitive to survival prospects. Natural selection could therefore not explain the development or maintenance as they often impose a *handicap* on survival. Across species, ornaments have been sexually selected in the minimally investing sex because they help gain reproductive resources despite the negative impact on survival. Zahavi (1975) named this the Handicap Principle, stating that these ornaments aid reproduction because they provide important signals of the bearer's genetic fitness as they are able to survive despite the costs they impose. Furthermore, sexually selected ornaments are fitness dependent, meaning they can only be displayed to the extent an individual can withstand. An example of this can be seen in peacocks. The plumage of a peacock's tail signals important information about his genetic fitness because its size is exaggerated, imposing energetic costs whilst disadvantaging survival as avoiding predation is more difficult. It is also sensitive to environmental changes such as calorie deficits, parasites, and disease which result in drab colouration, asymmetry and patchiness. Its quality therefore providing peahens with an *honest signal* of genetic fitness by the ability to accrue essential survival resources and avoid predation *despite* the burden imposed (Zahavi, 1975). The Handicap Principle was mathematically formalised by Grafen (1990) who suggested this is an evolutionarily stable strategy, whereby the sex with the highest fitness variance engage in costly displays as a form of mating effort.

Costly Signalling Theory is a modern extension of the Handicap Principle (Bliege Bird, Smith, & Bird, 2001; Bliege Bird & Smith, 2005; Hawkes & Bliege Bird, 2002; Smith & Bliege Bird, 2000; Zahavi, 1975, 2003). It stipulates four criteria which must be met in order for an ornament to qualify as a costly signal; it must be costly for the signaller, easily observable, increase the likelihood of the signaller gaining a reproductive advantage, and indicate genetic fitness (Griskevicius et al., 2007; Smith & Bliege Bird, 2000). Signal strength is varied so the signaller can only partake in the display to the level at which his genotype will allow, thus making it *honest* - less fit individuals cannot fake higher quality signals therefore signal strength reflects the quality of the signaller's genotypes (Gangestad & Simpson, 2000; Graffen, 1990). This highlights the mutually beneficial nature of costly signalling to both the signaller and receiver, who may not otherwise be able to access honest information about genetic fitness (Hawkes & Bliege Bird, 2002).

In humans, competitiveness is suggested to be a costly signal (Wilson & Daly, 1985) meeting the four criteria stipulated by Smith and Bliege Bird (2000). Competing, particularly in the ancestral environment, was risky and costly, but maintaining unnecessary competition increases these risks. It is easily observable by both potential rivals and mates; the competition outcomes inform the dominance hierarchy, impacting on an individual's ability to obtain resources. Competing also provides potential mates with information about an individual's genotypic quality due to the extent to which they are successful in competition, which is the *strength* of their honest signal. The variation in competitive successes and failures both determines *and* signals how men feature within the social hierarchy by *honestly signalling* their genetic fitness with reference to their competitors in an accessible way. Fitter men will naturally assume a higher position among the social hierarchy by outcompeting their less fit rivals. Less fit men will therefore be less successful in securing resources, despite being motivated to compete when engaged in mating effort (Ermer, Cosmides, & Tooby, 2008). In this instance, less fit men who would be less successful in overt competition may compete cooperatively (Roberts, 1998, 2015); specifically, they may *competitively cooperate*.

Although competing in the ancestral environment would have predominantly been physical (Kanazawa, 2003) research suggests that competitive motivation is evident now in many domains. For instance, engagement in artistic displays, conspicuous consumption, conspicuous giving, (Bliege Bird & Smith, 2005; Miller, 1999; Sundie et al., 2010) body modification, academic output (Kanazawa, 2000, 2003) sport (Deaner, 2006; Faurie, Pontier, & Raymond, 2004) and risk taking (Baker Jr. & Maner, 2009; Beattie, 2008; Byrnes, Miller, & Schafer, 1999; Ermer et al., 2008; Wilson & Daly, 1985) has been shown to be sexually dimorphic, consistent with the current theoretical framework. Productivity within these domains fluctuate consistently with an adaptive baseline of reproductive energy allocation, supporting the suggestion that competitive motivation serves as mating effort in men. Miller (1999) documented patterns of cultural output consistent with the sexual dimorphism in the adaptive baseline of reproductive energy; the production of music albums, paintings and books by men increased in late adolescence, peaked in young adulthood, then gradually decreased. Kanazawa (2000, 2003) documented similar distributions in lifetime productivity in musicians, scientists, painters, writers and in criminal activity, suggested to be another contextually sensitive facet of the same evolved motivation for reproductive resources (Kanazawa, 2003). Wilson and Daly (1985) stated men aged 18-25 are the riskiest demographic and this ‘taste for risk’ was sexually selected. Criminality and risk taking are suggested to be other forms of culturally specific outlets for the evolved motivation to compete for reproductive resources (Griskevicius et al., 2013; Griskevicius, Tybur, Delton, & Robertson, 2011) and are often sexually dimorphic. It is acknowledged here that rather than refraining from competing, women tend to compete in more implicit, indirect ways consistent with predictions made by parental investment theory (Fisher, 2013, 2015; Griskevicius et al., 2009), however this is not the focus of this thesis.

If costly signals display genetic quality which increase status and mating opportunities, then we should see evidence that men who successfully engage in such displays *do* secure increased mating opportunities. Research indicates adolescent men who are more dominant and aggressive are more sexually active than their lower-status counterparts (de Bruyn, Cillessen, & Weisfeld, 2012) and athletes report having more sexual partners than non-athletes (Faurie et al., 2004). Aggressive-competitive sportsmen are deemed more attractive than non-sportsman and non-aggressive sportsmen (Brewer & Howarth, 2012) and men perceived as dominant due to the development of secondary sexual characteristics (which are highly heritable, such as facial structure) (Frederick & Haselton, 2007; Havlíček, Roberts, & Flegr, 2005; Kokko, Brooks, Jennions, & Morley, 2003; Valentine, Li, Penke, & Perrett, 2014) are more desired by women. Similar findings are demonstrated cross culturally, for example ritual wrestlers have more children than non-wrestlers (Llaurens, Raymond, & Faurie, 2009) and hunting ability in Aché men positively correlates with the number of offspring raised to adulthood (Kaplan & Hill, 1985). Despite the costs associated with hunting, Meriam turtle hunters distribute their gains with the groups rather than retaining it for immediate family (Bliege Bird et al., 2001; Hawkes & Bliege Bird, 2002; Smith & Bliege Bird, 2000). This seems counterintuitive to reproductive success, however evidence suggests such behaviours lead to illegitimate mating opportunities with higher quality women, reproducing earlier, and having more offspring (Bliege Bird & Smith, 2005). This therefore implicates conspicuous giving as a costly signal as well as hunting ability. Such evidence provides support for the notion that competitiveness in men has been sexually selected in order to increase mating opportunities, but they manifest in culturally sensitive ways (Griskevicius et al., 2009).

Mating strategy is partially informed by internal indicators of genetic fitness; those fit enough to successfully follow a fast mating strategy are able to bear the costly signals in order to enable this. Explicit competition (*state* competitiveness) provides the opportunity to honestly signal to rivals (intrasexual) and potential mates (intersexual) one's fitness as social comparisons assert one's place in society's dominance hierarchy. However, the internal motivation to compete propels this; in the absence of state competition, one can implicitly make social comparisons about his own genetic fitness and place in the dominance hierarchy. This can then be signalled at appropriate times, when environmental cues trigger state competitiveness; specifically, trait and state competitiveness *interact*.

This framework of middle level evolutionary theories suggests that costly signalling via competitiveness has been ingrained in humans throughout ancestral development, allowing comparisons to be made which would inform *adaptive* calibration of life history energy and ultimately aid survival and reproduction. The evolutionary underpinnings of competitiveness may be further validated if there were evidence of a physiological, heritable mechanism underlying the sexually selected fluctuations in reproductive energy. Indeed, there is endocrinological evidence that reproductive energy is intricately associated with physiological fluctuations. This is discussed further in the following section.

1.6. Testosterone

Testosterone is an androgen associated with masculinity due to its involvement in the development of both primary (directly involved in reproduction) and secondary male sexual characteristics (Booth et al., 2006). Secondary sexual characteristics are sexually dimorphic physical characteristics which develop during puberty, such as facial and body hair, and increased muscle mass. Men have much more testosterone (50-210 pg/ml) than women (1-8.5 pg/ml) (Thompson & Dalkin, 2014), suggesting it has been sexually selected. Testosterone can be bound to protein rendering it inaccessible for immediate use, or it can be circulating freely and available for immediate use. It is circulating testosterone which is predominantly associated with both the physical and psychological aspects of mating effort (Deaner et al., 2012; Del Giudice, Kaplan, & Gangestad, 2010).

Testosterone is traditionally associated with aggression and dominance in various species, including in humans (Archer, 2006), but it is a misconception that testosterone *causes* aggressiveness, (Archer, 2006; Book, Starzyk, & Quinsey, 2001; Booth et al., 2006). Mazur and Booth (1998) suggest this fallacy originates from animal research where a positive relationship is more consistently found between testosterone and aggression, known as 'the mouse model' (Archer, 2006). Instead Mazur and Booth (1998) suggest testosterone supports the *desire to dominate* in species-typical ways in the sex with the highest fitness variance in order to secure reproductive resources. This suggestion is consistent with the notion of *state competitiveness*, but as testosterone is sexually dimorphic, it provides an explanation as to why men are more sensitive to state competition than women. Dominating rivals and displaying fitness to potential mates secures reproductive resources in the sex with the highest fitness variance. In some species, dominance is achieved aggressively, however higher primates can achieve dominance in other ways (Mazur, 1973), such as cultural domains (Griskevicius et al., 2009). Support for this comes from Ehrenkranz, Bliss, and Sheard (1974) who found no difference in the testosterone levels of socially dominant prisoners due to their levels of aggression, suggesting higher testosterone levels support social dominance independent of aggression. Furthermore, research suggests aggression is resorted to when dominance cannot be achieved non-aggressively (Ainsworth & Maner, 2012) or when there is a higher risk of this occurring (Stulp, Kordsmeyer, Buunk, & Verhulst, 2012).

Links have been noted in various domains of competition between *dominance* and testosterone levels. For instance, testosterone levels in men tend to increase in anticipation of competition (Mazur, Booth, & Dabbs, 1992; Mazur, Susman, & Edelbrock, 1997), in order to support the motivation to dominate a competitor. Suay, Salvador, Gonza, Simo, and Montoro (1999) supported this showing testosterone increases only occurred prior to a *competitive* interaction, not a non-competitive interaction. Men who are successful in competition tend to have elevated testosterone levels compared to losers, the so-called ‘winner effect’ (Gladue, Boechler, & McCaul, 1989; Mazur & Lamb, 1980; Mazur et al., 1992; McCaul, Gladue, & Joppa, 1992; Pound, Penton-Voak, & Surridge, 2009; van der Meij, Buunk, Almela, & Salvador, 2010). This is suggested to support the maintenance of the elevated social status achieved and to encourage further competition. Losers in competition typically experience a decrease in testosterone levels which discourages further competition.

Mehta, Jones, and Josephs (2008) suggest that the ‘winner effect’ must also be informed by individual differences in initial levels of testosterone, as well as their relative increase or decrease. They suggest individuals with high initial levels of testosterone are more motivated to seek high status than individuals with low initial levels. Mehta et al. (2008) also suggests initial testosterone levels and dominance status should be congruent for optimal cognitive functioning. Incongruence produces dissonance between current and ideal social status, therefore testosterone motivates the desire to ascend the status hierarchy. Support for the relationship between circulating testosterone levels and social dominance come from accurate peer perception of an individual's dominance (Edwards, Wetzel, & Wyner, 2006) and the administration of testosterone supplements increasing dominance behaviours in humans (Kouri, Lukas, Pope, & Olivia, 1995; Nadler, Jiao, Alexander, Johnson, & Zak, 2016; Pope, Kouri, & Hudson, 2000). Research that experimentally administers circulating testosterone supplements in humans is limited but suggests that exogenous application of testosterone encourages impulsive decision making and inflates an individual's self-confidence (Nadler et al., 2016). This link between testosterone and dominance is reinforced by research linking external perceptions of dominance in men with well-developed secondary sexual characteristics (Frederick & Haselton, 2007; Gallup, O'Brien, White, & Sloan WIlson, 2010; Kruger & Fitzgerald, 2011; Pound et al., 2009; Simpson, Gangestad, Christensen, & Leck, 1999; Valentine et al., 2014).

Testosterone is highly heritable and approximately 60 percent of its variance is inherited (Chiu, Lin, & Chang, 1998; Travison et al., 2014). This further supports the suggestion that testosterone-related behaviours and traits have been sexually selected. Additionally, testosterone itself is costly as it is an immunosuppressant. Higher levels of testosterone therefore increases the signaller's vulnerability to disease (Manning, Kilduff, Cook, Crewther, & Fink, 2014; Zuk & McKean, 1996), as well as increasing exposure to the risks involved with dominance-seeking behaviours. Demonstrating increased testosterone levels by successfully exhibiting secondary sexual characteristics and competitiveness therefore demonstrates superior genetic fitness as the individual successfully bears the *latent handicap* of testosterone (Folstad & Karter, 1992; Zuk & McKean, 1996). This association between vulnerability and signal intensity therefore conveys honest information regarding fitness to potential mates, consistent with costly signalling. This then suggests higher testosterone individuals are more motivated to compete because their higher genetic fitness means they could successfully follow a fast mating strategy.

As mating effort is a costly signal which demonstrates fitness and secures reproductive resources, it would be adaptive for men to reduce this once resources are secured to reduce the risks of mating effort. Grafen (1990) states that as reproductive resources are secured, the costs of maintaining mating effort increases while the benefit of accumulating additional resources decreases. Redistributing reproductive effort to prioritise parenting effort would therefore be beneficial to reduce the costs of mating effort and the risks to existing resources although modern competitive environments are not necessarily as risky as the ancestral environment. While this thesis suggests that both trait and state competitiveness may serve ultimate goals, state competitiveness in particular appears closely related to the hypothesised adaptive function of testosterone. Both competing and testosterone levels impose a burden upon signallers which should reduce as reproductive resources are secured. Evidence suggests this occurs in the sex with the highest fitness variance across many species; the following section discusses this research.

1.7. The Challenge Hypothesis

The challenge hypothesis (Wingfield, Hegner, Dufty, & Ball, 1990) suggests that in species with bi-parental care, levels of circulating testosterone fluctuate to aid the adaptive allocation of reproductive energy in the sex with the highest fitness variance. This theory was first proposed in avian species with a similar mating system to humans, where the male provides some degree of parental care despite him potentially increasing his reproductive fitness by maintaining mating effort.

Wingfield et al. (1990) showed testosterone levels of bi-parental avian males increased to support mating effort and decreased to support parenting behaviours. Wingfield, Lynn and Soma (2001) showed testosterone further increased in males during mating season when faced with intrasexual challenges. Conversely, the males of polygynous avian species who do not engage in parental care maintain maximal testosterone levels throughout mating season to support maximal levels of mating effort (Wingfield et al., 1990; Wingfield et al., 2001). Testosterone levels of monogamous bi-parental birds have also been experimentally manipulated; in males with naturally reduced testosterone engaging in parenting behaviours, testosterone supplementation increases mating behaviours and reduces parenting behaviours (De Ridder, Pinxten, & Eens, 2000; Peters, 2002; Stoehr & Hill, 2000; Wingfield, 1984). This supports the view that testosterone levels fluctuate congruently with mating and parenting behaviours in birds. Assumptions from the challenge hypothesis have since been modified to account for variation in the mating systems of other species and successfully applied to some species of fish (Hirschenhauser, Taborsky, Oliveira, Canàrio, & Oliveira, 2004; Pankhurst & Barnett, 1993), lizards (Cavigelli & Pereira, 2000; Klukowski & Nelson, 1998), rhesus monkeys (Rose, Gordon, & Bernstein, 1972) and non-human primates (Muller & Wrangham, 2004) further supporting the role of testosterone in adaptively allocating reproductive energy.

Archer (2006) successfully applied the challenge hypothesis to humans, stating that it is a cost-benefit analysis of the behavioural and physiological consequences of testosterone. The purpose is to maximise reproductive success by supporting mating effort while minimising the costs this imposes. Archer (2006) documented increased testosterone levels in men when faced with intrasexual rivals, when preparing for competition, in winners relative to losers of competitive interactions, and also after interacting with women (potential mates). These findings are consistent with the challenge hypothesis applied to humans, indicating that testosterone fluctuates adaptively across the spectrum of reproductive energy. Archer (2006) supports the suggestion that testosterone supports mating behaviours in culturally sensitive ways and the link between testosterone and aggression in humans being weak.

Increasing reproductive success depends on both survival *and* reproduction, but the high costs associated with maintaining testosterone means it is beneficial to reduce mating effort once reproductive resources are secured (Grafen, 1990). Reducing mating effort reduces the associated individual risks as well as increasing offspring survival prospects. Research indicates testosterone levels decrease in men when in a committed relationship (Burnham et al., 2003; Edelstein, Chopik, & Kean, 2011; Sakaguchi, Oki, Honma, & Hasegawa, 2006) and when engaging in paternal care (Berg & Wynne-Edwards, 2001; Gettler, McKenna, McDade, Agustin, & Kuzawa, 2012; Gray, Parkin, & Samms-Vaughan, 2007; Gray, 2003; Gray, Yang, & Pope, 2006; Pollet, Cobey, & van der Meij, 2013; Storey, Walsh, Quinton, & Wynne-Edwards, 2000) supporting the adaptive association between testosterone levels and mating effort (discussed in Chapter 4). Proximate explanations for lifetime fluctuations of male testosterone levels indicate an age-related decline in testosterone however the evolutionary approach suggests age is a bi-product(Seidman et al., 2001; Vermeulen, 2000; Yasuda et al., 2007). Older men should maintain mating effort if they have not secured reproductive resources; testosterone levels in men increase in divorced men to a level comparable to single men (Mazur & Michalek, 1998), supporting the evolutionary perspective.

The challenge hypothesis in humans upholds when controlling for cross cultural variation in mating traditions. For example partnered polyamorous men have higher testosterone levels than partnered monogamous men despite being partnered (van Anders, Hamilton, & Watson, 2007). When monogamously partnered men report interests in additional mates, their testosterone levels also remain elevated (Booth & Dabbs, 1993; Edelstein et al., 2011; Mcintyre, Gangestad, Gray, Chapman, & Thornhill, 2006; Puts et al., 2015). Conversely, men who report being satisfied and invested in monogamous relationships have reduced testosterone levels (Farrelly, Owens, Elliott, Walden & Wetherell, 2015; Gray et al., 2002; Julian & McKenry, 1989; Perini, Ditzen, Fischbacher, et al., 2012). These findings support the evolutionary account of variation in competitiveness and testosterone levels in men as those who report being satisfied in their relationships should invest in them via increased parenting effort at the expense of mating effort in order to reduce the risk of losing reproductive resources. However, testosterone remains elevated in men who perceive their reproductive success will benefit from maintaining mating effort at the expense of parenting effort. Evidence of fluctuations in testosterone levels consistent with predictions made by life history theory have led to testosterone levels being implicated as the physiological correlate of mating effort (Ellison, 2001; Penke & Asendorpf, 2008).

As well as predicting a positive relationship between circulating testosterone levels and mating effort, the challenge hypothesis predicts that testosterone will increase to *directly* support access to reproductive resources via intersexual displays, and in response to intrasexual challenges, which is *indirectly* related to securing reproductive resources (Archer, 2006). Fales, Gildersleeve, and Haselton (2014) showed when partnered men face a potential rival, testosterone levels increase but only when their partner is fertile, highlighting how these factors interact to protect reproductive success. Research also shows testosterone levels of single men increase when interacting with a potential mate (Ronay & von Hippel, 2010; Roney, Mahler, & Maestripieri, 2003; Roney, Lukaszewski, & Simmons, 2007). This supports the suggested function of elevated testosterone in supporting behaviours both directly and indirectly related to gaining access to reproductive resources, protecting and maximising reproductive success.

Research examining the challenge hypothesis as applied to humans provides robust, cross cultural evidence of testosterone fluctuations supporting the allocation of reproductive energy. When considered in conjunction with the research discussed so far, it is suggested that the behavioural responses in humans to these physiological fluctuations is *fluctuations in the motivation to compete*. Despite the risks associated with competing in a physical way in the ancestral environment, it was greatly beneficial to the reproductive success of men and was therefore selected for by women as indicators of genetic fitness which would be beneficial to offspring. Society changes faster than humans can adapt and evolve, therefore this psychological process remains but it is no longer constrained to physical competition. The implication of testosterone fluctuations in supporting competitiveness in men consistent with the challenge hypothesis suggests fluctuations in their motivation to compete should also be evident in, and reflect, their mating strategy.

The adaptive baseline of reproductive energy in men shows mating effort increases after puberty, peaks in young adulthood then decreases. This has been documented both in testosterone fluctuations (Seidman, Araujo, Roose, & McKinay, 2001; Vermeulen, 2000; Yasuda et al., 2007) and in levels of productivity across different culturally specific domains (Kanazawa, 2000, 2003; Miller, 1999). Support for the evolutionary perspective of fluctuations in reproductive effort comes from fluctuations in testosterone due to relationship and parental status, relationship satisfaction and levels of investment, as well as interests in mating opportunities in partnered polyamorous men. Therefore, if engagement in culturally specific, competitive activities is a form of mating behaviour and supported by fluctuating levels of testosterone, then we *should* also see differences in the competitiveness of men according to their reproductive energy consistent with the documented shifts in testosterone levels and in productivity.

1.8. Conclusions and Research Questions

This chapter has provided a theoretical framework for the research presented throughout this thesis. In line with evolutionary theory, the unconscious genetic level goal is to propagate; in humans, survival and reproduction is essential in achieving this. Ensuring offspring survive to reproductive age would have vastly improved the prospect of achieving this in the ancestral environment.

Throughout human evolution, men and women faced different reproductive challenges. The higher fitness variance of men meant they were potentially able to increase their reproductive success by pursuing a fast mating strategy as they were not *obliged* to provision offspring. Conversely, women have a lower fitness variance and provisioning from men would be beneficial in increasing her reproductive success, but in the absence of this, genetically fit offspring had higher survival prospects. Women made trade-offs in potential mates between indicators of genetic fitness and indicators of investment. Men competed for limited resources by engaging in costly signalling. This motivation remains in modern men, supported by fluctuating testosterone levels as the physiological correlate of mating effort. Although men could potentially increase their reproductive success by seeking further reproductive resources, this was a riskier strategy than reducing mating effort and provisioning resources acquired. Therefore, although parenting effort reduces the quantity of offspring a man may have, it increases the quality of those he has.

Much of the research discussed here has documented fluctuations in testosterone levels consistent with fluctuations in mating effort, and further research demonstrates fluctuations in various areas of competition in accordance with the challenge hypothesis and Miller's (1999) suggestion that cultural output serves as a costly signal to secure mating opportunities. What is lacking in the literature however, is whether competitiveness fluctuates in men in accordance with fluctuations in mating effort commensurate with the established fluctuations in testosterone levels. Furthermore, testosterone levels are highly responsive to environmental cues, such as the presence of potential rivals and mates, however corresponding fluctuations in competitive motivation have not been documented. This thesis will therefore address two research questions:

1. *What are the effects of variation in mating effort on the competitive behaviour of men? Specifically, will men without reproductive resources be more competitive than men with reproductive resources? And will the amount and quality of reproductive resources obtained (such as whether offspring are present or not, and whether a man is satisfied in his relationship or not) affect competitiveness? Will there be differences in the testosterone levels of men consistent with the challenge hypothesis? Will testosterone levels be associated with competitiveness?*

2. *Will external factors, such as the presence of an audience, impact on the competitive behaviour of men, consistent with their effects on testosterone levels? Specifically, if competitiveness serves both intrasexual and intersexual means, then will it be increased when an audience is viewing the competitive interaction rather than when an individual competes alone? Furthermore, will the impact of these external factors on the competitiveness of men in committed relationships depend upon whether they remain motivated to pursue additional mates?*

This thesis will now address these research questions in five experimental chapters using materials developed and piloted in two additional chapters (Chapters 2 and 6). Each chapter will provide a literature review which extends that discussed in this chapter, and specific hypotheses generated from the research questions. The following section will detail the approach taken to the data analysis throughout this research.

1.9. Null Hypothesis Significance Testing, Effect Sizes and Parametric Assumptions

Throughout the thesis, analyses proceed with parametric tests even if the normality assumption is violated, as robustness research suggests that both Type I (Norton, 1952) and Type II (Donaldson, 1968) error rates decrease in this instance. However, Norton (1952) indicates that when the homogeneity of variance assumption is violated, Type I error rates increase to an above acceptable rate (7.26%). However, this primarily affects results that are borderline significant (those where *p* is between .04 and .05) therefore, when the homogeneity of variance assumption is violated, parametric tests are used in order to reduce the greater Type II error rate associated with non-parametric alternatives. It is acknowledged that these analyses may lack reliability and non-parametric alternatives are employed when appropriate, specifically when *p* is between .04 and .05.

This thesis also relies upon both null hypothesis significance testing *and* the reporting of effect sizes. This is because of the growing awareness of the flaws surrounding null hypothesis significance testing, specifically that it encourages dichotomous thinking and deceitful research practices, and is easily manipulated (Cumming, 2014; Kline, 2004). One problem with null hypothesis significance testing is the effect of different sample sizes. Negligible differences or relationships in large samples may yield significant results, whereas meaningful effects or relationships cannot achieve significance when samples are small (Field, 2013). As this thesis is focused on men, who are notoriously difficult to recruit in psychology research, it was expected that power may be reduced, increasing the likelihood of making Type II errors. Cumming (2014) advocates the complete abandonment of null hypothesis significance testing however its prevalence means there is a reluctance to do so.

Field (2014) suggests this would be a retrograde move and advocates keeping the choices of statistical analysis open in order to use the method that best fits the data. The American Psychological Association now also encourages the reporting of effect sizes (APA, 2010), therefore the results sections throughout this thesis consistently report both the old (null hypothesis significance testing) and new (effect sizes) statistics. Part of the new statistics includes the use of 95% Bias Corrected Accelerated Confidence Intervals which are informative however do not address the problems of small sample sizes (Kirby & Gerlanc, 2013). As small sample sizes were anticipated throughout, 95% Bias Corrected Accelerated Confidence Intervals are omitted and null hypothesis significance testing and effect sizes are relied upon in conjunction. The effect sizes utilised here are Cohen's *d* (corrections are applied when this is a within subjects design) and partial eta squared (η_p^2); in correlation designs Pearson's *r* is also discussed in terms of the size of the relationship between the two variables. Effect sizes which appear meaningful (according to Cohen's guidelines; Cohen, 1992, 1988) will be discussed regardless of whether or not they are significant, likewise significant values with negligable effect sizes will be acknowledged but not discussed further.

Chapter 2. Development of an Extra-Pair Interests Scale and a Competitive Task

2.1. Study One: A Measure of Extra-Pair Interests

Introduction

Fluctuating levels of testosterone have been implicated as the physiological correlate of reproductive effort (Ellison, 2001; Penke & Asendorpf, 2008) due to the pervasive finding that testosterone appears to facilitate mating behaviours in men in culturally specific ways (discussed in Chapter 4) and reduces in men who involved in parenting effort. This includes men who are in committed relationships (Gray et al., 2002; Julian & McKenry, 1989; Perini, Ditzen, Fischbacher, et al., 2012) compared to men who prioritise mating effort, such as single men (for example, Edelstein et al., 2011), partnered men with extra-pair interests (Alvergne et al., 2009; Booth & Dabbs, 1993; Edelstein et al., 2011; Mcintyre et al., 2006; Puts et al., 2015) and recently divorced men (Mazur & Michalek, 1998). These findings are consistent with life history theory, suggesting trade-offs must be made in the allocation of reproductive energy, and the challenge hypothesis which suggests this trade-off is often evidenced by fluctuations in testosterone. This suggests that an individual's *mating strategy,* specifically their propensity for maintaining mating effort despite being partnered, evidenced by higher levels of testosterone, may be independent of relationship and parental status. However, what remains unclear is whether there will be commensurate fluctuations in behavioural measures of competitiveness. An appropriate measure of mating strategy independent of external indicators was therefore required. Previous research attempted this by administering the sociosexual orientation inventory (Simpson et al., 1999; discussed in section 2.2.1.), with two additional questions asking about the individual's past experience of engaging in extra-pair sex and whether it is something they would ever consider in the future (Mcintyre et al., 2006). However, this subject is socially sensitive therefore this method may be subject to socially desirable responding (Gray, 2003; Gray et al., 2006) therefore an alternative method of measuring mating strategy was sought. A literature review highlighted some relevant existing measures which will now be discussed further.

2.2.1. The Revised Sociosexual Orientation Inventory (SOI-R) (Penke & Asendorpf, 2008; Simpson & Gangestad, 1991). The concept of sociosexuality refers to an individual's willingness and desire to engage in uncommitted sexual relations (Kinsey, Pomeroy, & Martin, 1948; Kinsey, Pomeroy, Martin, & Gebhard, 1953). Simpson and Gangestad (1991) suggested that sociosexuality could be gauged on a single dimension with an *unrestricted sociosexual orientation* at one extreme and a *restricted sociosexual orientation* at the other. Those with an unrestricted sociosexual orientation tend to have relaxed views about engaging in uncommitted sexual acts and claim they could enjoy such acts without emotional closeness and may pursue multiple sexual partners at any given time (Seal, Agostinelli, & Hannett, 1994); conversely those with a restricted orientation report the need for emotional closeness and commitment before feeling able to engage in sexual acts and ultimately have fewer sexual partners. This distinction may reflect differences in mating strategy, as an unrestricted orientation may reflect a greater propensity to prioritise mating effort at the expense of parenting effort or a faster mating strategy. Indeed, it has been noted that men tend to have a more unrestricted sociosexuality orientation (Schmitt, 2005).

Simpson and Gangestad (1991) constructed the Sociosexual Orientation Inventory (SOI), a seven item measure intended to measure individual differences in sociosexual orientation. The measure received a large body of support (for example;

Jones, 1998; Simpson, Gangestad, & Biek, 1993; Simpson, 1987) and became the standard measure for this construct. However, despite its success, it has repeatedly faced criticism for taking a reductionist approach by conceptualising sociosexuality as a single unitary construct (for example; Jackson & Kirkpatrick, 2007; Jones, 1998; Penke & Asendorpf, 2008; Penke, 2011; Webster & Bryan, 2007). Additional problems have been highlighted with the wording of some of the original SOI items, as well as the response format, and the internal consistency (Penke & Asendorpf, 2008) which was addressed in the revised SOI (SOI-R). The SOI-R now assess sociosexuality across three facets; sociosexual behaviours, sociosexual attitudes and sociosexual desires, as well as global sociosexual orientation which is the amalgamation of scores on these subscales.

The behaviour subscale provides an insight into how an individual has previously allocated their reproductive energy by assessing past sociosexual behaviours (Penke & Asendorpf, 2008). It includes two items from the original SOI concerned with the number of sexual partners over the previous twelve months and the total number of 'one night stands' an individual has engaged in. An additional question was added which asks for the number of sexual partners an individual has had when they have had no interest in pursuing a long term relationship with them. This subscale alone would not be a reliable indication of current or future mating strategy because it is expected that a man's mating strategy would develop over time, for example as discussed previously, men are typically more mating-oriented in adolescence and this should reduce as reproductive resources are secured.

The sociosexual attitudes subscale is concerned with individual ideals and morals regarding sociosexuality. The first two items of this subscale are from the original SOI. They ask whether an individual believes that sex without love is acceptable, and how comfortable they would feel enjoying casual sex. An additional item was added to this facet to replace an item which was poorly worded (Penke & Asendorpf, 2008); this item asks whether an individual believes there should be the prospect of entering into a long term relationship before consenting to sex. Again it is clear to see how this relates to an individual's allocation of reproductive energy, however attitudes and behaviours, or the intention to perform a behaviour, do not necessarily correlate (Ajzen & Fishbein, 1977). Attitudes are often affected by cultural norms and societal rules such as monogamy, which may be incongruent with past, present or future sociosexual behaviours. The sociosexual attitudes subscale alone is therefore not appropriate for the current research.

The third component of the SOI-R, sociosexual desires, is a more recent addition as it was under represented in the original SOI (Penke & Asendorpf, 2008). As with general sexual desire, sociosexual desire is a motivational state represented by increased sexual interest, arousal and fantasies but it is a specific form of general sexual desire *only* concerned with uncommitted sexual encounters. This component of sociosexuality is comprised of three items regarding: the frequency of sexual fantasies about someone who the individual is not in a relationship with, the frequency of experiencing sexual arousal when in contact with someone who the individual is not in a relationship with and the frequency of sexual fantasies about an individual they have just met. Penke and Asendorpf (2008) suggest this facet encapsulates an individual's motivational disposition regarding mating strategy, regardless of the likelihood of it becoming reality. However, despite research which has linked sociosexual orientation and mating strategy (Jones, 1998) it has also been suggested that these two facets are not entirely congruent (Jackson & Kirkpatrick, 2007). It has been suggested that sociosexuality is *only* applicable to the faster end of the life history spectrum and in order to gauge the full range, a separate measure must be included to address long term mating orientation (Jackson & Kirkpatrick, 2007). The current research is specifically concerned with mating effort *independent* of externally imposed labels by examining the desire of men with a partner and/or children to seek and engage in additional mating opportunities. Thus, the many factors which impact on the already highly varied human mating strategies may be too complex to assess solely by considering sociosexual orientation.

2.2.2. The Modified Relationship Assessment Scale (M-RAS) (Hendrick, 1988; Washburn, 2009). A measure of relationship satisfaction may be relevant to the current research. Relationship satisfaction measures draw upon a range of cues which contribute to overall 'satisfaction' in the relationship. This may differentiate between men who perceive they are 'satisfied' in their primary relationships and therefore reduce mating effort in comparison to men who are 'unsatisfied' and therefore maintain mating effort.

Early measures of relationship satisfaction were particularly lengthy, therefore Hendrick (1981) produced an alternative, more practical, brief measure to rectify this; the Marital Assessment Questionnaire. This measure consisted of five items but was criticised for the narrow focus, which was on *marital* relationships, excluding long term committed relationships outside of marriage. This was readdressed with the production of the Relationship Assessment scale (RAS; Hendrick, 1988) which encapsulated relationship satisfaction of romantic relationships in general using seven items, for example, *how well does your partner meet your needs? To what extent has your relationship met your original expectations?* Responses on the RAS correlated moderately with measures of self-esteem, passionate love, altruistic love, commitment and investment but not with sex practices (Hendrick, 1988); and it accurately discriminated between couples who remained together at a later date and those who had separated. The scale was modified by Washburn (2009) to initially produce a ten item measure although one item was subsequently removed. The nine item modified relationship assessment scale (M-RAS) was shown to be slightly more reliable than the original scale, although as it is relatively new, it awaits a body of research to support this.

Nevertheless, the items on the M-RAS have faced criticism for being vague and lacking in context which would impact on accurate responding. The lack of specified context may produce undesirable variance in the source of individual responses; for example asking how well your partner has met your needs may refer to sexual needs, provisioning needs or emotional needs. This lack of operational definition would be problematic here. Some items on the M-RAS may *contribute* to extra-pair desires, for example the emotion ‘love’ is suggested to serve as a commitment device that suppresses sexual desire toward others (Gonzaga, Haselton, Smurda, Davies, & Poore, 2008). However this is only implied and none of the items directly relate to extra-pair interests. The link between these items on the M-RAS and an individual’s mating strategy as evidenced by their desire to pursue additional mating opportunities is tenuous. Interestingly, Hendrick (1988) found responses on the RAS did not correlate with sex practices and the item that Washburn (2009) removed from the M-RAS due to being unreliable was ‘*Do you ever think of other people as possible romantic interests?’*. These findings suggest that ‘love’ and sexual desire, though linked, are conceptually different, which may be due to cultural influences on the perception of monogamy and relationship commitment as being congruent, however this may be nothing more than a social construct derived from a moralistic fallacy which ignores the influence of evolved motivations on behaviour.

2.2.3. Extra-Pair Interests Questionnaire (Gangestad, Thornhill, & Garver, 2002). The final measure considered here concerns women's mating preferences. There is much research that shows shifts in women's mating preferences around the time of ovulation. The evidence is consistent with evolutionary theories that suggest it is adaptive for women to show increased sexual interest in men who demonstrate genetic fitness when they are fertile (for example, Gangestad, Garver-Apgar, Simpson, & Cousins, 2007; Gangestad, Simpson, Cousins, Garver-apgar, & Christensen, 2004; Gangestad et al., 2002; Gangestad & Haselton, 2015; Gildersleeve, Haselton, & Fales, 2014; Pillsworth & Haselton, 2004). This research therefore suggests that women may be adapted to pursuing a *pluralistic* mating strategy (Gangestad & Simpson, 2000), which would be to form a long term bond with an investing man and to seek short term, extra-pair encounters with dominant men around the time of ovulation discussed further in Chapter 8.

Gangestad et al., (2002) researched the extra-pair interests of women in the fertile stage of their cycle compared to the luteal stage. Out of a total of 35 questions in the measure, they included 13 questions focused toward sexual feelings, fantasies and behaviour, both toward the primary partner and people other than the primary partner. Although Gangestad et al., (2002) were successful in demonstrating the hypothesised differences in female sexual desire when fertile compared to not fertile, the fact that this measure was designed for use with females makes it inappropriate for use in the current research. In line with sex differences in parental investment, men and women desire different traits in potential partners (Buss, 1989; Buss &

Schmitt, 1993) therefore some of the items in this questionnaire would not be applicable to men.

The current research requires a measure which can successfully identify how a man in a committed relationship allocates his reproductive energy; that is, whether he is fully invested in the relationship or whether he retains interests in additional mating opportunities. Due to the shortcomings of the measures discussed here in assessing the construct of interest, a new measure was designed and piloted here.

2.3. Method

2.3.1. Participants

Seventy-four heterosexual participants were recruited online on a psychological research participation website (Psychological Research on the Net, Hanover College). The inclusion criteria stipulated participants must be over 18 years old and be in a relationship. Ages ranged between 19 and 58 (M = 29.49 years, SD = 9.85). Sex was not recorded.

2.3.2. Materials

The format of this questionnaire is short, individual, hypothetical scenarios, for example, *Imagine you are getting ready for work and you make an extra effort to look nice. Although you are in a relationship, this extra effort is to impress an attractive colleague who has recently started working with you.* Participants are asked to rate the likelihood of engaging in each scenario using a 4-point Likert scale ranging from 1 = *extremely unlikely* to 4 = *extremely likely*. A four-point scale was chosen in order to avoid mid-point responding. The purpose of using short hypothetical scenarios was to refrain from asking about past behaviours due to the potential flaws of assessing an individual's current or future mating strategy on this, and also to diffuse potential social desirable responding by asking about socially undesirable behaviours an individual may have engaged in. Although this is a self-report measure, and such measures are often criticised for their inability to differentiate between how an individual *believes* they would behave and how they would *actually* behave, it was proposed that the additional context provided in each item would help to provide a more accurate frame of reference for inferring one's own behaviour and help reduce variance in responses due to unclear questions.

Twenty scenarios were initially generated through discussion with supervisors and were centred on different aspects of extra-pair interests (such as sexual infidelity, the motivation to impress an attractive individual, and prioritising the potential to obtain extra-pair sexual opportunities over the primary partner). Of the 20 items, 12 were selected for piloting as they were suggested to be the most culturally relevant and therefore more relatable to participants. Scores on this questionnaire were totalled; potential scores ranged from 12-48. Three items were reverse scored (items 3, 11 and 12).

The SOI-R (Penke & Asendorpf, 2008) and M-RAS (Washburn, 2009) were distributed as measures of convergent validity. Furthermore, due to the socially sensitive nature of the subject, the short form of the Marlowe-Crowne Social Desirability scale (M-C Form C; Reynolds, 1982) was also administered (see Appendix 2.B).

The SOI-R (Penke & Asendorpf, 2008; provided in Appendix 2.C) is a nine item measure that assess sociosexuality across three facets; behaviours, attitudes and desires. All items are scored using nine-point rating scales. The rating values for the sociosexual behaviour items range from zero to 20+ (for example the response choices for the question *'With how many different partners have you had sex within* *the past 12 months?'* is 0, 1, 2, 3, 4, 5-6, 7-9, 10-19 or 20+). The rating values for the sociosexual attitudes items range from *strongly disagree* (1) to *strongly agree* (9), with question 6 being reverse scored; and the values for the sociosexual desires facet are frequencies ranging from *never* (1) to *at least once a day* (9). Items 1-3 are summed to comprise the sociosexual behaviours facet, items 4-6 the sociosexual attitudes facet, and items 7-9 the sociosexual desires facet, and all facets can be summed as a measure of global sociosexual orientation; lower scores indicate a restricted sociosexuality whereas higher scores indicate an unrestricted sociosexuality.

The M-RAS (Washburn, 2009; discussed in section 2.1.2. and provided in Appendix 2.D) is a nine item measure of romantic relationship quality and satisfaction. Responses are on a four-point Likert scale, although the anchors vary, higher scores indicate a higher level of relationship satisfaction. For example, one item asks, *In general, how satisfied are you in your relationship? w*ith available responses being *1 = extremely unsatisfied, 2 = unsatisfied, 3 = satisfied, 4 = very satisfied.*

The MC-Form C (Reynolds, 1982; Appendix 2.B) is a 13 item measure of social desirability. It addresses a range of behaviours that tend to be subject to bias responding (for example, '*It is sometimes hard for me to get on with my work if I am not encouraged'*) with a forced choice *true/false* response format. The frequency of false responding was included as a covariate in order to assess how susceptible the measures were to socially desirable responding.

2.3.3. Procedure

The study was presented in the online cloud-based survey builder, SurveyMonkey and advertised online between July 2010 and August 2010. Participants were first presented with the study information and consent forms. Upon indicating informed consent, participants completed demographic information (Appendix 2.E) then completed each questionnaire, which were followed by feedback questions asking about the clarity and ambiguity of the questionnaires, whether they knew the aim of the research, if so, whether this affected their response.

2.4. Results

The aim of this study was to develop and pilot a measure of extra-pair interests. The data from one participant was removed due to their global SOI-R score being over eight standard deviations above the mean. A total of 73 data sets remained in the analyses. The sample demographics are presented in Table 2.1.

Table 2.1. Sample demographic characteristics

		n	**%**
Relationship Length	1-6 months	7	9.59
	7-12 months	6	8.22
	13-24 months	13	17.81
	25-60 months	12	16.44
	61+ months	24	32.88
	Missing	11	15.07
Parents	Yes	25	34.25
	No	48	65.75
Education level	Secondary/high school	6	8.22
	One or more years of university/college	23	31.51
	A university/college degree/diploma	33	45.21
	A postgraduate qualification or diploma	11	15.07
Nationality	British	60	82.19
	Other	13	17.81

Cronbach's alpha assessed the reliability of the ExPI. A series of Pearson's (*r*) correlations and partial-order correlations assessed convergent validity while controlling for socially desirability. Finally, ExPI responses were subject to a principal component analysis (PCA).

2.4.1. Reliability

Cronbach's alpha (.67) was increased to .80 following the removal of two:

- *11. Imagine it is Valentine's Day and you have given your partner a card and breakfast in bed to show how much they mean to you. You get ready for work and arrive at the usual time to find an anonymous Valentine's Day card has been left for you. You are a little shocked and also flattered, but at the same time you have no interest in establishing who sent it (reverse scored).*
- *12. Imagine you are away from your partner in a different city. You meet an attractive member of the opposite sex. One thing leads to another and the opportunity to have a one-night stand arises. However, you decline due to being in a relationship (*reverse scored*).*

2.4.2. Validity

The correlations are shown in Table 2.2. and the first-order partial correlations are shown in Table 2.3.

Table 2.2. Correlations between psychometric measures and the new ExPI

	SOI-Beh	**SOI-Att**	**SOI-Des**	**M-RAS**	**ExPI**
SOI-R	.918**	.041	.466**	-.278*	.328*
SOI-Beh	-	-.212	.218	-.251*	.296*
SOI-Att	-	-	-.046	-.082	-.187
SOI-Des	-	-	-	-.207	.448**
M-RAS	-	-	-	-	-.411**

**p<.05* ***p<.001*

Table 2.3. Partial correlations between psychometric measures and the new ExPI, controlling for M-C Form C

	SOI-Beh	SOI-Att	SOI-Des	M-RAS	ExPI
SOI-R	.921**	.049	.465**	-.278*	.332*
SOI-Beh	-	.194	.215	-.254*	.309*
SOI-Att	-	-	-.040	-.082	-.205
SOI-Des	-	-	-	-.207	.452**
M-RAS	-	-	-	-	-.412**

$^{*}p<.05$ $^{**}p<.001$

The KMO measure (KMO = .75) and Bartlett's test of sphericity indicated the sample was sufficient for PCA, $X^2(45) = 225.60$, $p < .001$. Initial analysis revealed three components had eigenvalues exceeding Kaiser's criterion of 1, explaining 62.8% of the variance in the data, however the scree plot (Appendix 2.F) suggested a 1-factor solution explaining 38.5% of the variance. The scree plot solution was retained, Table 2.4. show the factor loadings.

Table 2.4. Summary of PCA for the new ExPI

Item	Factor Loadings
1	.62
2	.61
3	.42
4	.80
5	.40
6	.27
7	.73
8	.73
9	.80
10	.58
Eigenvalue	3.85
% of variance	38.48

2.5. Discussion

The aim of this study was to develop and pilot a measure of extra-pair interests to measure mating strategy which may be independent of relationship and parental status. There were positive relationships between ExPI scores and global sociosexuality, as well as the behaviour and desire SOI-R subscales, and a negative relationship with the M-RAS suggesting the ExPI is valid in measuring extra-pair interests. The relationship was strongest between ExPI score and sociosexual desire, which was expected due to the nature of sociosexual desire indicating an individual's desire to pursue uncommitted sexual relations regardless of the likelihood of achieving this. The weaker relationship between the ExPI and the sociosexual behaviour subscale supports the suggestion that this is not the most appropriate measure of current or future reproductive effort, as this is dynamic. Likewise, the lack of association between the ExPI and sociosexual attitudes subscale supports the suggestion that sociosexual attitudes are less relevant to the desire for extra-pair encounters. This may be due to a time-lag effect resulting from the faster-paced evolution of culture and society in comparison to the slower rate of human evolution. This means that as cultural norms, which influence attitudes and beliefs, evolve much faster than human biology and psychology, they may no longer correspond with evolved motivations. Thus, if the desire to pursue additional mating opportunities reflects an evolved motivation to maximise reproductive success, cultural norms and social constructs of what is morally 'right' or 'wrong' may no longer correspond with evolved motivations and have little influence in swaying these visceral predispositions (Loewenstein, 1996; Macdonald, 2008).

The negative association between the ExPI and the M-RAS (Washburn, 2009) was also expected, despite the M-RAS not explicitly referring to within-pair or extra-pair sex. Feelings of love and the overall quality of the relationship are assessed by the M-RAS, and this has been suggested to increase the feelings of commitment to one's partner, reducing the likelihood of seeking alternative mating opportunities (Gonzaga et al., 2008). It is therefore suggested that reduced feelings of love would lead to a greater interest in alternative mating opportunities and less satisfaction within the primary relationship. This in turn would increase mating effort and extra-pair interests, which is also supported here.

The associations between the constructs measured here were increased only minimally when controlling for social desirability. This suggests that the measures were not particularly susceptible to socially desirable responding, despite the sensitive nature of these constructs. This may be due to conducting the research online, increasing the participant's sense of anonymity and encouraging honest responding.

Overall, this study suggests the ExPI is a reliable and valid measure of extra-pair interests. From the perspective of life history theory, this should be useful in indicating an individual's mating strategy, specifically whether they are invested in the relationship or maintain additional mating interests. It is acknowledged that both men and women piloted this measure despite the research focus being primarily on men. The reason for this is that sex differences mating behaviours are of secondary importance to the current research, therefore a measure that is applicable to both men and women is helpful, however knowing the sex ratio of the sample is also important. These analyses therefore suggest that the ExPI will be more effective at highlighting the variation in mating strategy than either the SOI-R or the M-RAS could do separately.

2.6. Study Two: A Behavioural Measure of State Competitiveness

Introduction

The aim of study two was identify a suitable behavioural measure of competitiveness to be used throughout the research. Chapter 1 discussed the distinction between *trait* (a relatively stable, enduring construct; Harris & Houston, 2010) and *state* competitiveness (environmentally induced temporary changes in trait competitiveness), indicating state competitiveness can only be exhibited to the extent an individual's trait competitiveness will allow. There are many self-report measures of trait competitiveness, however if individual capacity for state competitiveness is beyond conscious awareness, it will be unavailable for reflection and self-report (Loewenstein, 1996). For this reason, a behavioural measure would be more appropriate for the current research, however research to date has not used a neutral competitive task outside of niche areas such as sports and arts. Therefore, a new behavioural measure of competitiveness was developed. Previously used measures of competitiveness will now be discussed briefly (more detail in Chapter 3).

There are numerous psychometric measures of competitiveness, such as the Competitiveness Index (Houston, Harris, McIntire, & Francis, 2002; Smither & Houston, 1992) and the Hypercompetitive Attitude scale (Ryckman, Hammer, Kaczor, & Gold, 1990), both of which only measure trait competitiveness. The Competitiveness Questionnaire (Griffin-Pierson, 1990) does consider both trait and state competitiveness however research by Hibbard and Buhmester (2010) suggests this would not be suitable for use here. Self-report measures are notoriously susceptible to biased responding; individuals may consciously portray themselves in a desirable way or may be unable to accurately reflect on their own traits. Hibbard and Buhmester (2010) found low convergent rates between self, peer, and parent ratings among adolescents using the Competitiveness Questionnaire, suggesting sole reliance on questionnaire data weakened their findings. As competitiveness is more socially acceptable in men than women, this may be subject to socially desirable responding and as competitiveness is influenced by environmental factors, questionnaires may not be able to capture this variation.

Some researchers have used niche samples of participants who could be categorised as being more competitive than a general sample, such as various sports players including football, volleyball, and tennis (Booth, Shelley, Mazur, Tharp, & Kittok, 1989; Brewer & Howarth, 2012; Edwards et al., 2006; Faurie et al., 2004; Koch & Tilp, 2009; Manning & Taylor, 2001; Mazur & Lamb, 1980), athletes, including runners, wrestlers, and weight lifters (Deaner, Masters, Ogles, & Lacaille, 2011; Deaner, 2006, 2013; Elias, 1981; Rhea, Landers, Alvar, & Arent, 2003; Tamiya, Lee, & Ohtake, 2012), and judoists (Salvador, Suay, Martinez-Sanchis, Simon, & Brain, 1999; Suay et al., 1999). These specialist samples have also gone beyond physical realms, including video gamers (Mazur et al., 1997) and chess players (Mazur et al., 1992). There are clear benefits to such methods, such as increased ecological validity, however the specialist nature of these samples narrows the available participant pool and reduces the generalisability of the results. The current theoretical framework suggests the motivation to compete for reproductive resources in men is universal regardless of trait competitiveness, however individual fitness would limit competitive success. By limiting samples to those high in trait competitiveness, who may be more sensitive to state competition, there is little variation in the motivation to compete in the samples. Furthermore, results cannot be extrapolated to those with lower levels of trait competitiveness and therefore will not provide evidence of universal fluctuations in competitiveness as a form of mating effort.

Research has used various laboratory-based tasks such as word association tasks (Ainsworth & Maner, 2012; Massar & Buunk, 2009), reaction time tasks (Gladue et al., 1989), The Multi-Tasking Framework (Purple Research Solutions, Plymouth England; Farrelly, Slater, Elliott, Walden, & Wetherell, 2013), Scalextric games (van Zanten et al., 2002) and videogames using non-specialist samples, (Mazur et al., 1997). Whilst there are advantages to conducting research in laboratory conditions, such as increased control, some of these tasks could be criticised for being too artificial and uninteresting, reducing the motivation to compete and biasing the results. Furthermore, there are no clear risks or benefits to competing in these tasks, which are what qualifies tasks or activities as costly signals. This questions the suitability of using these tasks in the current research.

Some researchers have used laboratory tasks similar to those above but with rigged outcomes. These tasks include reaction time tasks (Gladue et al., 1989), number tracing tasks (Carre, Putnam, & McCormick, 2009; Mehta, Snyder, Knight, & Lassetter, 2014; Mehta & Josephs, 2006; Welker & Carré, 2015), the Verbal Meanings Subscale of the Primary Mental Abilities battery (van Anders & Watson, 2007), videogames (Welling, Persola, Wheatley, Cárdenas, & Puts, 2013) and competitive tasks that were intended to appear as intelligence testing items (van der Meij et al., 2010). Randomly assigning participants to winning or losing the competition is primarily used as an independent variable in order to assess its effects on testosterone, the hypothesised physiological counterpart of competition. This is not appropriate for the current research which is concerned with competitiveness as a dependent variable.

Finally, other research has used chance based tasks, such as coin tossing (McCaul et al., 1992) and lottery draws (Mazur & Lamb, 1980). These tasks are not suitable here because there is no opportunity to display differences in fitness, which is the purpose of a costly signal, therefore the motivation to take part may not be the same as tasks based on merit.

It was important to use a competitive task in this research in order to provide *observations of competitiveness,* as recommended by Hibbard and Buhrmester (2010). The task needed to be *accessible* in order to maximise the potential pool of participants and the generalisability of the findings. Relying on a niche task may be intimidating to novices, therefore as well as being accessible to men who otherwise would be less motivated via overt competition for fear of failure, the task needed to be *novel* to reduce familiarity with the task which may bias the results. Finally, it needed to be able to assess an individual's *motivation to compete* as well as their *performance.* It was considered important to use an online task to maximise participant recruitment, by making participation more flexible and convenient to the participant, and also allowing participation in familiar surroundings similar to those in which other competitive tasks are often completed (such as certain Facebook applications). Tasks used in previous research are not able to fulfil these requirements, or they use natural samples of highly competitive individuals which reduces generalisability. Four different tasks were designed to address these issues and piloted here with the aim of identifying which, if any, could be used in the current research.

2.7. Method

2.7.1. Participants

Ninety-two participants (male = 21, female = 71) were recruited from online psychological research sites (such as Psychological Research on the Net, Hanover College) and the undergraduate psychology programme. Students completed the study for partial course credit whereas non-students received no incentive for participation. Ages ranged from 18-64 (*M* = 26.67 years, *SD* = 9.93).

2.7.2. Materials

2.7.2.1. Task one: 'Questions'. The first task required participants to answer 30 questions from six domains with the aim of getting them correct as quickly as possible. The time pressure was to increase the feeling of competitiveness and to discourage cheating by referring to other sources for correct answers, which would increase completion time. Thirty questions were included to induce fatigue, which would then influence responding dependent upon motivation, impacting upon their final score. The six domains were maths, general knowledge, Raven's Matrices (Raven, 1936), word definitions, anagrams and syllogisms. This was to ensure that success at this task was not dependent upon niche knowledge.

Each question had an easy option worth one point per correct answer, and a hard option worth three points per correct answer. The score achieved provided a measure of competitive *performance*. Participants were free to choose which option to answer for each question and this measured variation in the *motivation* to succeed independent of the *success*. Participants had to decide on a strategy to maximise the pay-offs; harder questions were worth more points but took longer to complete whereas easier questions were quicker to answer but were worth fewer points. The six domains were randomised to prevent participants from tactically selecting to answer a hard question in a stronger area, therefore selecting the easy or hard option provided a measure of risk. The 60 questions (each easy and hard option) can be seen in Appendix 2.G.

2.7.2.2. Task two: 'Number Square'. The second task, 'Number Square' is adapted from the competitive task used by Farrelly et al. (2013). Their research used The Multi-Tasking Framework (Purple Research Solutions, Plymouth England), a computer based task requiring participants to respond to four tasks simultaneously to collect points. Individually, the tasks appeared to meet the required criteria for implementation as a competitive task, however Farrelly et al. (2013) concluded the tasks were not successful, suggesting this was due to the tasks being implemented simultaneously. The Multi-Tasking Framework was originally designed to elicit stress responses in participants, which may explain the lack of suitability in its original format. Number Square is one of these tasks and was piloted for use here. Participants are presented with a 4x4 number grid on their computer screen (shown in Appendix 2.H). They must find the highest number in the grid then click on all occurrences of it to reset the grid and earn one point. It cannot be reset if any incorrect numbers are selected, or if any occurrences of the correct number are not selected. This task was more challenging than the other Multi-Tasking Framework tasks, it is accessible and not reliant upon any specialist skills or knowledge yet success at this task does not depend on chance. It is novel with a slim chance of participants encountered anything similar before, reducing potential practice effects. The aim of Number Square is to collect as many points as possible in a three-minute time frame, which again is intended to induce fatigue in participants who are less motivated to compete. The score obtained is a measure of performance, however there is no measure of competitive motivation.

2.7.2.3. Task three: 'Circles and Squares'. The third task, 'Circles and Squares', is also computer based and involves shapes being presented at random points on the computer screen at one second intervals. Participants must click the shape to collect points with the aim being to score as many points as possible in three minutes. This task is novel, requires no previous skill or expertise and therefore does not limit the potential participant pool or generalisability of the results, yet success in the task is not dependent upon chance. Participants were provided with full information in order to select their game strategy; specifically, whether they played 'circles' or 'squares'. Circles appeared relatively large on the screen, making them easier to click and were worth one point. Squares appeared relatively small on the screen, making them more difficult to click and were worth three points each (see Appendix 2.I). The total score obtained by correctly clicking on the presented shape provided a measure of competitive performance; the overall number of clicks made in the task, whether correct or incorrect, provided a measure of competitive motivation and the choice of play provided a measure of risk.

2.7.2.4. Task four: 'Marbles'. The final task, 'Marbles', was adapted for online use from a task used by Frankenhuis and Karremans (2012). The task provides a measure of risk taking propensity, a facet closely related to competitiveness and also implicated as a costly signal. In this task, participants are shown a 'bag' on the computer screen and are told it contains ten marbles, nine of which are red and one is black. The aim is to collect as many points as possible by withdrawing red marbles, worth one point each but if the black marble is withdrawn all points are lost. This task is set-up so the black marble is always withdrawn last in order to obtain a measure of an individual's full willingness to take risks. For example, if participants were willing to withdraw nine marbles before stopping but the black marble was withdrawn second, we would not obtain an accurate measure of their risk taking propensity. This is also a novel task which participants are unlikely to have encountered before, it is accessible and not reliant upon expertise or skills, and provides a measure of motivation to take risks. However, it does not provide a measure of performance (Appendix 2.J).

2.7.2.5. Other materials

Participants provided demographic information (Appendix 2.L) and feedback about each task to evaluate their effectiveness. Participants were asked: 'How did the tasks make you feel? For example, bored, tired, competitive, motivated etc.' 'Were the tasks difficult?' 'Do you have any other comments regarding the tasks?' 'Were the tasks effective in making you feel competitive?' These questions had open response formats.

2.7.3. Procedure

The study was presented in an external online server and advertised online (02/2011-10/2011 and 09/2012-10/2012). Participants read the study information sheet then provided consent and demographic information. Tasks were randomised to control for order effects. Participants provided open-ended feedback about each task before proceeding to the next task. After providing feedback on the final task, participants were given the opportunity to provide any further comments, which completed the study. Ethical approval was granted from the University of Sunderland Research Ethics Committee (Appendix 2.M).

2.8. Results and Discussion

Participants piloted four potential tasks and provided feedback (Appendix 2.M) in a within-subjects design. However, the platform was sometimes not supported on individual systems resulting in a different number of participants completing each task. The sample characteristics of those who completed each task can be seen in Table 2.5.

Feedback obtained from participants indicated that the ‘questions’ task largely invoked feelings of competiveness but that the difficulty of the task often overwhelmed participants, deterring them from competing. The feedback strongly suggested that this task only measured trait competitiveness, as participants often reported selecting hard questions in order to push themselves and stated that aside from pushing themselves there was no additional competitive element due to the absence of a competitor and no scope for having their performance compared against others. This suggests that this task was no more helpful in measuring the interaction between trait and state competitiveness than traditional competitiveness questionnaires, as although participants largely reported enjoying the task and feeling motivated, they did not feel as though they were in a competitive situation.

Feedback from participants regarding the second task, ‘number square’, suggested that while it was successful in inducing competitiveness, it was also frustrating and stressful, causing participants to feel agitated which overshadowed the motivation to compete. As this task was adapted from The Multi-Tasking Framework (Purple Research Solutions, Plymouth England), which was designed to elicit stress responses, this response is perhaps not surprising. Furthermore, as this task was only able to provide a measure of competitive performance and no measure of competitive motivation, this task was not optimal for use in the current research.

Table 2.5. Sample demographic characteristics

		Questions		Number Square		Circles and Squares		Marbles	
		(*n* = 50)		(*n* = 74)		(*n* = 75)		(*n* = 92)	
Age	Range	18-64		18-57		18-57		18-57	
	M (*SD*)	29.66 (2.07)		25.03 (9.28)		24.49 (8.19)		25.66 (9.93)	
		n	***%***	***n***	***%***	***n***	***%***	***n***	***%***
Sex	Male	6	12.00	17	22.97	17	22.67	71	77.17
	Female	23	46.00	57	70.03	59	78.67	21	22.83
	Did not respond	21	42.00						
Sexuality	Heterosexual	47	94.00	67	90.54	68	90.67	85	92.39
	Bisexual	1	2.00	6	8.11	6	8	6	6.52
	Homosexual	2	4.00	1	1.35	1	1.33	1	1.09
Relationship status	Single	19	38.00	33	44.59	34	45.33	43	46.74
	Casually dating	2	4.00	3	4.05	3	4.00	4	4.35
	Long term relationship	10	20.00	21	28.38	21	28.00	21	22.83
	Cohabiting	11	22.00	8	10.81	8	10.67	10	10.87
	Married	8	16.00	9	12.12	9	12.00	14	15.22
Education	Primary school	1	2.00	3	4.05	3	4.00	6	6.52
	Secondary	2	4.00	20	27.03	20	26.67	23	25.00
	1+ years of university	12	24.00	22	29.73	23	30.67	28	30.43
	University degree/ diploma	20	40.00	19	25.68	19	25.33	22	23.91
	Postgraduate qualification	15	30.00	10	13.51	10	13.33	13	14.13
Nationality	British	31	62.00	59	79.73	60	80.00	70	76.09
	American	11	22.00	9	12.16	8	10.67	11	11.96
	Other	8	16.00	6	8.11	7	9.33	11	11.96

Feedback from the third task, ‘circles and squares’, indicated that participants often felt competitive and motivated to perform well. Participants indicated that the length of the task induced boredom and feelings of tiredness. However, this was not unexpected because this task and ‘number square’ were purposely designed this way, assuming fatigue would affect competitiveness dependent upon their motivation. Specifically, it was expected that those less concerned with mating effort would become less competitive throughout the three minutes than those more motivated by mating effort. Participants also reported that the instructions for this task were clear, increasing the accessibility.

With regards to the fourth task, ‘marbles’, the feedback indicated that participants felt somewhat competitive. However, feedback predominantly indicated this task seemed easy but confusing. Furthermore, this task appeared to the participant to be based on chance (as participants were unaware that the chance element had been removed). This may therefore discourage full engagement with it as participants perceive there is no opportunity to display variation in genetic fitness. This is a requirement for tasks and activities to be classed a costly signal and is why other chance based tasks were not suitable for use here.

The feedback overall indicated that the third task, circles and squares, would be suitable for use in the current research. This task seems to fulfil the required criteria for use as participants reported it was accessible and it was novel, having been newly designed here. It is suggested that as the shapes appear at random points on the screen, participants’ performance on the game will not improve during participation. Finally, this game is implemented online and provides a measure of competitive performance (the score achieved by correctly clicking the shapes presented) as well as competitive motivation (the number of correct and incorrect attempts to click a shape) independent of performance. Furthermore, feedback indicated this task successfully induced feelings of competitiveness in participants therefore this task was implemented as the competitive task throughout this research, providing measures of risk, competitive performance, and competitive motivation.

Chapter 3. Sex Differences in the Effect of Life History Variables on Competitive Behaviour

3.1. Introduction

There is much research suggesting men are more motivated than women to compete, consistent with the suggestion that this secures reproductive resources. Deaner and Smith (2012) and Deaner et al. (2012) showed physical competition is usually male-biased. Miller (1999) extended this other areas of cultural output. Using a comprehensive reference list of jazz albums, Miller (1999) randomly sampled 20 percent finding 1800 jazz albums were released by 685 men compared to 92 jazz albums released by 34 women (Carr, Fairweather & Priestly, 1988; cited by Miller, 1999). Productivity of artists was more sexually dimorphic with 2979 paintings by 644 men compared to 395 paintings by 95 women (The Tate Gallery Collections, 8th edition, 1984; cited by Miller, 1999); and in authors, 2213 books by 180 men and 624 books by 49 women (The Writer's Directory, 10th edition, 1992; cited by Miller, 1999). Kanazawa (2000, 2003) showed not only extreme sexual dimorphism in the productivity of a sample of scientists, 97.5 percent of which were men, but also a sex-differentiated distribution of productivity across the lifespan consistent with life history theory.

Kanazawa (2000, 2003) presented evidence of a distribution in the productivity of men characterised by a sharp increase during adolescence which peaked at approximately aged 30, decreasing relatively sharply in middle-age. This is consistent with the hypothesised baseline of reproductive energy allocation discussed in Chapter 1. While Kanazawa (2000, 2003) demonstrated a similar pattern in the productivity of women, it was much less pronounced, further supporting the theoretical basis outlined in Chapter 1. However, this productivity distribution was only evident in men who had married at some point in their lives, indicating that once reproductive resources were secured, mating behaviours reduced, compared to individuals who never married (Kanazawa, 2000; 2003). The productivity of unmarried men did not peak as high or decrease as markedly. It is suggested this lower peak productivity of unmarried men represents their lower genetic fitness, making them less successful in securing reproductive resources despite being motivated to do so. Consistent with this, Farrelly and Nettle (2007) showed a desisting effect of marriage among professional male tennis players. Here, performance decreased significantly in the year after marriage compared with the year before after controlling for playing time. This pattern was not evident in a group of age matched, unmarried controls. This effect of marriage was also demonstrated in the 'age-crime curve' (Kanazawa, 2003) of engaging in criminal activity, another forum for displaying mating effort (Wilson & Daly, 1985).

Fluctuating levels of testosterone are implicated in men as the physiological counterpart of mating effort (Ellison, 2001) as they encourage the desire to dominate (Mazur & Booth, 1998) via costly signalling. As testosterone is a latent handicap itself, it leads to variation in signal quality. Research suggests that men with higher testosterone levels are perceived as more dominant, are more likely to marry, have a higher number of sexual partners in their lifetime and have more children (Gettler, McDade, Feranil, & Kuzawa, 2011; Jasienska, Jasienski, & Ellison, 2012; Peters, Simmons, & Rhodes, 2008; Pollet et al., 2011; Slatcher et al., 2011). Therefore, although less fit men should still be motivated to compete in order increase reproductive success, they will be less successful in doing so and secure fewer reproductive resources. Documented fluctuations in the testosterone levels of men across the lifespan (Uchida et al., 2006) are similar to the variation in productivity and competitiveness predicted by life history theory and demonstrated by Kanazawa

(2003). Conversely, in women there are no consistent patterns in testosterone fluctuations (Carré et al., 2009; Edelstein, van Anders, Chopik, Goldey, & Wardecker, 2014; Kivlighan, Granger, & Booth, 2005; Pollet et al., 2011; van Anders & Goldey, 2010). This supports the suggestion that sex-differentiated fluctuations in reproductive energy (both testosterone and mating behaviours) are ultimately due to sex differences in adaptive reproductive problems discussed in Chapter 1. This has produced a greater intrinsic motivation in men to strive for dominance and display genetic fitness in various cultural domains than women leading to women being outnumbered in many fields.

Further support for the theoretical basis outlined in Chapter 1 is provided by consistent evidence of single men having higher levels of testosterone than both mated non-fathers and mated fathers (Gettler et al., 2011; Gray, 2003) hypothesised to support mating behaviours such as competitiveness. Theoretically, testosterone and competitiveness should decrease in men on becoming partnered, and then further on becoming a father. This is because reproductive resources are being gained, therefore the associated risks of maintaining elevated mating effort will typically outweigh the benefits (Grafen, 1990). However, the supporting empirical evidence shows some inconsistencies. Some evidence suggests testosterone decreases incrementally as reproductive resources are gained so that mated non-fathers have reduced levels of testosterone in comparison to single men but elevated levels in comparison to mated fathers (for example, Burnham et al., 2003). This is consistent with the theoretical basis outlined in Chapter 1 as the incremental reduction in testosterone levels represents the incremental decrease in mating effort in favour of parenting effort. However other research indicates mated non-fathers maintain testosterone levels comparable to single men (Gray, 2003; Gray et al., 2006), or that mated non-fathers have comparable levels of testosterone as mated fathers (Gray et al., 2002; Gray, Campbell, Marlowe, Lipson, & Ellison, 2004). Gray, (2003) and Gray et al. (2006) suggest these discrepancies can be explained by cultural differences in socially acceptable mating strategies. This is discussed further in Chapter 4, however it is suggested that the proximate influence of cultural and social norms still influences these fluctuations adaptively.

Life history theory suggests that a baseline of lifetime energy has been selected to fluctuate adaptively however, the nature of evolution favours organisms who can adapt to a rapidly changing environment, resulting in adaptive individual deviations from the baseline. Gray, (2003) and Gray et al. (2006) suggested the documented inconsistencies in the testosterone level fluctuations of mated non-fathers may be due to cultural differences in social and cultural influences on mating strategies. Specifically, in some Eastern cultures it is more acceptable for mated non-fathers to seek additional mating opportunities until they become fathers (discussed in Chapter 4). In these cultures, mated non-fathers may maintain mating effort (both testosterone levels and mating behaviours), comparable to single men as a faster mating strategy is more socially acceptable than in Western cultures. Additional research supports this; testosterone remain elevated in men who report having extra-pair interests despite being in a monogamous relationship (Anders et al., 2007; Edelstein et al., 2011; Mcintyre et al., 2006), or in openly polygynous relationships (Alvergne et al., 2009). Elevated testosterone has also been demonstrated in men who report being less invested in, or less satisfied in the primary relationship (Edelstein et al., 2014) and men categorised as being in 'new relationships' of less than 12 months who have not yet fully committed to the relationship (Farrelly et al., 2015). This supports the suggestion that men are psychologically adapted to be flexible and responsive to proximate cues in order to optimally allocate reproductive energy in an individually adaptive way. Therefore, if competitiveness is a behavioural facet of reproductive energy, there should be corresponding deviations from the baseline of reproductive energy allocation documented by Kanazawa (2000, 2003) in competitiveness.

The implication of this is that external indicators of reproductive energy allocation, such as relationship status, may not be accurate. A more suitable measure of reproductive energy allocation may be *mating strategy,* specifically whether men maintain a fast mating strategy (higher mating effort) despite having secured reproductive resources, or if they slow their mating strategy by reducing mating effort. The ExPI was developed in study one to address this by measuring an individual's extra-pair interests. Higher ExPI scores suggest an individual is interested in extra-pair opportunities and will have high mating effort (testosterone and mating behaviours) despite being partnered (following a fast strategy).

A facet closely related to extra-pair interests is mate value, including perceptions of one's own value as a potential mate, a potential partner's value, and the difference between these perceived values. Individuals who perceive they have a higher mate value than a partner have more extra-pair opportunities and incur fewer costs following a fast mating strategy because lower value women want to retain higher value men (Edlund & Sagarin, 2010). Buss and Shackelford (1997) suggest a discrepancy in the perception mate values of predicts susceptibility to extra-pair relations; specifically men who perceive themselves as having a higher mate value than their partner are more inclined toward extra-pair relations. In support of this, Welling et al. (2013), found a higher self-perceived than perceived-partner mate value predicted preferences for more feminine faces in men. Femininity is a fitness indicator in females, therefore this supports the current theoretical framework suggesting adaptive cost-benefit analyses of, and calibration to, relevant cues is individually adaptive.

The current research is concerned with interactions between state and trait competitiveness and therefore uses a newly developed behavioural measure of competitiveness rather than traditional self-report measures. The circles and squares game provides measures of competitive performance and motivation. An additional measure of competitive motivation was also taken by asking participants to self-report how competitive they felt after participating. As self-report measures are easily biased, which in the current research may therefore indicate competitive motivation, this was not the sole measure of competitive motivation but may yield informative data.

Five hypotheses were tested in study three. Firstly, if men are intrinsically more motivated to dominate than women, then men will have greater competitive motivation than women (make more successful and unsuccessful attempts on the game and report higher self-reported post-task competitiveness ratings) (Hypothesis 1). If men have been selected to be more competitive, then they should be more adaptable to novel competition and therefore be more successful in the circles and squares game than women, (a higher score on the game) (Hypothesis 2). As risk taking is also a form of mating effort (Wilson & Daly, 1985), men will be more inclined to adopt the riskier gaming strategy (selecting squares) than women, who will play a safer strategy (selecting circles) (Hypothesis 3). If competitiveness represents mating effort, single men should be motivated to dominate in the competition than committed fathers due to the innate drive to reproduce. Therefore there should be an effect of relationship/parental status on competitiveness; single non-fathers should be more competitive (both in motivation and performance) than committed fathers (Hypothesis 4). Committed non-fathers should have intermediary levels of competitiveness due to the gradual reduction of mating effort, being slightly more competitive than committed fathers but less competitive than single non-fathers. This within-sex variation in competitiveness due to relationship/parental status should not be evident in women. As men have the potential to increase their reproductive success by following a faster mating strategy, ExPI scores and perceived mate value discrepancies should positively relate to competitiveness regardless of relationship/parental status (Hypothesis 5).

3.2. Method

3.2.1. Participants

155 people participated (f=92, m=63) in this study. The age range was 17-60 (*M* = 27.56, *SD* = 11.19). Participants were recruited both from the university for course credit, and on psychology research participation websites (such as Psychological research on the net, Hanover College) and social media (such as Facebook and Twitter) from 01/2013-02/2013 for no incentive.

3.2.2. Design

The experimental aspect of study three used sex as an independent variable with two levels (male, female), and relationship and parental status as one independent variable on four levels (single non-parents, single parents, committed non-parents, committed parents). This is in-line with life history theory, which suggests reproductive energy occupies a single continuum of purely mating effort-to-purely parenting effort, acknowledging the gradual reduction of mating effort through becoming partnered and having children. There were three dependent variables; competitive performance (score obtained on the circles and squares game) and two measures of competitive motivation (total attempts made on the game and self-reported post-task competitiveness). The correlational aspect included risk taking propensity measured by the choice of shape to play on the game ('circles' represented less risk, 'squares' represented greater risk), and sex. Two further variables were included here; mating strategy (ExPI scores), and mate-value discrepancy (relative mate-value) alongside the three measures of competitiveness.

3.2.3. Materials

Participants received full study information (Appendix 3.A) and were asked to provide consent (Appendix 3.B). Demographic information was collected, including date of birth, sex, relationship and parental status, and sexuality (Appendix 3.C). Sexuality was asked because non-heterosexual individuals are expected to differ in their mating strategies (van Anders & Watson, 2006b) so therefore would be excluded from analysis.

The ExPI (section 2.1, Appendix 2.A) measured the mating strategy of committed participants via ten hypothetical scenarios. Each scenario was measured on a 4-point Likert scale, available scores ranged from 10-40 with higher scores indicating a greater interest in extra-pair opportunities and therefore a faster mating strategy (α = .80).

Adapted versions of Phillips' (2010) mate value measures were used to measure the discrepancy between perceptions of own and partner's mate value. These measures were inspired by previous work detailing factors important in mate selection (Buss, 1989; Buss & Barnes, 1986). The original measures ask participants to rate their *own mate value* (OMV) then their *partner's* mate value (PMV) relative to other students of their sex and age on 15 items with a Likert scale of 0-10, where 0 is

0% (*Extremely Below Average*), and 10 is 100% (*Extremely Above Average*) (Phillips, 2010). As the current sample was not limited to students, the measures were modified to remove this focus; this involved removing the final item, '*Good student/likely to graduate college'*, reducing the measures to 14 items each, and editing the instructions to '*Below are a range of characteristics. Please rate yourself [your partner] on a scale of 0-10 (extremely below average to extremely above average)*'. The scores on the OMV (Appendix 3.D) and PMV (Appendix 3.E) were used to calculate *relative mate value* (RMV), the discrepancy between individual and partner mate value (OMV – PMV = RMV) (Phillips, 2010). A negative RMV indicates a perceived lower mate value than one's partner, and a positive value indicates a perceived higher mate value than one's partner. Reliability was comparable to that reported by Phillips' (2010) for both OMV (α = .87) and PMV (α = .86).

The circles and squares game (section 2.2) was the competitive task. An additional element, a picture of a league table (Figure 3.1). The aim of this was to induce state competition by providing a standard of comparison. Participants were informed that the aim was to collect as many points as possible in three minutes and appear on the league table. To increase validity, the scores included were the top ten from study two.

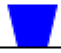
Rank	Symbol	User ID	Score
1		01011970	480
2		05071991	453
3		02101984	447
4		01051970	438
5		06071971	426
6		11041983	414
7		11021984	402
8		06091992	390
9		05111994	384
10		11011983	381

Figure 3.1. League table used in the Circles and Squares game

Participants read the instructions as in section 2.2. Participants selected whether to play ‘circles’ or ‘squares’, where ‘circles’ appeared on the screen relatively larger than ‘squares’ making them easier to click. Circles were therefore worth one point per correct click and the squares were worth three points per correct click. The selected shape appeared momentarily on the screen and was replaced by another shape in a different location at the one second interval regardless of whether or not the participant correctly clicked the shape; screen shots are shown in Figures 3.2 and 3.3. The game provided two measures of competitiveness; the motivation to compete regardless of success (total number of correct and incorrect clicks made during the game) which is the number of attempts made to succeed. Competitive performance was the score obtained by correctly clicking on the selected shape as they were presented on the screen. When the game finished, participants indicated “*How competitive did the task make you feel*?” taken as a subjective measure of competitive motivation, on a nine point Likert scale (1=*not at all,* 9=*extremely*) as it can be easily manipulated.

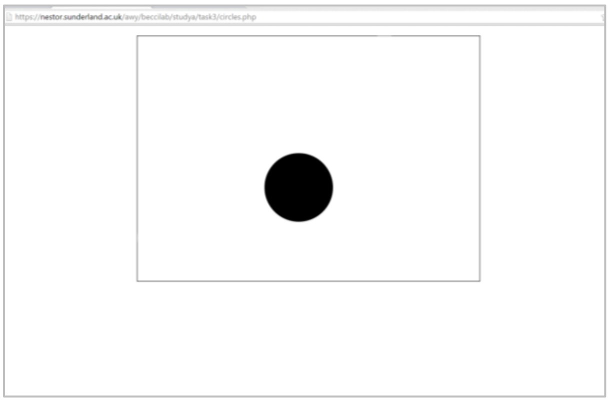


Figure 3.2. Example of playing 'circles' in the competitive game

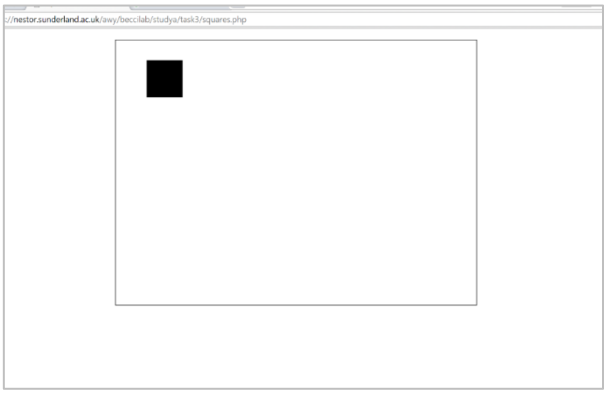


Figure 3.3. Example of playing 'squares' in the competitive game

3.2.4. Procedure

Participants accessed the study via a web link which opened the information sheet and consent form. Participants provided demographic information, then completed the ExPI, OMV, and PMV (Phillips, 2010). The platform of the study did not allow participants to complete selected questionnaires, therefore single participants were instructed to complete the ExPI *as if they had a partner*, and to complete the PMV as what they would desire in a mate, though these were not analysed. Participants then saw the league table and game instructions, played the game for three minutes then provided their competitiveness rating before reading the debrief. This study was approved by the University of Sunderland Research Ethics Committee (Appendix 2.M).

3.3. Results

Data from homosexual participants (*n* = 4) were excluded from analysis. Due to the low recruitment rate of single parents (*n* = 6), their data were also excluded from analysis. Participants who indicated they were single or casually dating were allocated to the ‘single’ level of the relationship and parental status variable, all other participants were considered to be in committed relationships. The remaining sample demographic characteristics can be seen in Table 3.1. The parametric assumptions and data analysis will be discussed before presenting the results, beginning with the experimental hypotheses.

Table 3.1. Sample demographic characteristics

		Women (*n* = 90)		**Men (*n* = 61)**	
		n	%	*n*	%
Relationship status	Single	27	30.00	15	24.59
	Casually dating	6	6.67	2	3.28
	Long term relationship	37	41.11	14	22.96
	Cohabiting	7	7.78	5	8.20
	Married	13	14.44	25	40.98
Parental status	No children	73	81.11	39	63.93
	Children	17	18.89	22	36.07
Nationality	British	75	83.33	54	88.52
	American	4	4.44	2	3.28
	Other	11	12.22	5	8.20
Education level	Primary/grade school	10	11.11	15	24.59
	1+ year at college/university	48	53.33	9	14.75
	A university degree/diploma	15	16.67	25	40.98
	A postgraduate qualification	16	17.78	12	19.67

3.3.1. Experimental Hypotheses (1, 2 and 4)

The assumption of normality was violated for both scores on the game and the number of attempts made ($p < .001$) yet the homogeneity of variance assumption was met for both the score on the game, F (5, 136) = 1.01, $p = .413$, and the number of attempts made, F (5, 136) = 1.57, $p = .172$. The assumption of normality was also violated for post-task competitiveness ratings ($p <.001$) but the assumption of homogeneity of variance was also violated, F (5, 100) = 2.65, $p = .026$, inflating the risk of Type II error. The analysis of hypotheses 1, 2 and 4 proceeded with parametric analyses, followed by a non-parametric alternative to analyse the ratings of post-task competitiveness ratings if *p* was between .04 and .05.

It was intended to analyse the number of attempts made on the game and the score obtained in conjunction using a MANOVA, as the score on the task may be influenced by the number of attempts made. The two variables correlated appropriately ($r = .6$), therefore a MANOVA was conducted, followed by a discriminant function analysis. However, the discriminant function analysis revealed a correlation greater than 1, discrediting the reliability of the analysis which was therefore excluded (Appendix 3.F).

As age has been implicated in testosterone fluctuations, it was intended include it as a covariate in the analysis of each dependent variable. However, the assumption of independence between the covariate and the independent variable of relationship/parental status was violated meaning an ANCOVA could not be reliably conducted. This showed that committed parents were significantly older than the non-parents. Instead, a series of correlations were conducted between age and each dependent variable separately for each level of relationship/parental status. There was only one notable relationship which was between age and post-task competitiveness in single participants only, $r\,(46) = .30$, $p = .044$. These analyses suggest there is no influence of age on the measures of competitiveness in the current sample. There was an effect of shape choice on the score obtained, $t\,(127.83) = 7.21$, $p<.001$, $d = 1.28$, where those who played ‘squares’ scored more points than those who played ‘circles’, as expected. Analysis of variations in performance and attempts across the duration of the game was not possible due to the design of the program. A series of three, two-way 3 (relationship/parental status) x 2 (sex) independent groups ANOVAs were then conducted to address each of the experimental hypotheses with Tukey post hoc tests on the independent variable of relationship/parental status where necessary.

3.3.1.1. Hypothesis 1. Men will make more attempts on the game, and report feeling more competitive following the game, than women. There was no main effect of sex on number of attempts made in the game, F (1, 145), p = .970, η_p^2 <.001, (men: M = 124.88, SE = 6.59; women: M = 125.21, SE = 5.78); however men reported feeling significantly more competitive following the game, (M = 6.51, SE = 0.27), than women, (M = 5.32, SE = 0.24), F (1, 145) = 11.40, p = .001, η_p^2 = .073.

3.3.1.2. Hypothesis 2. Men will score more points in the game than women. There was a non-significant effect of sex, F (1, 145) = 2.46, p = .094, η_p^2 = .033, with men scoring non-significantly higher in the task (M = 216.83, SE = 16.45) than women (M = 179.20, SE = 14.69).

3.3.1.3. Hypothesis 4. All measures of competitiveness will be higher in single men compared to mated fathers, a pattern that will not be evident in women. There was a significant main effect of relationship/parental status on the number of attempts made in the game, F (2, 145) = 4.40, p = .014, η_p^2 = .057. Tukey post hoc tests indicated that committed parents (M = 106.65, SE = 8.24) made significantly fewer attempts at the game than single non-parents (M = 139.42, SE = 7.63). There was no interaction between mating effort and sex, F (2, 145) = 1.32, p = .272, η_p^2 = .018. The descriptive statistics are shown in Table 3.2.

Table 3.2. Mean (and standard deviation) of number of attempts made on the game

	Single Non-Parents	Committed Non-Parents	Committed Parents	Overall
Males	149.12 (89.71)	123.18 (44.25)	102.35 (51.37)	124.88
Females	129.73 (45.01)	134.97 (41.89)	110.94 (35.70)	125.21
Overall	139.42	129.08	106.65	125.05

There was no main effect of relationship/parental status on post-task competitiveness, F (2, 145) = 1.33, p = .269, η_p^2 = .018; the descriptive statistics are shown in Table 3.3. There was a significant interaction between sex and relationship/parental status on post-task competitiveness levels, F (2, 145) = 4.23, p = .016, η_p^2 = .055, shown in Figure 3.4.

Table 3.3. Mean (and standard deviation) of ratings of post-task competitiveness (1-9 scale)

	Single Non-Parents	Committed Non-Parents	Committed Parents	Overall
Males	7.24 (1.15)	5.73 (2.19)	6.59 (1.97)	6.52
Females	4.61 (1.94)	5.40 (2.47)	5.94 (2.05)	5.32
Overall	5.92	5.56	6.27	5.92

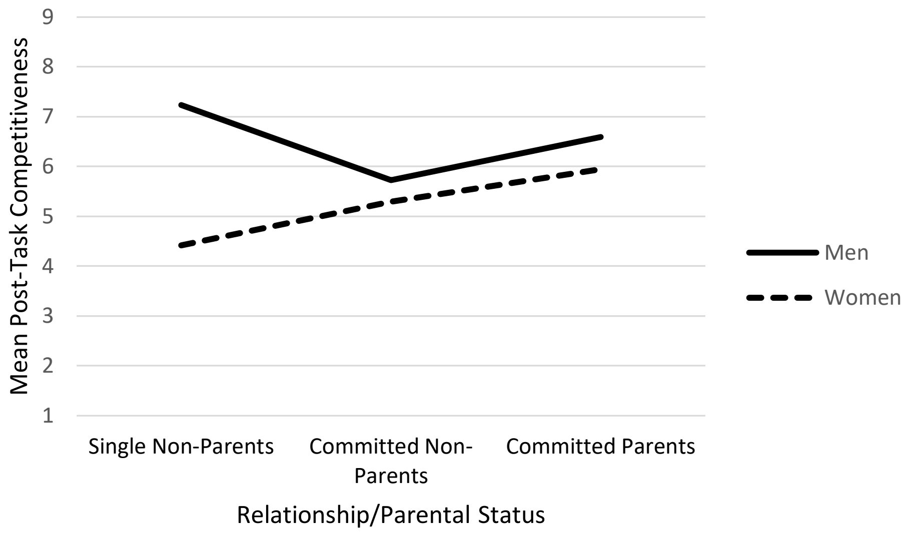


Figure 3.4. Interaction between sex and relationship/parental status on post-task competitiveness (1-9 scale)

Simple effects showed single non-fathers (*M* = 7.24, *SD* = 1.15) felt more competitive after the task than single non-mothers (*M* = 4.61, *SD* = 1.96), *t* (48) = 5.14, *p* < .001, *d* = 1.48. There was also an effect of relationship/parental status on the post-task competitiveness of men, *F* (2, 58) = 3.21, *p* = .048, η_p^2 = .10, but not women, *F* (2, 87) = 2.31, *p* = .105, η_p^2 = .05, although the effect size was respectable. Tukey post hoc tests revealed committed non-fathers (*M* = 5.73, *SE* = 0.40) reported feeling significantly less competitive than single non-fathers (*M* = 7.24, *SE* = 0.45).

There was a significant main effect of relationship/parental status on the score obtained in the game, *F* (2, 145) = 6.04, *p* = .003, η_p^2 = .077. Tukey post hoc tests indicated committed parents (*M* = 142.47, *SE* = 20.71) scored lower than both committed non-parents (*M* = 208.42, *SE* = 17.45) and single non-parents (*M* = 239.81, *SE* = 19.47); these descriptive statistics are shown in Table 3.4. There was a non-significant interaction between mating effort and sex, F (2, 136) = 2.45, p = .090, η_p^2 = .035, as shown in Figure 3.5.

Table 3.4. Mean (and standard deviation) of score achieved on the circles and squares game

	Single Non-Parents	Committed Non-Parents	Committed Parents	Overall
Males	293.53 (168.05)	212.77 (145.77)	140.76 (119.72)	216.83
Females	186. 10 (116.33)	210.73 (125.98)	140.76 (119.72)	179.19
Overall	239.81	211.45	142.47	198.01

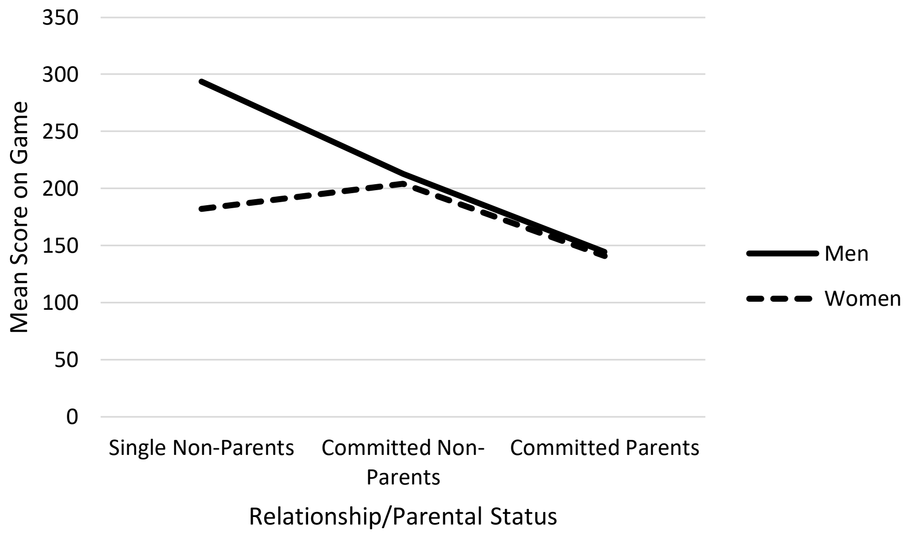


Figure 3.5. Non-significant interaction between sex and relationship/parental status on score

Simple effects analysis showed a significant sex difference in the score obtained in the game in single non-parents, t (48) = 2.65, p = .011, d = 0.73, with single men scoring higher (M = 293.53, SD = 168.05), than single women (M = 186.10, SD = 116.33). There was also a significant decrease in men's scores, from single non-fathers (M = 293.53, SE = 34.68), to committed non-fathers (M = 212.77, *SE* = 30.48), and again to committed fathers (*M* = 144.18, *SE* = 30.48), *F* (2, 58) = 5.24, *p* = .008, η_p^2 = .153.

3.3.2. Correlational Hypotheses (3 and 5)

A two-way chi-square test of independence examined the sex difference in risk taking propensity (Hypothesis 3), and Pearson's correlations analysed the relationships between indicators of mating strategy (ExPI scores and RMV) and measures of competitiveness (number of attempts, post-task competitiveness and score) (Hypothesis 5).

3.3.2.1. Hypothesis 3. Men will take more risks in the competition than women by choosing to play 'squares' more often than 'circles'. A two-way chi-square test of independence demonstrated a significant association between sex and shape played in the competitive task, X^2 (1) = 3.90, *p* = .048, *V* = .16. Women were more likely to play circles more and men were more likely to play squares.

3.3.2.2. Hypothesis 5. All three measures of competitiveness will correlate positively with both ExPI and RMV in men but not in women. The descriptive statistics for the ExPI are shown in Table 3.5 as it is a new measure they will be informative in evaluating it further. There were no notable relationships between either indicator of mating strategy and measures of competitiveness; results are shown in Table 3.6.

Table 3.5. Mean (and standard deviation) of ExPI scores

	Committed Non-Parents	Committed Parents	Overall
Males	16.68 (5.01)	18.30 (6.18)	18.64
Females	14.94 (4.15)	15.77 (4.62)	15.73
Overall	15.81	15.73	17.18

Table 3.6. Pearson's coefficients of the relationships between indicators of mating strategy and measures of competitiveness

	Women		**Men**	
	RMV	**ExPI**	**RMV**	**ExPI**
Score Obtained	-.14	.02	.04	.005
Number of Attempts	-.19	.12	.03	-.04
Post-Task Competitiveness	.14	-.10	-.03	-.26

3.4. Discussion

The aim of this study was to examine whether there were sex differences in competitiveness fluctuations due to relationship/parental status consistent with the evolutionary theory discussed in Chapter 1. This suggests that competitiveness serves mating effort and fluctuates more substantially in men than in women and is supported by testosterone research and fluctuations in testosterone dependent behaviours. Previous research has relied upon natural niche samples to examine fluctuations in competitive behaviour (for example, Farrelly & Nettle, 2007; Kanazawa, 2000, 2003) which may limit generalisability. Study three therefore used a novel, accessible, competitive task to examine whether these previously demonstrated fluctuations in mating effort would be evident in a non-specialist sample.

Sex differences in competitiveness were firstly examined including the number of attempts (correct and incorrect) made on the game and ratings of post-task competitiveness on a 9-point scale (Hypothesis 1) and the score obtained on the competitive game (Hypothesis 2). Hypothesis 2 was not supported by the results of the current study, as men scored non-significantly more points on the game than women. Hypothesis 1 was partially supported by the current results as men reported feeling more competitive following the game than women did, yet there was no sex difference in the number of attempts made on the game.

Self-rated competitiveness after the game was included in the current study as a measure of *motivation* because it can be easily biased. It was expected that men would report feeling more competitive after the game than women, consistent with the suggestion that men are motivated to compete in order to achieve social dominance. However, social and cultural influences may have contributed to this finding because competitiveness is more culturally acceptable in men than women (Hibbard & Buhrmester, 2010), perhaps encouraging this response in men. The evolutionary account of sex differences in competitiveness acknowledges these roles, suggesting they originate from sex differences in adaptive reproductive strategies. However without behavioural evidence of sex differences in competitive motivation, this finding alone cannot differentiate between the evolutionary and social role accounts of competitiveness.

It was expected that men would be more motivated to compete in the game than women, evidenced by the number of attempts made, however this was not the case. This finding is slightly puzzling as men achieved a non-significantly higher score than women (a good effect size, Hypothesis 2). There are two potential explanations for this; the first is that there were sex differences in the number of *successful* attempts made on the game rather than the combined number of successful and unsuccessful attempts. As men have been sexually selected to be more competitive in order to achieve social dominance in culturally sensitive ways, they may be able to adapt to novel forms of competition in various domains. In the current research, this would lead to men making more *accurate* attempts in the competitive game, leading to a higher score, which is supported here. Another explanation for these results is that, consistent with the suggestion that risk taking is also a form of mating effort (Wilson & Daly, 1985), men took more risks in the game than women by selecting to play the harder option (Hypothesis 3), leading to men having a higher potential score available to them. Participants who played squares scored significantly more points than those who played circles, and the analysis of hypothesis 3 show that men were more inclined to play squares whereas women were more likely to play circles. Therefore, if playing the harder option has indeed led to the higher score achieved by men rather than an increased number of attempts, this supports the suggestion that men are generally more adaptable to novel competitive tasks as they have been more successful than women despite competing at a harder level. These findings may therefore support the theoretical basis outlined in Chapter 1, indicating sex differences in reproductive biology and fitness variance have led to sex differences in risk taking and adaptability to novel forms of competition. However, sex differences in *successful* attempts on the game were not examined in the current study and must therefore be explicitly examined in future research in order to support this conclusion. Conversely, it may also be the case that, rather than there being an effect of sex on performance which is not fully evident due to a lack of power, variation in performance is solely due to the shape played. If this is the case, then it would appear that the competitive game is perhaps not entirely suitable for use in exploring fluctuations in mating effort in men.

It was hypothesised that in addition to sex differences on the three measures of competitiveness, there would also be an effect of relationship/parental status in men but not in women (Hypothesis 4). This would support the suggestion that competitiveness is a form of mating effort in men, serving as a costly signal to secure mating opportunities. Testosterone research has consistently demonstrated that single men have higher levels of testosterone than committed fathers, therefore it was expected that single non-fathers would be more competitive than committed fathers. However, testosterone research has yielded somewhat inconsistent results with regards to the levels of testosterone of committed non-fathers which is comparable to single men in some studies, and comparable to committed fathers in others. This is suggested to be due to cultural differences in the socially acceptable view of seeking additional mating opportunities (Gray, 2003; Gray et al., 2006) in a manner which is still compatible with life history theory. It was therefore expected that in the current study, single non-fathers would be the most competitive, committed fathers would be the least competitive, yet there would be more variation in the competitiveness of committed non-fathers.

The results of study three showed an effect of relationship/parental status on the number of attempts made on the task and the score achieved. In both instances, single non-parents were more competitive by making more attempts (competitive motivation) and scoring higher on the task (competitive performance) than committed parents. However there was no interaction between sex and mating effort, suggesting this was consistent across the sexes, which was not expected. This pattern was somewhat reversed when examining self-rated post-task competitiveness; there was no effect of relationship/parental status overall but there was an interaction with sex. Single non-fathers reported feeling more competitive than single non-mothers and committed non-fathers whereas there was no effect of mating effort in women. This can also only partially support the evolutionary account of competitiveness because it may also be more socially acceptable in single men compared to committed fathers. The interaction between mating effort and sex on self-rated competitiveness cannot solely support the evolutionary account of competitiveness without appropriate behavioural evidence.

The results of the behavioural measures of competitiveness in study three can also only partially support the theoretical basis. Competitive performance in the current study (score) and competitive motivation (number of attempts) were both lower in committed parents than in single non-parents yet the interaction between mating effort and sex was not significant. Further analyses showed there was a sex difference in the performance of single participants only, with single non-fathers scoring more points in the game than single non-mothers, consistent with the suggestion that single men should be more engaged in mating effort than single women. Furthermore, analyses showed competitive performance decreased incrementally in men as their reproductive resources increased; single non fathers scored the most points, followed by committed non-fathers, and finally, committed fathers, fluctuations which were not evidenced in the competitive performance of women. This is partially consistent with research by Farrelly and Nettle (2007) who demonstrated an effect of mating effort on the performance of male tennis players, whereby performance decreased after players were married. However their sample did not include fathers and could therefore only consider part of the spectrum of reproductive energy by not including those primarily concerned with parenting effort, which the current sample does. Results from the current study therefore extend the findings from Farrelly and Nettle's (2007) research by showing performance in a novel, arbitrary task also reduces as reproductive resources are acquired and furthermore by considering the cumulative influence of a partner and offspring in reducing mating effort. However, this finding alone cannot support the evolutionary account of competitiveness. Competitive performance does not inform us of an individual's *motivation* to compete, only of their *success* in doing so. This flaw of examining competitive performance as an indicator of mating effort rather than competitive *motivation* was discussed previously and contributed to the rationale for developing a novel, accessible measure of competitiveness for use in the current research. It was therefore suggested that there would be a sex-differentiated effect of mating effort on the behavioural measure of competitive motivation in study three, however this was not the case.

The incremental decrease in the competitive performance of men is also consistent with testosterone research which has shown testosterone levels decrease incrementally as reproductive resources are obtained (Burnham et al., 2003). This supports the suggestion that reproductive energy gradually reallocates adaptively from being primarily mating oriented in individuals with no reproductive resources to primarily parenting oriented as reproductive resources are secured. The incremental decrease in competitive performance is also consistent with the suggested influence of cultural norms in influencing adaptive allocation of reproductive energy (Gray, 2003; Gray et al., 2006). This is because the sample in study three was predominantly western, where cultural norms promote monogamy regardless. Gray (2003) and Gray et al. (2006) suggested that, if testosterone levels support mating effort, men in cultures where it is acceptable for committed non-fathers to pursue additional mates will only reduce their mating effort once they become fathers. Therefore it is perhaps not surprising that the competitive performance of the men in the current sample also reduced incrementally. However, as stated, it was expected that this reduction in competitiveness would be evidenced in competitive motivation rather than competitive performance.

As discussed, testosterone is suggested to support mating effort in men. Previous research suggests that testosterone may fluctuate independently of relationship/parental status in men with extra-pair interests (Anders et al., 2007; Edelstein et al., 2011, 2014; Mcintyre et al., 2006). This is consistent with life history theory, indicating mating effort remains elevated in men despite having secured reproductive resources, consistent with a faster mating strategy. Study three therefore suggested that, consistent with previous testosterone research, competitiveness, as the hypothesised behavioural indicator of mating effort, would also remain high in men who indicated they had extra-pair interests (Hypothesis 5). Two measures were used to indicate mating strategy, the ExPI and the discrepancy between perceived own partner mate value (RMV). Positive relationships were expected between measures of mating strategy and competitiveness in men, however there were no notable relationships at all.

There was a slight notable relationship was between post-task competitiveness and ExPI scores in men, however this was negative which was unexpected. There are three potential reasons for the lack of support for hypothesis five. The first is that the indicators of mating strategy (RMV and ExPI) perhaps do not accurately measure mating strategy. However, RMV is a relatively well established measure and appeared to be reliable in the current study, though perhaps more useful in women. This criticism may be more relevant to the new ExPI; further research is required to inform this. Conversely, it may be that the behavioural measures of competitiveness in study three are not accurate indicators of mating effort; potential flaws in these measures will soon be discussed. The third potential reason is that these hypotheses were theoretically informed, and the supporting empirical evidence was predominantly endocrinological. Examining fluctuations in testosterone as a facet of mating effort provides a less biased measure of reproductive effort that cannot be consciously attenuated, however the corresponding behavioural facet can. A relationship maintenance adaptation has been hypothesised, where committed men actively derogate extra-pair opportunities to protect the primary relationship (Bazzini & Shaffer, 1999; Simpson, Gangestad, & Lerma, 1990). If this were the case in the current study, it may be that mating-motivated men in relationships *actively* reduce their mating behaviours in order to conceal their mating effort. However, relationship maintenance is only relevant to men who are committed to their relationships, for whom mating behaviours would incur costs. Nevertheless, this theory would suggest higher relationship commitment would be shown by low ExPI scores and competitiveness, but there were no relationships between RMV and ExPI with any measure of competitiveness.

Although the results from the current study provide some support for the evolutionary account of competitiveness, there are additional flaws in the study which must be discussed. Examining variation in competitive performance due to sex and relationship/parental status can be informative to an extent, but performance is limited genetic fitness. Measures of competitive performance therefore does not allow us to examine variation in behavioural indicators of reproductive energy in less fit individuals. Competitive performance, as a costly signal, cannot be faked by less fit individuals however less fit men should still be motivated to pursue reproductive resources though their success would be fitness dependent. The current research suggests the motivation to secure reproductive resources is universal in men, therefore it is vital to be able to examine this regardless of success in competition. Competitive performance may therefore not be an optimal reflection of how motivated a man is to engage in mating effort. Arguably, Miller (1999) and Kanazawa

(2000, 2003) examined competitive motivation by considering the number of cultural displays produced rather than the quality of them. For these reasons, it had been expected that there would be a sex-differentiated effect of relationship/parental status on competitive motivation in the current study. Instead, there was a sex difference in the performance of single participants, and an effect of mating effort on the competitive performance of men. It is suggested that the competitive task may need changing in order to provide a more appropriate measure of competitive motivation. Specifically, the rate of shape presentation (one-per-second) may be too long, resulting in more accurate performance on the game and fewer attempts made; the rate of shape presentation will therefore be reduced in study four to make successful performance on the game more difficult.

Cumulatively, the findings of the current study provide some support for the evolutionary theory of competitiveness by tentatively showing sex differences in competitive performance, and an effect of relationship/parental status in reducing competitiveness in men more so than in women. While socialisation accounts of competitiveness may be able to explain the effects of sex and mating effort on post-task competitiveness, it is less able to explain these effects on competitive performance. Further support for the evolutionary explanation of competitiveness would have been provided by an effect of sex and relationship/parental status on competitive motivation which was not evident the current study. This may be due to the rate of shape presentation in the competitive task chosen for this study, therefore adjusting this in study four may allow for a clearer analysis of competitive motivation rather than successful performance. The decrease in the competitive performance of men as they obtain reproductive resources supports the evolutionary explanation that trade-offs must be made in finite reproductive resources. Furthermore, this decrease in competitive performance demonstrates a cumulative effect of relationship and parental status on reducing competitiveness, consistent with previous testosterone research and life history theory.

Chapter 4. The Effect of Mating Effort and Mating Strategy on Testosterone Levels and Competitiveness in Men

4.1. Introduction

While there was evidence of relationship/parental status reducing competitiveness in men in study three, it was expected for this not to occur in women. A sex difference in competitiveness was only shown in single participants whereby single non-fathers scored more points on the game than single non-mothers. In accordance with costly signalling theory, it was expected that this effect would be evident in competitive motivation rather than successful performance. The competitive task was adjusted in study four to make successful performance more difficult to achieve. There were therefore four primary aims of study four. The first aim was to examine whether the adjustment would result in an effect of relationship/parental status on the competitive *motivation* of men rather than competitive *performance*. A second aim was to examine whether there was an effect of relationship/parental status on the testosterone levels of men. Thirdly the relationship between mating strategy and testosterone levels was explored. Finally, the study examined whether there was an effect of primed mating motives on the competitiveness of men.

The rationale presented in Chapter 3 was largely derived from endocrinological research which shows testosterone fluctuates congruently with the theoretical fluctuations in reproductive energy predicted by life history theory. Testosterone has therefore been labelled as the physiological correlate of mating effort (Ellison, 2001); it is typically higher in men with no reproductive resources to support mating effort, and lower in those with reproductive resources to encourage parenting effort. However there are more inconsistencies in the literature regarding the testosterone levels of men with *some* reproductive resources (such as committed non-fathers) (as discussed in Chapter 3, for example, Burnham et al., 2003; Perini, Ditzen, Fischbacher, Ehlert, 2012; Perini, Ditzen, Hengartner, Ehlert, 2012). Once resources are secured, the risk of maintaining mating effort increases (Grafen, 1990); reducing mating effort reduces the immediate risks associated with competition and encourages investment into offspring. In support of this, Storey et al. (2000) showed the testosterone levels of committed non-fathers reduced further during the transition from expectant to new father and Perini, Ditzen, Hengartner and Ehlert (2012) found new fathers reported increased tenderness in their committed relationships. Reduced tenderness has been implicated in maintaining elevated testosterone levels in men in committed relationships (Edelstein et al., 2014). This supports the evolutionary account of testosterone fluctuations discussed in Chapter 1, suggesting testosterone fluctuates to adaptively promote reproductive success by encouraging mating behaviours in single men and reducing them in committed fathers. However, there is more variance in what may be perceived as an adaptive use of reproductive energy for committed non-fathers as they have some relevant reproductive resources (a partner) but they are yet to have offspring, which is central to gene propagation.

When considering the hypothesised spectrum of reproductive energy, which ranges from *mating* to *parenting* effort, committed non-fathers may allocate their reproductive energy at a more intermediary position on the spectrum than single non-fathers and committed fathers. This is because they have made progress toward gene propagation by attracting and retaining a mate, but they have not yet had offspring. Conversely, single non-fathers have yet to secure any resources, reflecting a ‘nothing to lose’ attitude to engaging in mating effort, and it is adaptive for committed fathers to provision their offspring to increase their reproductive success.

Committed non-fathers still have the potential to increase their reproductive success by abandoning their primary partner if they were able to secure a higher quality mate. The negative repercussions of this strategy would be quickly recovered due to the higher fitness variance of men. However committed non-fathers have still secured a partner, therefore they cannot fully engage in mating effort as they would stand to lose what they have secured. Burnham et al. (2003) found baseline testosterone levels of single men were significantly higher than committed non-fathers, who in turn had non-significantly higher testosterone than committed fathers (p = .058; effect sizes not provided and could not be calculated). Berg and Wynne-Edwards (2001) demonstrated significantly lower testosterone levels of committed fathers in comparison to a control group, however the control group consisted equally of single non-fathers and committed non-fathers, which could potentially be confounding. Storey et al. (2000) controlled for this and showed testosterone decreased further in committed fathers compared to committed non-fathers, consistent with Burnham et al.'s (2003) findings that testosterone levels decrease incrementally as reproductive resources are obtained.

Cumulatively, the research discussed provides a clearer understanding of the adaptive function of testosterone fluctuations in conjunction with the theoretical basis outlined in Chapter 1. Specifically, it appears testosterone is positively associated with mating behaviours which serves to secure reproductive resources and reduces to encourage provisioning. However, sometimes external indicators of an individual's mating effort, such as relationship and parental status, may be inconsistent with their mating strategy, as discussed previously. This means men must be sensitive to a range of internal and external cues in order to adaptively calibrate their reproductive effort, albeit unconsciously.

As discussed in Chapter 3, culture is an external factor which may affect reproductive effort. Social norms in modern western societies encourage men to provide some form of offspring provisioning, even if the parental relationship has broken down, which was highly unlikely in the ancestral environment. Likewise, there is cultural variation in the acceptability of seeking additional mating opportunities outside of a committed relationship. Gray et al. (2006) noted cultural differences in tolerance toward extra-pair mating. They suggested that people in China are more tolerant of mated-men pursuing extra-pair opportunities until becoming fathers, therefore it is quite typical for committed non-fathers to retain testosterone levels comparable with those of single men in order to support mating behaviours (Gray, 2003; Gray et al., 2006). Conversely, western populations are much less tolerant of men pursuing extra-pair mating opportunities regardless of offspring presence, therefore incremental decreases in testosterone are more typical (Anders & Watson, 2006a; Booth & Dabbs, 1993; Burnham et al., 2003; Gray et al., 2002; Gray et al., 2004; Mazur & Michalek, 1998). The findings of Maestripieri, Klimczuk, Traficonte, and Wilson (2014) supported the role of culture in influencing variation in mating effort; they found mated Asian-American men tend to have more extra-pair interests and higher testosterone levels than typical of mated men. Evidence also suggests that culture influences variation in men's testosterone and parenting behaviours. In societies where father-offspring involvement is encouraged, involved-fathers have lower testosterone than less involved fathers (Gettler, McDade, Agustin, Feranil & Kuzawa, 2011; Gettler et al., 2012; Muller, Marlowe, Bugumba, & Ellison, 2009). This provides further evidence for the individually adaptive nature of reproductive energy in response to relevant external cues.

This thesis refers to reproductive energy as both testosterone levels and testosterone-supported behaviours, including competitiveness. Therefore, competitiveness is expected to fluctuate congruently with testosterone to support an adaptive mating strategy. As discussed, testosterone is typically higher in single men, lower in committed fathers, but there is more variance in committed non-fathers. Further research shows committed men maintain testosterone comparable to single men if they remain motivated to secure more reproductive resources (Anders et al., 2007; Edelstein et al., 2011; 2014, Farrelly et al., 2015, Mcintyre et al., 2006). In light of the current theoretical basis, mating behaviours such as competitiveness should vary in the same way consistent with relationship/parental status and mating strategy.

Reproductive energy allocation is sensitive to both internal and external cues (for example, Buss & Shackelford, 1997; Ronay & von Hippel, 2010). For reallocation to occur, cues should be relevant to reproductive success, consistent with the challenge hypothesis. The challenge hypothesis suggests mating effort should increase when reproductive success could benefit either directly (by securing mating opportunities) or indirectly (by defending their status) (Archer, 2006). Endocrinological research supports this, for example testosterone increases significantly in men following exposure to a potential mate compared to men in control groups (Meij, Buunk, & Salvador, 2008; Ronay & von Hippel, 2010; Roney et al., 2003; Roney et al., 2007), and in response to status threats (Archer, 2006 provides a review of this supporting literature). As mating effort is costly, particularly as reproductive resources increase, men with reproductive resources should be less responsive to extra-pair opportunities, only to status threats. Fales et al. (2014) demonstrated that among committed men, testosterone levels only increase in response to a status threat when their partner is fertile. Behavioural evidence also supports the challenge hypothesis in humans; aggression in men increases following exposure to mating-motives or status-threat primes (Ainsworth & Maner, 2012; Griskevicius et al., 2009). Aggression is not typically perceived as attractive to women (for example, Kruger & Fitzgerald, 2011), therefore it would be counterintuitive for aggression to increase to secure mating opportunities. Ainsworth and Maner (2012) showed aggression in men only increased following exposure to mating motives when dominance over a rival could not be achieved non-aggressively. Cumulatively, this provides evidence for the contextually sensitive and highly plastic nature of mating behaviours in men; following exposure to cues relevant to reproductive success, men increase dominance striving behaviours by taking more risks (Greitemeyer, Kastenmüller, & Fischer, 2012; Ronay & von Hippel, 2010; Wilson & Daly, 2004) and being more sensitive to items that will ultimately increase their reproductive success (Janssens et al., 2010). Consistent with this process being individually adaptive, mated men may sometimes unconsciously perceive reproductive success could benefit by maintaining mating effort. Frankenhuis and Karremans (2012) showed single men matched their behaviours to what they believed women perceive to be attractive whereas in mated men, the degree to which they matched their behaviours was dependent upon their level of commitment to the relationship. Men who were less committed to their relationship increased their frequency of mating behaviours whereas men committed to their relationships actively reduced behaviours perceived as attractive to women. It was suggested that men committed to their relationships engage in relationship maintenance by derogating alternative mating opportunities (Maner, Rouby, & Gonzaga, 2008; Miller & Maner, 2010). This supports the suggestion that men who unconsciously perceive they have acquired appropriate reproductive resources should have reduced responsiveness to mating opportunities.

Evidence suggests men have been sexually selected to adaptively regulate their baseline of mating effort (both physiological and behavioural) in response to relevant cues. The current study aimed to test five hypotheses; there will be a difference in testosterone levels of due to relationship/parental status where single non-fathers will have higher levels than committed non-fathers who in turn will have higher levels than committed fathers (Hypothesis 1). There should be congruent differences in competitive motivation (the number of attempts made on the game and self-reported feelings of competitiveness after the game) due to the theoretical positive association with testosterone (Hypothesis 2). This effect of relationship/parental status should be evident in the behavioural measure of competitive motivation, not competitive performance, following the increase in the rate of shape presentation consistent with costly signalling theory. Testosterone should predict competitive motivation (number of attempts made and post-task competitiveness; Hypothesis 3). Mating strategy (ExPI scores) is expected to predict competitive motivation (Hypothesis 4); RMV was not included in study four as the results of study three suggested it was more relevant to a female sample, which was also found by Buss and Shackelford (2007). Finally, exposure to mating-motive primes similar to those used previously (for example, Baker & Maner, 2008; Greitemeyer et al., 2012; Griskevicius et al., 2007; Griskevicius, Cialdini, & Kenrick, 2006; Wilson & Daly, 2004) will increase competitive motivation compared to those in a control condition (Hypothesis 5).

4.2. Method

4.2.1. Participants

Participants were 174 heterosexual men aged 16-59 years old (*M* = 23.57, *SD* = 6.85). Participants were randomly allocated into one of two priming conditions, the experimental (mating-motives) condition (*n* = 93) and the control condition (*n* = 81). Participants received a £5.00 high street voucher for participation; students additionally received partial course credit.

4.2.2. Design

There were two independent variables in the experimental between-subjects aspect of study four; relationship/parental status on four levels, (single father, single non-father, committed non-father, committed father) and priming condition on two levels (experimental mating motives, control). There were four dependent variables; the number of attempts made on the game and post-task competitiveness on a 1 (*low*) to 9 (*high*) rating scale (competitive motivation), the score obtained in the game (competitive performance) and testosterone levels measured in picograms per millilitre. There were five variables in the correlational aspect; scores on the ExPI, number of attempts made, post-task competitiveness, score, and testosterone levels.

4.2.3. Apparatus and Materials

Mating-motives primes in previous research involved showing participants photographs of attractive women, asking them to select the one they found most attractive, and writing about their ideal first date with her. Participants in the control condition undergo a similar exercise but void of sexual connotation to avoid activating a mating mind-set (Griskevicius et al., 2006). Before proceeding with study four, suitable stimuli was required for this process, described in section 4.2.3.1.

4.2.3.1. Development of the mating-motives prime. Seven males aged 19-39 years took part in a pilot study to develop a mating-motive prime similar to those used previously (for example, Greitemeyer, Kastenmüller, & Fischer, 2012;

Greitemeyer, 2007; Griskevicius, Cialdini, & Kenrick, 2006; Mcalvanah, 2009; Wilson & Daly, 2004). Twenty-five photographs of young female faces were procured from various freely available and non-copyright online sources, such as dating websites and Instagram, as previous research had done. Participants privately rated the attractiveness of each photograph on a Likert scale of 1 (*low*) to 10 (*high*). The mean rating was calculated for each image and the six photographs with the highest ratings (5.75 – 7.25) were used in study four (see Appendix 4.A).

4.2.3.2. Priming methods. Participants viewed all six photographs simultaneously, selected, and wrote about their ideal first date with that person. Participants in the control condition saw a picture of a street and were asked to write about the ideal weather conditions to explore the street in. There was no specified length or timeframe for this writing task.

4.2.3.3. Circles and squares game. The competitive task used in study four is the same as that used in study three but with an adjustment made to the rate of shape presentation. In study three, shapes were presented at one-per-second; it is now one-per-0.5 second. The procedure and aims remain the same as in study three with the shape disappearing if not correctly clicked to maintain the new timeframe of shape presentation.

4.2.3.4. Testosterone samples. Salivary samples were taken to measure the concentration of circulating testosterone. Blood serum measures are considered the gold standard in accuracy and reliability, however they are less accessible because specialist training is required to be able to take blood samples. Arreggar, Contreras, Tumilasci, Aquilano and Cardoso (2007) report salivary samples of testosterone correlate with serum levels above .9, and Liening, Stanton, Saini and Schultheiss

(2010) report salivary testosterone measures are stable and reliable. Saliva samples can be taken via passive drool or a ‘collection pillow’. Passive drool salivary samples are suggested to be more reliable than a ‘collection pillow’ followed by centrifugation (Bloomer, 2015), therefore the current research used the passive drool collection method. Samples were provided in 2mL polypropylene tubes and refrigerated after participation was complete, then stored at -20°C within 24 hours. Salivary testosterone was analysed in duplicate using enzyme-linked immunosorbent assays according to the manufacturer’s instructions (Salimetrics, Suffolk, England). Intra and inter coefficients of variation were ≤ 10%. The raw data are shown in Appendix 4.B. Inadequate samples were excluded from analysis (n = 5).

4.2.3.5. Additional materials. The study was conducted on IPads. Demographic information, including age, nationality, education, relationship and parental status (Appendix 4.C), was collected. Participants completed the ExPI (Appendix 2.A) as a measure of mating strategy. Additional materials included serviettes and Trident® sugar free gum, as individuals can have difficulty in producing saliva for the passive drool collection method. The reliability of some salivary hormones is compromised by using gum, but not testosterone (Schultheiss, 2013).

4.2.4. Procedure

Time of participation was not controlled for; all samples were taken between 10.00am and 7.00pm. Before entering the laboratory, participants were randomly assigned to the experimental or control condition via coin-toss and the relevant condition was preloaded onto the iPad. Participants were seated in a private booth, shown the study information (Appendix 4.D), then provided consent (Appendix 4.E). Participants chewed Trident® sugar free gum for 15-30 seconds prior to providing

5ml of saliva. After collection of the sample, the researcher left the booth in order for the participant to proceed with the online section of the research.

In both conditions, participants provided demographic information then completed six short psychometric measures; five measures related to other research and the ExPI. Participants viewed the leader board of the game, read the instructions, and selected their shape to play. They were then exposed to their prime and completed their writing task. Once they submitted their writing task, they were reminded of the shape they selected and the aim of the game, and to click ‘start’ when ready to play. The duration of the game was three minutes, then participants were asked how competitive the task made them feel. This completed participation; this was approved by the University of Sunderland Research Ethics Committee (Appendix 4.F).

4.3. Results

The final sample of participants was vastly reduced from the original 174. Participants who provided testosterone samples unsuitable for analysis (n = 5), and participants with testosterone levels outside of the acceptable range indicated by controls (n = 3) were excluded from all analyses. Technical issues with the programming of the competitive task resulted in the loss of 119 data sets. This left a low number of single fathers in the sample (n = 3), who were therefore excluded from analyses. This reduced the number of levels of the independent variable of relationship/parental status to three, as in study three. Single participants consisted of those who indicated they were single or casually dating, all other participants were considered to be in committed relationships. The final sample demographic characteristics (n = 59) are in Table 4.1, consisting of 29 participants in the experimental condition and 30 in the control condition. Ages range from 18-59 years

(M = 25.17, SD = 8.72). Details of the parametric assumptions and data analyses relating to each hypothesis will now be presented alongside the results.

Table 4.1. Sample demographic characteristics

		n	***%***
Relationship status	Single	26	44.07
	Casually dating multiple people	4	6.78
	Casually dating a single person	5	8.47
	Long term relationship	12	20.34
	Cohabiting	3	5.08
	Married	9	15.25
Parental status	No children	49	83.05
	Children	10	16.95
Nationality	British	54	91.53
	Other	5	8.47
Education level	Secondary/high school	4	6.78
	1+ year at college/university	39	66.10
	A university degree/diploma	7	11.86
	A postgraduate qualification	9	15.25

4.3.1. Hypothesis 1. Single non-fathers will have higher testosterone levels than committed non-fathers, who will have higher levels than committed fathers. Age could not be included as a covariate as the assumption of independence between relationship/parental status and age was violated (p < .001);

but there was no correlation between age and testosterone levels, r (57) = -.161, p = .222, and only three participants were over the age of 40 (the age at which testosterone levels are suggested to decrease) and the testosterone levels of these participants were within the appropriate range. This analysis proceeded with a one-way independent groups ANOVA, with relationship/parental status as a between-subjects independent variable on three levels, and testosterone as the dependent variable. The assumption of normality was violated (p = .005), but homogeneity of variance was met (F (2, 56) = .034, p = .712).

There was no effect of relationship/parental status on testosterone levels; F (2, 56) = 0.19, p = .824, η_p^2 = .007. The descriptive statistics are shown in Table 4.2, alongside Z-scores because testosterone was unusually high in the current sample. However, they were within the standards indicated by control samples, therefore testosterone variation in this sample can be considered valid.

Table 4.2. Descriptive statistics of baseline testosterone levels (picograms per millilitre) and z-scores

Relationship/Parental status	***M (SE)***	***M (SE) Z-Scores***
Single Non-Father	240.10 (15.08)	-0.11 (0.13)
Committed Non-Father	247.28 (23.86)	-0.05 (0.21)
Committed Father	224.54 (28.27)	-0.25 (0.25)
Overall	237.31 13.31)	-0.14 (0.12)

4.3.2. Hypothesis 2. Relationship/parental status will reduce competitive motivation (number of attempts and post-task competitiveness); single men will be more competitive than committed non-fathers, who will be more competitive than committed fathers. As the rate of shape presentation has

been adjusted, this will not be shown on competitive performance (score). A MANOVA could not be conducted on this data because score loaded onto a discriminant function greater than 1, therefore questioning reliability (Appendix 4.G). As discussed, the assumption of independence was violated between the independent variable and covariate, therefore an ANCOVA would not be reliable. Age correlated with the number of attempts made, r (57) = -.43, p = .001, with post-task competitiveness, r (57) = -.29, p = .027, and with score, r (57) = -.30, p = .019. The assumption of normality was met for the number of attempts made (p = .110), and score, (p = .246), yet was violated for post-task competitiveness, (p < .001). Analyses proceeded with a one-way ANOVA on each dependent variable. Homogeneity of variance was met for the number of attempts made, F (2, 56) = 0.47 p = .630, post-task competitiveness, F (2, 55) = 2.70 p = .076, and for score, F (2, 56) = 0.52 p = .597. People who chose to play squares (M = 43.40, SD = 13.08) scored significantly more points than those who played circles (M = 19.94, SD = 6.19), t (53.50) = 9.29, p <.001, d = 2.54, as expected. However there was no effect of shape choice on the number of attempts made in the game, t (57) = 0.38, p =.709, d = 0.10, or on post-task ratings of competitiveness, t (57) = 0.77, p =.447, d = 0.20.

There was a non-significant effect of relationship/parental status on the total number of attempts made on the game, F (2, 56) = 2.60, p = .083, η_p^2 = .085. The descriptive statistics, shown in Table 4.3, indicates single non-fathers made the most attempts on the game and committed fathers made the fewest attempts on the game. The effect size is reasonable (Cohen, 1988) indicating power was low due to the small sample size of committed fathers in particular. An independent t-test was conducted to compare the number of attempts made by single non-fathers and committed fathers, t (43) = 1.99, p = .053, d = 0.61, which supports this suggestion.

There was no effect of relationship/parental status on post-task competitiveness, F (2, 55) = 1.32, p = .276, η_p^2 = .046; or on score, F (2, 56) = 1.54, p = .223, η_p^2 = .052. The descriptive statistics are also shown in Table 4.3.

Table 4.3. Mean (and standard error) of the number of attempts made on the competitive game.

Relationship/Parental status	***Number of Attempts***	***Post-Task Competitiveness***	***Score Obtained***
Single Non-Father	265.56 (8.97)	7.17 (0.28)	38.03 (2.62)
Committed Non-Father	242.29 (14.17)	6.36 (0.44)	40.00 (4.14)
Committed Father	226.10 (16.77)	6.67 (0.55)	29.40 (4.90)
Overall	244.75 (7.91)	6.73 (0.25)	35.81 2.31)

4.3.3. Hypothesis 3. Testosterone will predict variation in competitive motivation (the number of attempts and post-task competitiveness) but not competitive performance. Three simple linear regression analyses were conducted with testosterone as the predictor variable in each analysis and each measure of competitiveness, the total number of attempts made on the game, post-task competitiveness, and score, as outcome variables.

Testosterone levels did not significantly predict the number of attempts made on the game (t = 0.22, p = .824); post-task competitiveness, (t = 0.20, p = .846); or competitive performance, (t = -0.39, p = .701). Neither model was significant; attempts, F (1, 57) = 0.50, p = .824, post-task competitiveness, F (1, 56) = 0.38, p = .846, or score, F (1, 57) = 0.15, p = .701. Coefficients are in Table 4.4.

Table 4.4. Coefficients of the influence of testosterone levels on measures of competitiveness.

Measure		B	*SE* B	β
Number of Attempts*	**Constant**	249.15	20.86	
	Testosterone	0.02	0.08	0.03
Post-Task Competitiveness**	**Constant**	6.78	0.65	
	Testosterone	<0.01	<0.01	0.03
Score***	**Constant**	39.20	5.98	
	Testosterone	< - 0.01	0.02	- 0.05

Note: *R^2 = .03 (*p* = .824); ** R^2 = .01 (*p* = .846); *** R^2 = .03 (*p* = .701)

4.3.4. Hypothesis 4. Mating strategy (ExPI score) will predict competitive motivation (number of attempts and post-task competitiveness) of mated men, but not their competitive performance (score). Three simple linear regression analyses examined this with the ExPI scores of committed men (*n* = 24) as the predictor variable in each analysis and each measure of competitiveness as outcome variables. ExPI scores significantly predicted the number of attempts made by mated men, $t = 2.38$, $p = .026$. The model was significant, F (1, 22) = 5.68, p = .026, and explained 20.5 percent of the variance in the data. The coefficients are in Table 4.5.

Table 4.5. Coefficients for the ExPI scores on the number of attempts made in the competitive game

	B	*SE* B	B
Constant	166.25	30.50	
ExPI score	3.74	1.57	0.45

Note: R^2 = .21 (*p* = .026).

ExPI scores did not significantly predict the post-task competitiveness, t = 1.01, p = .324; this model was not significant, F (1, 21) = 1.02, p = .324, explaining

4.6 percent of the variance in the data; the coefficients are in Table 4.6. ExPI scores significantly predicted score, t = 2.30, p = .031; this model was significant, F (1, 22) = 5.30, p = .031, explaining 19.4% of the variance in the date. The coefficients are in Table 4.7.

Table 4.6. Coefficients for the ExPI scores on post-task competitiveness

	B	***SE* B**	**Β**
Constant	5.17	1.36	
ExPI score	0.07	0.07	0.09

Note: R^2 = .05

Table 4.7. Coefficients for the ExPI scores on competitive performance

	B	***SE* B**	**Β**
Constant	14.55	9.59	
ExPI score	1.14	0.49	0.44

Note: R^2 = .19 (p = .031).

4.3.5. Hypothesis 5. Men exposed to a mating prime will be more motivated to compete than men in a control condition; but there will be no effect of prime on score. This was to be analysed in conjunction with relationship/parental status in a 2 (mating motivation prime) x 3 (mating effort) independent groups design on each measure of competitiveness. The loss of data due to technical failure meant this was not possible. Analysis of this hypothesis relied instead on pooling the data regardless of relationship/parental status to examine the influence of the mating primes.

An ANCOVA was then to be conducted on each dependent variable, the covariate and the independent variable were independent, F (1, 65) = 1.81, p = .183,

η_p^2 = .027, however the homogeneity of regression assumption was violated for the number of attempts made, *F* (2, 64) = 7.31, *p* = .001, η_p^2 = .186. This assumption was statistically for score, however the effect size was too large to proceed reliably with this analysis, *F* (1, 56) = 3.05, *p* = .055, η_p^2 = .098. Inspection of the scatterplots of age against total attempts made, and age against score (Appendix 4.H) revealed a slightly stronger negative relationship between age and number of attempts made in the experimental prime group than the control prime group. An independent *t*-test showed those in the experimental condition (*M* = 26.72, *SD* = 9.84) were non-significantly older than those in the control condition (*M* = 23.67, *SD* = 7.35), *t* (57) = 1.36, *p* = .181, *d* = 0.34. Two independent t-tests were conducted to examine whether there was a difference in the number of attempts made or the score achieved due to which prime participants were exposed to. The homogeneity of regression assumption was met for post-task competitiveness, *F* (2, 63) = 1.67, *p* = .196, η_p^2 = .050, therefore this analysis proceeded with a one-way ANCOVA.

There was no difference in the number of attempts made, *t* (57) = 0.21, *p* = .835, *d* = 0.05; or the score obtained, *t* (57) = 0.15, *p* = .882, *d* = 0.03, due to prime exposure. The covariate (age) significantly predicted post-task competitiveness, *F* (1, 55) = 5.35, *p* = .024, η_p^2 = .089. Once the effects of this were partialled out, there was no effect of condition on post-task competitiveness, *F* (1, 55) = 0.25, *p* = .620, η_p^2 = .005. The descriptive statistics are shown in Table 4.8.

Table 4.8. Mean (and standard error) for the measures of competitive motivation by condition

Condition	***Number of Attempts***	***Score***	***Post-Task Competitiveness***
Mating Motives	252.00 (11.29)	37.34 (3.01)	7.01 (0.31)
Control	255.00 (8.86)	36.73 (2.75)	6.78 (0.30)

4.4. Discussion

Study four tested five hypotheses derived from the evolutionary perspective of competitiveness in men discussed in Chapter 1. As the hypothesised physiological component of mating energy, it was suggested that there would be an effect of relationship/parental status on testosterone levels (Hypothesis 1), however this was not supported. It was also expected that relationship/parental status would reduce competitive motivation in men rather than their performance (Hypothesis 2); this was supported here. As indicators of reproductive energy, it was expected that both testosterone (Hypothesis 3) and mating strategy (ExPI score) (Hypothesis 4) would predict competitive motivation (rather than performance); while mating strategy did predict competitiveness, testosterone did not. Finally, consistent with the challenge hypothesis, it was expected that men would be more competitive following exposure to a mating motives prime than a control prime (Hypothesis 5); this was not supported. Hypothesis 5 will firstly be discussed, followed by hypotheses 1 and 3 as they rely on similar literature. Hypothesis 2 will then briefly be discussed (as this was discussed in Chapter 3), followed by hypothesis 4.

The challenge hypothesis suggests that reproductive effort should fluctuate in men to increase reproductive success in response to direct (mating opportunities) and indirect (status threats) cues. Therefore it was expected that men would be more competitive following exposure to mating primes than men in a control condition (Hypothesis 5), but this was not the case. There are three potential explanations for this. Firstly, measures of reproductive energy could not incorporated into this analysis which may have confounded the results. Men committed to their relationships have been known to engage in relationship maintenance by actively derogating alternative mates (for example, Frankenhuis & Karremans, 2012). In the current study, this would mean if participants in the mating-motives condition had reduced mating effort, their competitiveness may be consciously attenuated. Pooling the data regardless of relationship/parental status and/or mating strategy may have increased the variance in the competitiveness of each condition resulting in the apparent ineffectiveness of the primes.

Related to this is the second potential explanation for the lack of support for hypothesis five. Exposure to the experimental prime may have increased testosterone in participants because this is beyond conscious control (Loewenstein, 1996), but as testosterone only partially moderates mating effort (Mcintyre et al., 2006), competitiveness may have been consciously reduced. As discussed, men have been known to engage in relationship maintenance when committed to their relationships by attenuating mating behaviours. Furthermore, men following a faster strategy may have attenuated their competitiveness as the mating stimuli was artificial meaning there would be no potential to increase reproductive success. Following a fast strategy is risky and the risk increases as reproductive resources do, therefore mating behaviours should be sensitive to situations that will increase potential benefits (the likelihood of securing a mate) and minimise risk. The use of artificial stimuli to induce mating motives may not be an appropriate substitute for ecologically valid methods.

This leads onto the third potential explanation for the lack of support in the current study for hypothesis five - the artificial stimuli may not have been suitable. Previous research appears to have been successful in using the same priming method. Specifically, previous research has shown that men increase risk taking, conspicuous consumption, creativity, and conformity to female mate preferences (Baker & Maner, 2008; Greitemeyer et al., 2012; Griskevicius et al., 2007, 2006;

Griskevicius et al., 2012) following exposure to primed mating motives. Therefore the specific stimuli used in study four may not have been optimal. The six photographs used here were rated as 5.75-7.25 out of 10 for attractiveness, whereas those used by Greitemeyer et al.’s (2012) were rated as 8-10 out of 10 in attractiveness, and those rated as 5-6 out of 10 were classified as only moderately attractive. The current stimuli may therefore not be attractive enough to increase mating effort, particularly in an artificial setting. It would have been helpful to ask participants to rate the attractieness of their chosen individual, as in Wilson and Daly (2004), to assess this.

The involvement of testosterone in mating effort could also not be supported here; there was no difference in testosterone according to relationship/parental status (Hypothesis 1), and testosterone did not predict competitiveness (Hypothesis 3). Inspection of the means show testosterone levels in the current sample are generally higher than typically expected (for eample, Burnham et al., 2003; Farrelly et al., 2015; Gray et al., 2002), although they are within the ranges indicated by the standardised curves, indicating they are valid. One potential reason for the elevated testosterone levels in the current sample is the use of female experimenters. Previous research shows that men’s testosterone is significantly higher when tested by female, rather than male, experimenters (Ronay & von Hippel, 2010), and this extended into testosterone-dependent mating behaviours. Much research indicates single men increase mating effort following exposure to a potential mate (for example, Frankenhuis & Karremans, 2012; Janssens, 2011; Miller & Maner, 2011), however these studies specifically examined this using attractive women whereas the attractiveness of the experimenters in study four was not controlled or rated. Salivary samples were taken within 10-15 minutes of the participant entering the laboratory, which may be too quick for an external effect to be evident in saliva. However, research also suggests that mating motives can be induced in men when anticipating female interaction regardless of attractiveness (Nauts, Metzmacher, Verwijmeren, Rommeswinkel, & Karremans, 2012). Students who participated for course credit knew who the experimenters were, therefore it is possible that testosterone levels were increased prior to entering the laboratory resulting in elevated testosterone levels across the sample. Future research should not disclose the sex of the experimenter to maintain control of this. If the female experimenters were perceived by some participants as potential mating opportunities, it may have confounded the effect of the primes, further reducing experimental control.

Another point to consider is the potentially confounding influence of a mating strategy which is incompatible with relationship/parental status on testosterone levels. This may have increased the variance in testosterone levels being attributed to variation *within* each level of relationship/parental status rather than *between* each level. As discussed, the mean testosterone levels in the current sample were higher than those typically reported in testosterone research. Previous research suggests testosterone levels remain high in men with reproductive resources if they follow a faster mating strategy (Anders et al., 2007; Edelstein et al., 2011; Mcintyre et al., 2006). Therefore, not controlling for mating strategy may have increased the variance in the data, reducing the power to detect variation in testosterone levels due to relationship/parental status (Hypothesis 1). However, if this were the case, testosterone levels should have still predicted competitiveness in the current sample (Hypothesis 3), yet this was not the case here

Another potential reason for the lack of support for the role of testosterone in study four is how testosterone was measured. Some research suggests the change in testosterone from an individual's baseline to post-prime exposure may be a more informative way of assessing reproductive energy allocation. The current study aimed to sample participant's baseline testosterone levels, before exposure to anything which may have caused a deviation from it. However, testosterone is a fitness-dependent costly signal, which means testosterone levels can only elevate to a level which an individual legitimately can bear, therefore less fit men cannot experience the same elevations in testosterone as more fit men. This means an individual's baseline testosterone level may better reflect their genetic fitness rather than their mating effort. Calculating the *change* in fluctuating testosterone levels from pre- to post-prime exposure as a percentage may therefore be a better indicator of mating effort (Carre et al., 2009; Roney et al., 2003; Roney et al., 2007). This would demonstrate the proportionate change in testosterone levels from baseline independent of genetic fitness, with a larger increase in testosterone levels indicating more mating effort than someone who experiences a smaller increase, or even a decrease which may indicate relationship maintenance.

Despite the generally higher mean testosterone levels in this study, there were small incremental decreases in testosterone levels from single non-fathers to committed non-fathers and committed fathers. This is consistent with the suggestion that testosterone levels will decrease in men as reproductive resources are secured (Hypothesis 1). It is therefore possible that study four did not have sufficient power to detect significant findings due to the small sample size, particularly of committed fathers (n = 10), which has been highlighted as problematic in previous research (for example, Burnham et al., 2003). However, the effect sizes in study four were also low, suggesting this is not due to insufficient power. Indeed, it is possible that the small decrease in testosterone levels is not an effect of relationship and parental status, but is instead an artefact of the generally older age of the committed fathers, reflecting an age related decrease in testosterone (Charlton, 2004; Uchida et al., 2006).

The measures of competitiveness did vary with relationship/parental status (Hypothesis 2) consistent with the suggestion that competitiveness is a behavioural form of mating effort, and furthermore, mating strategy predicted competitiveness (Hypothesis 4). The effect of relationship/parental status on competitive motivation (the number of attempts made in the competitive task) was not significant but had a medium effect size (Cohen, 1988) suggesting power was too low to detect a significant effect. This effect was also more substantial than the effect on competitive performance (the score obtained on the game), suggesting the increase of shape presentation on the game was justified. Inspection of the mean number of attempts showed an incremental decrease in competitive motivation from single non-fathers to committed non-fathers then committed fathers. This was in the hypothesised direction, consistent with previous testosterone research (for example, Burnham et al., 2003) despite the current study not replicating this. Furthermore, as the current study seems to lack power, the results of analysis of hypothesis two can only support a meaningful decrease in competitive motivation from single non-fathers to committed fathers. The competitive motivation of committed non-fathers was intermediate in comparison, but the current results cannot support this being due to relationship/parental status. These results also indicate that a man's *motivation* to compete is a better indication of mating effort rather than success in competition, which then reduces as reproductive resources are obtained consistent with the evolutionary framework outlined in Chapter 1; unless additional mating opportunities are desired (Hypothesis 4).

The current study has also supported the suggestion that competitiveness in men will remain elevated regardless if following a fast mating strategy (Hypothesis 4). This is consistent with previous endocrinological research (for example, Anders et al., 2007; Edelstein et al., 2011; Mcintyre et al., 2006) despite study four not providing corresponding endocrinological support. Competitive motivation is argued to be a more suitable indicator of a man's mating effort than competitive performance, therefore it was hypothesised that ExPI scores would best predict competitive motivation. Although this was supported here, the ExPI only predicted competitive motivation 1.1 percent more than competitive performance. While greater competitive motivation may lead to a higher score, successful performance is also fitness dependent. Therefore, as ExPI also predicted score, this suggests fitter men are more likely to pursue a fast mating strategy. This is further supported by there being no effect of relationship/parental status on competitive performance but there was on competitive motivation. Consistent with this is the suggestion in the literature that higher mate value men are more likely to pursue a faster mate strategy then lower mate value men (for example, Buss & Shackelford, 1997). Finally, there was no influence of relationship/parental status or mating strategy (ExPI scores) on post-task competitiveness in the current research. This supports the use of behavioural indictors of competitive motivation rather than self-ratings which, as discussed in Chapter 3, can be easily biased.

In conclusion, the results of study four support the suggestion that the competitive motivation reflects mating effort in men which decreases as reproductive resources increase unless following a fast mating strategy. There was no effect of mating effort on competitive performance, although this was predicted by mating strategy, consistent with the suggestion that success in competition may be a better indicator of fitness than mating effort. As this study used a male only sample, it remains to be seen whether this effect will be sex-differentiated, as predicted by the theroetical basis discussed in Chapter 1. The effect of relationship/parental status on competitiveness in study three was not consistently sex-differentiated, however study four has adjusted the competitive task, therefore study six (reported in Chapter 5) will examine this again.

There was no support for the influence of primed mating motives on competitiveness. The most plausible reason for this is due the stimuli in study four not being suitable to increase mating motives as they were only rated as moderately attractive. The impact of an audience on competitiveness will therefore be reexamined in studies five and six (both reported in Chapter 5) by using a ‘real’ audience (study five) and by varying the attractiveness of artificial stimuli (study six). Furthermore, in study four a lot of data was lost meaning mating motives could not be analysed in conjunction with relationship/parental status, therefore the lack of suitability of the current priming materials cannot be claimed confidently. It was expected that exposure to the mating-motives would interact with relationship/parental status, therefore this will be exaimined in studies five and six. This will provide clearer evidence regarding the suitability of the stimuli in study four, and clarify what conclusions can be drawn from the challenge hypothesis as applied to humans.

Finally, the results of this study could not support the hypothesised role of testosterone as a facet of mating effort. The most logical reason for this is due to the higher than usual levels of testosterone among the current sample, increasing the variance *within* groups and decreasing the variance *between* groups; however the behavioural evidence reported here does support previous endocrionological research. This then suggests that testosterone as a facet of mating effort cannot be consciously attenuated (Loewenstein, 1996), but mating behaviours can because competitive motivation differed due to mating effort and was predicted by mating strategy. This provides further support for the suggestion that mating effort is individually callibrated adaptively via relevant cues.

Chapter 5. Audience Effects on Competitive Behaviour

5.1. Introduction

Chapter 5 reports two studies both with the aim of examining the impact of an audience on competitiveness. There is tentative support in studies three and four for a reduction in the competitiveness of men as reproductive resources are gained. Study four supports the suggestion that competitiveness serves mating effort in men, but further support for the evolutionary perspective of competitiveness would come from evidence of fluctuations in competitiveness when an audience is present consistent with the challenge hypothesis. Studies five and six use both male and female participants to examine this in a natural-field task (study five) and in a variation of the circles and squares game (study six).

Previous accounts of the impact of an audience on competitiveness have neglected the evolutionary perspective. Social facilitation, where the presence of others appears to increase an individual's competitiveness, is the earliest, most prominent theory of the impact of an audience on competitiveness (Allport, 1924; Strauss, 2002; Uziel, 2007). Zajonc (1965) proposed the drive theory accounted for social facilitation, suggesting the presence of others increased physiological arousal due to apprehension of being evaluated (Cottrell, Wack, Sekerak, & Rittle, 1968), or engaging in social comparison (Festinger, 1954) increases competitiveness. This account fails to explain *why* individuals evaluate one another or *why* this leads to apprehension. A modification to the drive theory suggested physiological arousal occurs because it allows us to monitor others in the environment, which is adaptive as they may impact survival in the ancestral environment (Zajonc, 1980). While this modification is more inclusive of the evolutionary perspective, it is implicit and lacks a specific theoretical framework. Its focus is on *survival* in the evolutionary environment, implying that social facilitation has been naturally selected, but survival in the ancestral environment was secondary in achieving reproductive success. The modification to drive theory does not consider *sexual selection*.

Guerin and Innes (1982) and Guerin (1983) attempted to incorporate sexual selection into the uderstanding of social facilitation in competitiveness. They suggested the increased physiological arousal is to monitor others in the environment who may impact on reproductive success. This modification of drive theory is much more consistent with the evolutionary account of competitiveness however it is underdeveloped, perhaps because evolutionary psychology was in its infancy at this point. It does not consider the impact of parental investment theory and therefore overlooks sex differences in adaptive mating strategies. Men must compete for reproductive resources, and as these behaviours are costly, they should only occur when the signal will be received (Griskevicius et al., 2007; Smith & Bliege Bird, 2000). Evidence from the challenge hypothesis supports this; testosterone increases in males when reproductive success can benefit either directly or indirectly. This is also supported by sperm competition theory as cues of sperm competition lead to increases arousal and ejaculate quality (Pound, 2002). In accordance with the framework of evolutionary theories discussed in Chapter 1, it is suggested that social facilitation occurs to aid reproductive success by increasing mating behaviours when an audience is present if they are perceived as either potential mating opportunities or rivals to an individual’s status.

Much research conducted into the influence of an audience on competitiveness has examined the effect on competitive *performance* rather than competitive *motivation* which, as discussed, may not be an optimal indicator of mating effort. An audience should encourage reproductive energy allocation (testosterone mating behaviours) toward mating effort to encourage dominance behaviours regardless of how successful this is. However, evidence of the impact of an audience on competitive motivation does not exist, therefore the literature reviewed in this chapter relies on the risk taking literature, as well as on endocrinological evidence. Risk taking is a costly form of mating effort (Fischer & Hills, 2012; Wilson & Daly, 2004) and is measured as a *frequency* of risk taking rather than the success or quality of the risk. This is analogous to the motivation to compete; one must take a risk in order to compete, which is independent of success in the competition.

The challenge hypothesis suggests mating effort increases in response to cues which may affect reproductive success, specifically the presence of potential mates or rivals. This has been supported in men, for example Hellhammer, Hubert, and Schurmeyer (1985) showed testosterone increased after watching erotic or sexual films because this activates a mating mind-set, but testosterone does not increase after watching aggressive, stressful, neutral or comedy films. Ronay and von Hippel (2010) provided evidence of an increase in testosterone as well as risk taking in men following exposure to an attractive female confederate in a natural-field experiment involving skateboarders. This provides evidence for the adaptive, unconscious calibration of mating effort in men due to cues relevant to reproductive success. This was not supported in study four, however when this is considered in the context of previous research, it is likely due to methodological limitations. Both Ronay and von Hippel (2010) and Hellhammer et al. (1985) measured the impact of mating motives on testosterone levels which are beyond conscious control (Loewenstein, 1996) whereas study four measured the effect on competitivness, which is consciously accessible. This means participants may have consciously attenuated their competitiveness following exposure to a prime whereas it would not be possible to control testosterone. Furthermore, the stimuli in study four was not optimal to induce mating motives in men, either because it was artificial and/or it was not attractive enough. Ronay and von Hippel (2010) used a physically present confederate who had been pre-rated as highly attractive to induce mating motivation among participants, and although the study reported by Hellhammer et al. (1985) used artificial stimuli, it was sexually explicit. These factors would have a much stronger impact on mating effort than the photographs used in study four.

Further research examining the challenge hypothesis in humans has shown men experience significant increases in testosterone after an interaction with a young woman, and a non-significant increase following an interaction with a young man (Roney et al., 2003). Archer (2006) interpreted this as support for the challenge hypothesis as the young woman may directly impact reproductive success as a potential mate, whereas a man would only indirectly impact on reproductive success as he may or may not be perceived as a rival. Therefore there should be more variance in responding to male audiences than female audiences. This was supported by Ermer et al. (2008) who found risk taking in men only increasing when a male in the environment was perceived as a status threat. Archer (2006) suggested the inclusion of a control condition, where no interaction takes place, would help clarify these findings. Roney et al. (2007) examined the influence of a brief interaction with either a young man, a young woman, or no interaction on men’s testosterone levels and reported significant increases only after interacting with a young woman. The results of Frankenhuis, Dotsch, Karremans and Wigboldus (2010) were consistent with this interpretation. In their research, Frankenhuis et al. (2010) examined male risk taking in a virtual environment with two observers present, one within the virtual environment and an experimenter who was physically present in the room where participation took place. Men only took more risks when both observers were female, consistent with the suggestion that men should be more sensitive to a female audience than a male audience. When the virtual observer was female but the physical observer was male, men took fewest risks, which Frankenhuis et al. (2010) interpreted as evidence of participants yielding to the male observer. Cumulatively, this research supports the evolutionary perspective of fluctuations in competitiveness, indicating men should only engage in mating behaviours when the signal will be received to the extent the receiver may impact on reproductive success. This sensitivity in signalling helps maintain signal efficiency by reducing associated costs. This evidence indicates mating behaviours are more likely to be increased when females will receive the signal as there is more certainty about their potential impact on the signaller's reproductive success, in comparison to a male audience, who may or may not be perceived as a status threat.

Further research supporting the challenge hypothesis in humans shows sex differences in the response to mating cues consistent with the current theoretical framework. Using the same priming method as study four to activate a mating mind-set, Greitemeyer et al. (2012) showed men increased their their risk taking behaviours but women did not, a sex difference which did not occur in the control condition. Wilson and Daly (2004) provided similar results, and additionally showed an effect of attractiveness on risk taking. Here, participants rated the attractiveness of men and women in a selection of photographs. Men increased their risk taking behaviours after viewing photographs of attractive women but not after viewing unattractive women, whereas there was no effect of this on women's risk taking (Wilson & Daly, 2004). Gerdes and Gränsmark (2010) demonstrated similar findings in the game strategy of chess players. Male chess players opened with more risky moves when playing a female opponent despite this impeding their performance, yet this did not occur with same-sex opponents or in female chess players. Dreber, Gerdes, and Gransmark (2013) further analysed this effect and showed male chess players only opened with more risky moves when their female opponents were attractive; again this effect was not evident in female players. This research supports the application of the challenge hypothesis in humans, indicating men are more responsive to cues affecting their reproductive success.

The research discussed here supports the challenge hypothesis in humans by demonstrating a sex-differentiated effect of environmental cues on reproductive energy. It is therefore suggested that the presence, sex, and attractiveness of an audience will also show a sex-differentiated effect on competitiveness. Studies three and four have provided evidence in support of the challenge hypothesis by demonstrating competitiveness reduces in men as reproductive resources are gained indicating reduced mating effort. The research discussed here suggests risk taking as a form of mating effort varies in response to an audience consistent with predictions made by the challenge hypothesis and costly signalling theory. It is therefore suggested that there will be similar effects of an audience on competitiveness.

There is an important difference to be considered when examining the evolutionary perspective of fluctuations in risk taking and competitiveness, which is that risk taking in men is not always perceived as attractive to women. Women are more risk-averse than men due to their larger obligation to offspring (Fischer & Hills, 2012). In the ancestral environment, there was a greater risk to offspring survival without maternal provisioning in comparison to paternal provisioning. Women perceive risk taking in men as attractive in short-term mating contexts but unattractive in long-term mating contexts (for example, Kruger & Fitzgerald, 2011; discussed in Chapter 8). Research suggests that men adjust their behaviour consistent with women's perceptions of what is attractive, depending on their own mating strategy (Frankenhuis & Karremans, 2012), indicating there may be more variance in male risk taking as a form of mating effort. This distinction can be likened to aggressive displays of mating effort; overt aggression in men may be optimal in intrasexual scenarios but, as it is not perceived as attractive in a long-term mating context, overt aggression would therefore be less effective in an intersexual display than covert aggression (Matos & Schlupp, 2005). Evidence for this comes from Ainsworth and Maner (2012), who found men responded more aggressively to a same-sex partner in a competitive interaction than an opposite-sex partner following activation of a mating mind-set, whereas there was no variation in women's responding. As the current study examines mating effort in terms of competitiveness without physical risk, there should be no uncertainty in how attractive this would be perceived as a mating behaviour. This should show men are more competitive for a female audience than a male audience as there is less variance in the perception of women as potential mates, but more variance in the perception of men as potential threats.

A flaw in study four was the ineffectiveness of the primes. It was suggested that as there is such strong evidence for the challenge hypothesis in humans, that this was because the use of artificial stimuli was not a suitable substitute for observers who were physically present during participation in the competitive task. Therefore, study five uses a natural-field competitive task (rod balancing) to explore the influence of physical observers on competitiveness. Rod balancing involves individuals balancing a wooden dowel on one finger with the aim of balancing the rod for as long as possible. It was selected as an appropriate task here as it fulfils the criteria of a behavioural measure of competitiveness (discussed in section 2.2); primarily, it is novel and not reliant on any previous skills or experience. It was also suggested that, because there is evidence for the success of the method of priming mating motives used in study four, that the specific stimuli used in study four was not attractive enough to increase mating behaviours. For this reason, study six uses the online competitive task (the circles and squares game) but varies the presence, sex, and attractiveness of the audience. As the two studies reported in this chapter rely on new measures of mating effort (the circles and squares game and the rod balancing task), more evidence is required to validate them, therefore the effect of external indicators of mating effort was explored again.

Five hypotheses were tested in Chapter 5. Men were expected to be more motivated to compete than women in both the rod balancing task (study five) and the online task (study six), as evidenced by the number of attempts made on each task. Because men should engage in mating effort regardless of their success, there should be no effect of sex on competitive performance in either competitive tasks (Hypothesis 1). Relationship/parental status should reduce men's competitiveness in both tasks, so single non-fathers should be more competitive (both competitive motivation and performance) than committed non-fathers and committed fathers, and this effect will not be evident in women (Hypothesis 2).

The studies reported in this chapter also tested three new hypotheses. In study six (as study five had no control condition), men will be more competitive than women when an audience is present compared to no audience present. It is also expected that in both tasks, men will be more competitive for a female audience than a male audience (Hypothesis 3) because women have a greater potential impact on men's reproductive success than men do. Furthermore, in study six, an attractive audience should increase men's competitiveness more than an unattractive audience as they are more likely viewed as potential mates; again this effect should not be evident in women (Hypothesis 4). Finally, because male mating behaviours are individually adaptive, relationship/parental status will interact with audience presence and sex. Single non-fathers should be more competitive than committed non-fathers and committed fathers in the presence of an audience compared to no audience (the online task), and particularly so when the audience was female rather than male (both the rod balancing task and the online task) (Hypothesis 5).

5.2. Method: Rod Balancing (Study Five)

5.2.1. Participants

An opportunity sample of 250 heterosexual participants were recruited; 120 men (aged 16-40; M = 23.15, SD = 5.86) and 130 women (aged 16-43; M = 21.98, SD = 6.21). This included both student and non-students who participated for no incentive.

5.2.2. Design

This was an independent groups design with three independent variables. The first was participant sex, and the second was audience sex, both on two levels (male, female). The third independent variable was relationship/parental status on four levels; single non-parent, single parent, committed non-parent and committed parent. Two dependent variables were measured; the longest rod balance (seconds) was the measure of competitive performance, and the number of rod balancing attempts made was the measure of competitive motivation.

5.2.3. Materials

Nine voluntary student research assistants (five women, aged 21-29 years; four men, aged 20-38 years) were recruited to act as the audience. They appeared to participants as the experimenter, therefore they were briefed on the experimental procedure and provided with participation packs. Packs included participant information sheets (Appendix 5.A), consent forms (Appendix 5.B) and demographic questionnaires (Appendix 5.C). They were also equipped with a wooden dowel approximately 500 millimetres long and 75 millimetres in diameter, a stop watch, and a pen to record the length of each balance and the number of attempts made.

5.2.4. Procedure

Research assistants approached potential participants and took them to a private area if they provisionally agreed to participate. This was to ensure the experimenter was the only audience during participation. Participants received participation pack and allowed as much time as they required to read and complete before handing it back to the research assistant. Participants were informed the aim of the task was to balance the rod on one finger (whichever they chose) for as long as possible and that they could make as many attempts at this as they liked until they were satisfied with their longest balance. The research assistant used a stop watch to time the length of each balance and recorded each time on paper, simultaneously providing the number of attempts made balancing the rod. Participation was concluded when the participant made it clear that they did not want to make further attempts and returned the rod to the research assistant, this concluding participation. This research was approved by the University of Sunderland Research Ethics Committee Appendix 5.D).

5.3. Method: Online Task (Circles and Squares Game – Study Six)

5.3.1. Participants

200 heterosexual participants, 69 men (aged 18-57, M = 26.54, SD = 9.96) and 131 women (aged 17-51, M = 22.76, SD = 6.98) were recruited online via social media (for example, Facebook and Twitter) and psychology research participation sites (such as Psychological Research on the Net, Hanover College) from 11/2014-03/2015. This included both students, who participated for partial course credit, and non-students. All participants had the opportunity to be entered into a prize draw for a £50.00 Amazon voucher.

5.3.2. Design

Study six used a mixed experimental design with four independent variables; two independent groups variables were participant sex (male, female), and relationship/parental status on four levels (single non-parent, single parent, committed non-parent and committed parent). The two repeated measures variables were audience type with three levels (female audience, male audience, no audience), and within this variable was the variable of audience attractiveness on two levels (attractive, unattractive). Participants always saw the control condition first (no audience); the four audience conditions (attractive male, attractive female, unattractive male, unattractive female) were randomise (Figure 5.1). Each participant viewed one photograph (the ‘audience’) relevant to each audience condition, however there were three potential photographs per condition which could have been used (Appendix 5.E) which were also randomised. There were two dependent variables, the score obtained (competitive performance) and the number of attempts made (competitive motivation).

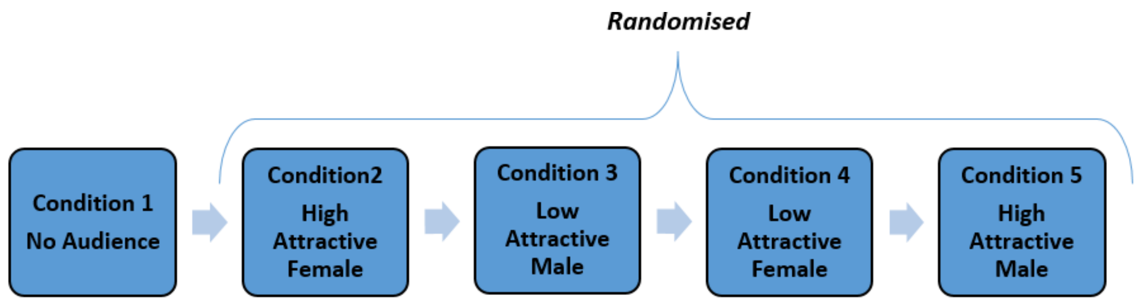


Figure 5.1. Schematic representation of the design of the online task (study six)

5.3.3. Apparatus and Materials

Demographic information (Appendix 5.F), including date of birth, relationship and parental status, was collected. The circles and squares game (see Chapter 4) was the competitive task, however as there were five different conditions, the duration of the task was reduced to one minute per condition. A photograph of a flower was present during the control condition, twelve photographs were used for the audience conditions, six of women and six of men (Appendix 5.E). Six of these photographs were obtained from the Helen Database online (Le, Brandt, Boudev, Lin, & Huang, 2012), one was from another online database (Spacek, 2007), the remaining five were obtained from individuals known to the researcher with their full consent. The photographs were naturalistic headshots with the subjects smiling in order to appear more ecologically valid, and were shown in colour. To assess the audience attractiveness, photographs were pre-rated by nine participants (aged 18-48) on a scale of 1-10, where higher values indicated higher attractiveness. The image ratings analysed using one-sample *t*-test to ensure the photographs were rated as significantly more or less attractive than the median. Three of the female images and three of the male images were rated as significantly lower than the median (the unattractive audience); three female and three male images were rated as significantly higher than the median (the attractive audience) (see Appendix 5.E). Two 'memory questions' were also incorporated at the end of each round to ensure participants attended to the photograph. Participants were asked to remember a two digit number which appeared on the subject of the photograph, as participants had done in research by Frankenhuis et al. (2010). The research by Frankenhuis et al. (2010) had examined the effect of audience presence and sex on risk taking in a virtual environment using two types of audience, one who appeared within the virtual environment and one who was physically present in the environment where participation took place. The participants were explicitly informed that there would be a number on the forehead of the virtual person that they would need to remember it. Although the number itself was not important to the study, it ensured that participants attended to the observer, which was important to the study. Participants in study six were old there would be a number on the photograph that they were to remember and report at the end of each round. Participants were also told that there would be another question about each photograph at the end of each round but they would not know what this question was until the end of each round. The intention of this second question was to ensure participants had attended to the stimulus and the answer they provided was not subject to analysis. The questions were ‘what colour were the petals in the picture?’, ‘what colour hair did the person in the picture have?’, ‘was the person in the picture smiling?’, ‘what colour eyes did the person in the picture have?’, and ‘what sex was the person in the picture?’ as appropriate to the photograph in each condition.

5.3.4. Procedure

Participants read the information sheet (Appendix 5.G) and provided consent (Appendix 5.H) followed by demographic information. Participants then read the circles and squares instructions and the leader board, and asked to select which shape to play. Prior to each round of the game, participants were reminded of the shape they had selected to play, the round number, and the aim. The five rounds were each one minute versions of the circles and squares game with the photograph corresponding to the condition presented adjacent to the grid where the game was played; the control condition is shown in Figure 5.2. Following each round, participants answered the two ‘memory’ questions. After answering the two questions in the final round, participants were fully debriefed (Appendix 5.I), and given the opportunity to be entered into the prize draw which completed participation. This study was approved by the University of Sunderland Research Ethics Committee (Appendix 5.J).

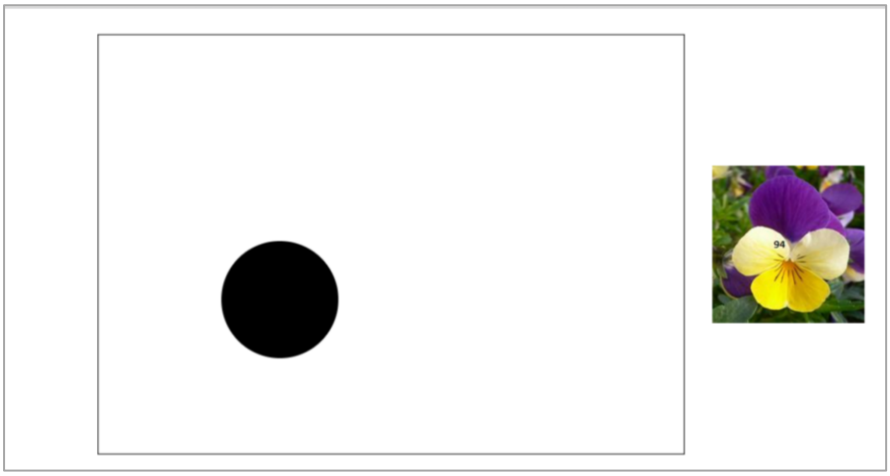


Figure 5.2. The control condition of the Circles and Squares game

5.4. Results of Studies Five (Rod Balancing Task) and Six (Online Task)

Due to the low recruitment rate of single parents, they were excluded from both studies five (*n* = 9) and six (*n* = 11), leaving three levels of relationship/parental status. Thirteen outliers were removed from study five as their data (either the number of attempts made or the longest balance) were over three standard deviations from the mean. More details of the data collected by each research assistant can be seen in Table 5.1. The demographic characteristics of the final samples can be seen in Table 5.2. The assumption of normality was violated for all measures of competitiveness across both studies ($p < .001$); further details of the parametric assumptions relevant to each of the hypotheses examined will now be addressed in turn.

Table 5.1. Descriptive statistics of rod balancing data from each research assistant.

Researcher	Number Recruited	***M* (*SD*) Longest Balance (seconds)**	***M* (*SD*) Balance Attempts**
Male 1	18	9.62 (9.81)	8.72 (6.82)
Male 2	23	6.60 (9.83)	7.96 (5.00)
Male 3	21	10.31 (14.06)	15.43 (9.34)
Male 4	9	9.22 (10.71)	15.00 (15.43)
Female 1	14	5.31 (2.70)	8.14 (4.67)
Female 2	17	9.27 (9.68)	16.35 (9.12)
Female 3	16	5.36 (4.56)	10.06 (7.95)
Female 4	86	5.74 (4.34)	9.94 (8.06)
Female 5	26	10.14 (21.33)	9.69 (5.45)

There was no effect of individual researcher on competitive performance (longest balance), F (8, 220) = 1.09, $p = .368$, $\eta_p^2 = .038$ (homogeneity of variance met). However, there was an effect of research assistant on competitive performance (number of balance attempts), F (8, 220) = 3.35, $p = .001$, $\eta_p^2 = .108$ (homogeneity of variance violated, $p < .001$). Tukey post hoc tests showed the participants recruited by male number two made significantly fewer attempts than the participants recruited by male number three and female number two. The participants recruited by female number also made significantly more attempts than the participants recruited by female number four. There were no other significant differences.

In both studies, committed parents were significantly older than both committed non-parents and the single non-parents. However, there was no relationship between age and either measure of competitiveness in either study.

Table 5.2. Demographic characteristics of participants in studies five and six

		Rod Balancing (*n* = 222)		Online Task (*n* = 189)	
		n	**%**	***n***	**%**
Sex	Male	106	47.75	65	34.39
	Female	116	52.25	124	65.61
Relationship status	Single	118	53.15	58	30.69
	Casually dating multiple people	2	0.90	2	1.06
	Casually dating a single person	21	9.46	22	11.64
	Long term relationship	56	25.23	63	33.33
	Cohabiting	13	5.86	12	6.35
	Married	12	5.41	32	16.93
Parental status	No children	195	87.84	157	83.07
	Children	27	12.16	32	16.93
Nationality	British	200	90.01	156	82.54
	Other	21	9.46	-	-
	Other European	-	-	14	7.41
	Asian	-	-	7	3.70
	North American	-	-	5	2.65
	South American	-	-	1	0.53
	Australian	-	-	1	0.53
	African	-	-	3	1.59
	Declined to indicate	1	0.45	2	1.06
Education level	No formal education	2	0.90	0	0.00
	Primary/grade school	0	0.00	0	0.00
	Secondary/high school	26	11.71	24	12.70
	1+ year at college/university	146	65.77	118	62.43
	A university degree/diploma	40	18.02	37	19.58
	A postgraduate qualification	7	3.15	10	5.29
	Declined to Indicate	1	0.45	-	-

5.4.1. Hypothesis 1. Men will be more motivated to compete than women (number of attempts made on each task) but will not perform better either task (longer balance and score). A MANOVA was not appropriate to analyse the data from study five because the two dependent variables did not correlate (r = .04). In study six, a programming error meant the score from each round could not be matched to the number of attempts, therefore a MANOVA was not possible.

ANOVA analyses were conducted on each dependent variable, with sex and relationship/parental status (Hypothesis 2) as independent variables. Levene's test indicated the homogeneity of variance assumption was violated for the two dependent variables of study five; the longest balance, F (5, 219) = 5.02, p < .001, and the number of attempts, F (5, 219) = 11.14, p < .001. Due to the increase in error rate when proceeding with parametric analyses when this is violated, analysis of these dependent variables tentatively proceeded with two, two-way, 2 (participant sex) x 3 (mating effort) independent groups ANOVAs with Tukey post hoc tests on the independent variable of mating effort if necessary (followed by the non-parametric Kruskal-Wallis test if results were close to the alpha level). Homogeneity of variance was assumed for the mean number of attempts made across all conditions of the online task, F (5, 183) = 1.93, p = .091, and the mean score obtained across all conditions of the online task, F (5, 188) = 1.29, p = .270, therefore these analyses were repeated on the two dependent variables (score and the number of attempts) from the online task to address both hypotheses one and two. The descriptive statistics are shown in Table 5.3. and Table 5.4.

There was no significant effect of participant sex on the longest rod balance achieved, F (1, 219) = 3.58, p = .060, η_p^2 = .016, on the number of balance attempts made, F (1, 219) = 0.37, p = .546, η_p^2 = .002, or on the score in the online task, F (1,

188) = 0.02, p = .963, η_p^2 < .001. Men (M = 96.70, SE = 3.65) mad significantly more attempts than women (M = 84.37, SE = 2.82) in the online task, F (1, 183) = 6.75, p = .010, η_p^2 = .036.

Table 5.3. Mean and (standard error) of measures of competitiveness in men and women.

Dependent Variable	Men	Women
Longest Balance (in seconds)	9.48 (1.31)	6.24 (1.10)
Number of Balance Attempts	8.66 (1.01)	9.46 (0.84)
Score in online task	7.12 (0.61)	7.01 (0.47)
Number of attempts in online task	97.35 (3.77)	84.96 (2.92)

5.4.2. Hypothesis 2. There will be an effect of relationship/parental status on competitiveness in men only; single non-fathers will be more competitive than committed fathers in both the rod balancing and online tasks. There was no effect of relationship/parental status on the longest balance, F (2, 219) = 2.43, p = .091, η_p^2 = .022, however there was an interaction between sex and relationship/parental status on the longest balance, F (2, 219) = 3.34, p = .037, η_p^2 = .030, shown in Figure 5.3. Simple effects analyses demonstrated significant sex differences in single participants, with men balancing the rod longer than women, t (115.36) = 3.69, p < .001, d = 0.68. Committed non-fathers balanced the rod for non-significantly longer than committed non-mothers, t (21.54) = 1.73, p = .098, d = 0.75, although this showed a large effect size, but there was no sex difference in the performance of committed parents, t (25) = 0.66, p = .516, d = 0.26.

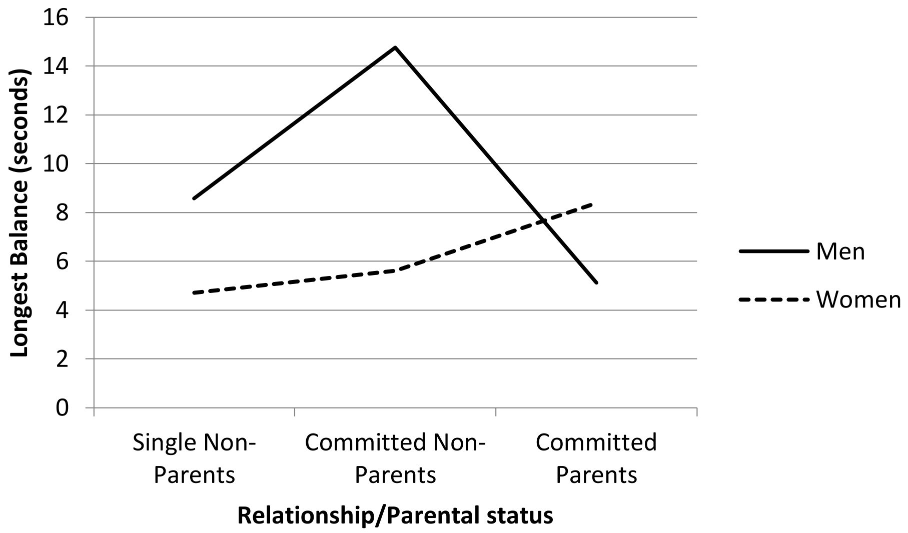


Figure 5.3. Interaction between sex and relationship/parental status on longest rod balance.

There was a main effect of relationship/parental status on the number of balance attempts, F (2, 219) = 11.24, p < .001, η_p^2 = .093. Tukey post hoc tests showed single non-parents (M = 12.62, SE = 0.65) made more attempts than both committed non-parents (M = 7.96, SE = 1.07) and committed parents (M = 6.56, SE = 1.52) (p < .05). There was no interaction between sex and relationship/parental status on the number of balances attempted, F (2, 219) = 0.72, p = .489, η_p^2 = .007.

There was no effect of relationship/parental status on the score in the online task, F (2, 188) = 0.53, p = .591, η_p^2 = .006, and no interaction between sex and relationship/parental status on score, F (2, 118) = 0.98, p = .376, η_p^2 = .010.

There was a significant main effect of relationship/parental status on the number of attempts made in the online task, F (2, 183) = 4.60, p = .011, η_p^2 = .048. Tukey post hoc tests revealed single non-parents (M = 99.20, SE = 3.21) made more attempts on the game than committed parents (M = 81.18, SE = 5.01) (p < .05). There was no interaction between sex and relationship/parental status on the number of attempts made on the online task, F (2, 183) = 0.83, p = .439, η_p^2 = .009. As the results from study four had shown a significant decrease in the competitiveness of men as reproductive resources were obtained but not in women, a separate ANOVA was conducted on men and women to examine this again. There was no significant effect of relationship and parental status on the number of attempts made by women, F (2, 121) = 1.45, p = .240, η_p^2 = .023 (small effect size), and a non-significant, medium effect on men, F (2, 62) = 2.44, p = .095, η_p^2 = .073. Inspection of the means showed a decrease in the number of attempts made on the online task from single non-fathers (M = 109.20, SE = 6.41) to committed fathers (M = 84.01, SE = 9.50).

Table 5.4. Means and (standard errors) of all dependent variables

		Single Non-Parents	Committed Non-Parents	Committed Parents	Overall
Longest balance achieved	**Men**	8.57 (1.15)	14.75 (2.21)	5.12 (3.05)	9.48
	Women	4.71 (1.26)	5.62 (1.71)	8.38 (2.53)	6.24
	Overall	6.64	10.19	6.75	7.86
Number of balance attempts	**Men**	13.12 (0.88)	7.24 (1.69)	5.64 (2.34)	8.66
	Women	12.12 (0.96)	8.69 (1.31)	7.56 (1.94)	9.46
	Overall	12.96	7.96	6.60	9.06
Score achieved on online task	**Men**	23.94 (2.50)	20.18 (3.49)	20.00 (3.48)	21.37
	Women	20.70 (2.03)	24.09 (1.90)	19.00 (3.21)	21.26
	Overall	22.32	22.13	19.50	21.32
Number of attempts made on online task	**Men**	109.20 (4.99)	98.84 (6.95)	84.01 (7.40)	97.35
	Women	89.20 (4.05)	87.32 (3.83)	78.36 (6.76)	84.96
	Overall	99.20	93.08	81.18	91.15

5.4.3. Hypothesis 3. An audience (compared to no audience in study six) will increase competitiveness in men, but not in women. A female audience will increase competitiveness in men more than a male audience in both studies. The rod balancing data was analysed using two, two-way, 2 (participant sex) x 2 (researcher sex) independent groups ANOVAs on each dependent variable of competitive performance (longest balance) and competitive motivation (number of attempts). Homogeneity of variance was violated (F (3, 226) = 3.33, p = .021). There was no significant effect of the sex of the audience on the longest balance, F (1, 230) = 0.24, p = .628, η_p^2 = .001, and no interaction between researcher and participant sex, F (1, 230) = 1.32, p = .252, η_p^2 = .006. This analysis was then repeated on the number of attempts made on the rod balancing task. Homogeneity of variance was violated (F (3, 226) = 2.78, p = .042). There was no significant effect of researcher sex, F (1, 230) = 1.21, p = .272, η_p^2 = .005, and no interaction effect, F (1, 230) = 0.15, p = .902, η_p^2 < .001.

Analysis of the data from the online task used two, 2 (sex) x 3 (female audience, male audience, no audience) mixed ANOVAs followed by Bonferroni pairwise comparisons on the audience variable if necessary, on each dependent variable of score achieved in the game and the number of attempts made.

The assumption of sphericity was violated for the score on the online task, W (2) = 0.96, X^2 = 7.02, p = .030, therefore the Greenhouse-Geisser correction was applied (ε = .965). There was an effect of the audience on the score obtained, F (1.93, 370.63) = 151.01, p < .001, η_p^2 = .440. Bonferroni pairwise comparisons showed participants scored significantly fewer points on the game when there was no audience present (M = 1.52, SE = 0.37) in comparison to either a male (M = 9.80, SE = 0.58) or female audience (M = 10.66, SE = 0.62) being present. There was no interaction between audience and participant sex, F (1.93, 376) = 0.36, p = .673, η_p^2 = .002,

The assumption of sphericity was violated for the number of attempts made in the online task, W (2) = 0.92, X^2 = 15.64, p < .001, therefore the Greenhouse-Geisser correction was applied (ε = .925). There was a non-significant effect of audience presence on the number of attempts made in the online task, F (1.85, 346.09) = 3.01, p = .055, η_p^2 = .016. Bonferroni pairwise comparisons showed more attempts were made for a female audience (M = 64.96, SE = 2.52) than for either a male audience (M = 91.98, SE = 2.26) or no audience (M = 91.97, SE = 2.20). The descriptive statistics are shown in Table 5.5.

Table 5.5. Mean (and standard error) of the effect of audience presence and sex on all dependent variables

	Men			Women		
Dependent Variable	**No Audience**	**Female Audience**	**Male Audience**	**No Audience**	**Female Audience**	**Male Audience**
Longest balance (seconds)	-	9.90 (15.69)	8.94 (8.68)	-	4.78 (3.82)	7.05 (12.04)
Number of balance attempts	-	12.00 (8.60)	10.47 (9.04)	-	10.84 (7.73)	9.61 (6.28)
Score achieved on online task	1.40 (0.60)	9.96 (0.94)	10.63 (1.16)	1.63 (0.04)	9.64 (0.68)	10.68 (0.67)
Number of attempts made on online task	99.77 (4.24)	102.64 (5.51)	97.75 (4.73)	84.17 (2.27)	87.29 (2.23)	86.21 (2.14)

5.4.4. Hypothesis 4. Men will be more competitive in the online task when the audience is attractive rather than unattractive, but there will be no

effect of audience attractiveness on the competitive motivation of women. A 2 (sex) x 2 (audience, attractive, unattractive) mixed ANOVA was conducted to analyse the number of attempts made on the game. There was no significant effect of audience attractiveness, F (1, 187) = 0.04, p = .837, $\eta_p^2 < .001$, and no interaction between sex and audience attractiveness, F (1, 187) = 0.17, p = .677, $\eta_p^2 = .001$.

5.4.5. Hypothesis 5. There will be an interaction between relationship/parental status in men and the audience presence and sex on competitiveness; single men will be more competitive than committed men when an audience is present in comparison to when no audience is present (in the online task). Furthermore, competitiveness will be greater when the audience is female rather than male (in both tasks). Two, three-way, 2 (sex), x 2 (male audience, female audience) x 3 (mating effort) independent groups ANOVAs were conducted on the longest balance and the number of balance. Two, three-way, 2 (sex) x 3 (no audience, male, female) x 3 (mating effort) mixed ANOVAs were conducted on the score and number of attempts on the online task.

Homogeneity of variance was violated for the balance attempts (p <.001). Inclusion of relationship/parental status in this analysis removed the significant effect of sex on the number of attempts made, F (1, 230) = 0.44, p = .506, $\eta_p^2 = .002$, there was still no effect of the audience sex, F (1, 230) = 0.35, p = .554, $\eta_p^2 = .002$, there was no interaction between audience and participant sex, F (1, 230) = 0.12, p = .730, $\eta_p^2 = .001$, audience sex and relationship/parental status, F (2, 230) = 0.56, p = .571, $\eta_p^2 = .005$, participant sex and relationship/parental status, F (2, 230) = 1.21, p = .301, $\eta_p^2 = .011$, or participant sex, relationship/parental status, and audience sex, F (2, 230) = 0.86, p = .918, $\eta_p^2 = .001$. There was an effect of relationship/parental status, F (2, 230) = 9.04, p < .001, $\eta_p^2 = .077$, with Tukey post hoc tests showing single non-parents (M = 12.23, SE = 0.68) made more balance attempts than both committed non-parents (M = 8.16, SE = 1.16) and committed parents (M = 6.43, SE = 1.48).

Homogeneity of variance was violated for the longest balance (p < .001). There were no interactions between researcher and participant sex, F (1, 230) = 2.48, p = .117, η_p^2 = .011, researcher sex and relationship/parental status, F (2, 230) = 0.68, p = .506, η_p^2 = .006, or researcher sex, parental sex, and relationship/parental status, F (2, 230) = 1.12, p = .328, η_p^2 = .010. There was an effect of relationship/parental status, F (2, 230) = 3.25, p = .041, η_p^2 = .029, where committed non-parents (M = 11.00, SE = 1.50) balanced the rod longer than both single non-parents (M = 6.61, SE = 0.88) and committed parents (M = 6.99, SE = 1.91). The interaction between sex and relationship status (shown in Figure 5.3) became non-significant, F (2, 230) = 2.63, p = .074, η_p^2 = .024.

In study six, there was a significant effect of relationship/parental status, F (1, 183) = 4.75, p = .010, η_p^2 = .049 on the number of attempts made in the competitive task. Tukey post hoc tests indicated single non-parents (M = 98.402, SE = 3.14) made more attempts than committed parents (M = 80.50, SE = 4.90). There was no interaction with sex, F (2, 183) = 0.77, p = .466, η_p^2 = .008. Sphericity was violated for the audience variable, (W (2) = 0.92, X^2 = 15.75, p < .001, therefore the Greenhouse-Geisser correction was applied (ε = .923). There was no effect of audience presence or sex on the number of attempts made, F (1.85, 366) = 2.02, p = .138, η_p^2 = .011, no interaction between audience presence and sex and relationship/parental status, F (3.69, 366) = 0.25, p = .896, η_p^2 = .003, and no interaction between audience presence and sex, participant sex, and relationship/parental status, F (3.69, 366) = 0.62, p = .637, η_p^2 = .007.

However, when examining the score on the online task, there was no effect of relationship/parental status, *F* (1, 188) = 0.53, *p* = .591, η_p^2 = .006, and no interaction with sex, *F* (2, 188) = 0.98, *p* = .376, η_p^2 = .010. Sphericity was violated for the variable of audience sex and presence, (*W* (2) = 0.96, X^2 = 6.78, *p* = .034, therefore the Greenhouse-Geisser correction was applied (ε = .966). There was no interaction between audience and relationship/parental status, *F* (3.86, 376) = 0.74, *p* = .559, η_p^2 = .008, and no interaction between audience, participant sex and relationship/parental sex, *F* (3.86, 376) = 1.08, *p* = .364, η_p^2 = .011.

5.5. Discussion

The aim of studies five and six was to examine the effect of an audience on competitive motivation and performance. It was suggested that would be more motivated to compete than women both in a rod balancing task (study five, indicated by the number of attempts at balancing the rod they made) and in an online task (study six, evidenced by the number of attempts made on the game). However, because all men should be motivated to compete for mating opportunities regardless of their success in doing so, it was suggested that there would be no sex differences in competitive performance either in the rod balancing task (the longest balance achieved) or the online task (the score achieved) (Hypothesis 1). As in chapters three and four, studies five and six also examined whether there was a sex differentiated effect of relationship and parental status on competitiveness whereby men would become less competitive as they gained reproductive resources (Hypothesis 2). This chapter included the variable of an audience as the challenge hypothesis suggests that men should be more responsive to cues in the environment which suggest a potential effect on reproductive status (a potential mate or rival) than women. These two studies therefore suggested that men would demonstrate increased competitiveness, both in the rod balancing task and in the online task, than women when an audience was present, particularly if the audience was female (Hypothesis 3). Furthermore, it was suggested that men should be more competitive for an audience high in attractiveness rather than an audience low in attractiveness because a more attractive audience are more likely to be perceived as potential mating opportunities or a threat to status (Hypothesis 4). Finally, it was suggested that single men would be more competitive than men with reproductive resources when an audience was present, particularly a female audience. Conversely, there would be no interaction between relationship/parental status and audience presence and sex on the competitiveness of women (Hypothesis 5). Studies five and six partially support hypotheses 1, 2 and 3, but hypotheses 4 and 5 were not supported.

There was no evidence of sex differences in competitive performance in either study five (rod balancing) or in study six (online) however men did make more attempts in the online game than women. This provides further support for the suggestion that competitive motivation is more accurately associated with mating behaviours than competitive performance. However, there were no sex differences in the competitive motivation in the rod balancing task. Sex differences in competitiveness in natural settings is well established (Deaner, 2006), therefore the lack of support for this in the rod balancing task is puzzling. It may be because research assistants primarily recruited participants known to them. This would lead to less motivation to display mating effort as the receiver of the signal are known to participants, therefore any impact they may have on reproductive success is known, reducing the need to communicate this. This is consistent with the challenge hypothesis which suggests that, because mating effort is costly, it should only increase when there are opportunities in the environment to increase reproductive success. Familiarity between an individual and an audience therefore negates the evolutionary need for judging and monitoring (Guerin & Innes, 1982; Guerin, 1983; Zajonc, 1980). In retrospect, the research assistants should have been instructed to only recruit participants who they did not know.

The second hypothesis suggested there would be an effect of relationship/parental status on competitiveness in men but not in women. There was only partial support for this hypothesis because single men performed better in the rod balancing task and made more attempts than single women, a sex difference which was not evident in committed non-parents or committed parents. However, in no evidence of a sex differentiated effect of relationship/parental status on competitiveness in the online task; there were no effects on the score in the online game but single participants made more attempts than committed parents overall. This reduction in competitive motivation is consistent with life history theory and the challenge hypothesis as it suggests that mating effort decreases gradually as reproductive resources are secured. These findings also indicate that, consistent with costly signalling theory, individuals with higher levels of mating effort than parenting effort are more motivated to engage in competition for reproductive resources regardless of their success in doing so. However, it was expected that this reduction in mating effect due to having secured reproductive resources would be exclusive to men consistent with predictions made by parental investment theory, yet this cannot be supported here.

When competitive motivation on the online task was examined separately for men and women, analyses suggested a stronger effect of mating effort in men than in women. Results showed non-significant decreases in the competitive motivation of both men and women as reproductive resources increased, yet the effect size was small in women and medium in men. This may indicate a stronger effect of reproductive resources gained in decreasing competitive motivation in men than in women but lack of power prevents stronger conclusions from being made. The online task used a repeated measures design, which has more power than independent designs. However, not many parents participated in this study which would have reduced the power in that level of the independent variable. Inspection of the mean number of attempts made in the rod balancing task also indicates a more pronounced reduction in the competitive motivation of men than in women as reproductive resources are secured. However, the interaction between sex and mating effort on the number of attempts made in the rod balancing task was not significant and did not show a meaningful effect size. When referring back to the results of study four, there was also evidence of a non-significant, medium effect of relationship/parental status decreasing men's competitive motivation, however sex differences in this could not be examined. The evolutionary account of competitiveness adopted in this thesis draws heavily upon hypothesised sex differences in the motivation to secure reproductive resources due to sex differences in reproductive biology however the results of studies four, five and six suggest this sex difference in competitive motivation is not as pronounced as originally thought. The potential reasons for these results will now be explored.

Firstly, as discussed, studies four, five and six may lack the power necessary to make strong conclusions that mating effort should reduce in men as reproductive resources are secured. The effect sizes for the reduction in competitive motivation of men in studies four and six are both respectable, which supports the suggestion that power may be reduced in these studies. However, the effect size of relationship/parental status on the number of balance attempts is very small, suggesting the effect of relationship/parental status is not sex-differentiated. This may be due to the discussed methodological flaws in the rod balancing task, including the research assistants recruiting many participants known to them. As competing is suggested to be a costly signal, it should be responsive to proximate cues and only engaged in when reproductive success can potentially be increased by doing so. Participants may not have increased their mating effort (competitive motivation) in this task because they did not feel judged by the 'audience', despite the audience being physically present, because they were aware that increased mating effort in this scenario would not ultimately increase their reproductive success. Therefore, one suggested reason for the pattern of findings in competitive motivation across studies four, five and six is that reduced power (due to the low recruitment of parents) has made it more difficult to draw firm conclusions about the effect of reproductive resources in reducing mating effort in men, and flaws in the design of the rod balancing task reduced the likelihood of men engaging in mating effort.

Secondly, it may be that mating effort fluctuates adaptively in women as well as in men. Although female competitiveness is beyond the scope of this thesis, evidence indicates women do engage in intrasexual competition for mates (for example, Fisher, 2015). This is because men typically provide substantial in offspring investment in comparison to other male mammals (Geary, 2005) which aids offspring survival, development, and reproductive success. Women typically have a more risk-averse nature than men, therefore more covert, indirect forms of competition may appeal to women more than for men (Fisher, 2015; Hudders, De Backer, Fisher, & Vyncke, 2014). The online task (study six) may have been more suited to women's preferences for indirect competition as it was online, in an environment of the participant’s choosing, and the ‘audience’ were unimposing and passive in comparison to someone who was physically present. Women in the online task may have felt more able to fully engage in the competitive task. Support for this suggestion comes from the increased competitive motivation demonstrated by women when the audience in the online task was female, despite the audience conditions being randomised. This is also consistent with the suggestion that explicit competitiveness in women is discouraged (Hibbard & Buhrmester, 2010). This suggestion is also supported by the results of the rod balancing study, because participants who were familiar with the research assistant may have felt more able to engage in the competitive task without fear of being judged. Cumulatively, although there was a consistent finding that competitive motivation was lower in those with reproductive resources than in those without, there is not sufficient evidence to support this being sex-differentiated as hypothesised.

The third hypothesis predicted that men would be more motivated to compete than women in the presence of an audience, and that this would be primarily due to a female audience. The design of the rod balancing task could not incorporate a no-audience condition, however there was no effect of audience sex on the competitive performance or motivation of men or women. This may be because for male participants, increasing mating effort is not necessary when the mating and dominance status of an audience are known. For female participants, being familiar with the audience may have reduced the apprehension about being judged for competing. Ultimately, in the rod balancing study the familiarity between participants and the research assistants may have caused increased error variance in the measure of mating behaviour exhibited (competitive motivation), leading to no difference in competitive motivation for a male or female audience. The online task did incorporate a no-audience condition and demonstrated both men and women performed better for an audience regardless of the audience sex. However, the hypothesised sex difference in this effect was not evident, and both men and women performed better when an audience was present. This does not support the evolutionary account of competitiveness firstly because the effect was on competitive performance and not on competitive motivation, and secondly because the effect of audience presence was the same for both men and women. This effect of audience presence may actually be due to a methodological flaw. All participants were exposed to the no-audience control condition first with the remaining conditions being randomised. The first condition was therefore the first experience participants had with the circles and squares game, which may have led to poorer performance in the first condition in comparison to the rest. It is therefore suggested that the apparent facilitating effect of an audience on the competitive performance of men and women in the online task is due to a practice effect rather than an audience effect. The number of attempts made in subsequent rounds did not increase which suggests accuracy and performance increased following the first round rather than just an increase in the motivation to compete. As rounds two-to-five were randomised, the extent of improvement in performance across conditions cannot be established, however it is unlikely performance was able to improve much beyond the first condition due to shape presentation being randomised. This suggests that participants would benefit from a practice round of the circles and squares game when rounds are only one minute long, as was the case here, and that any future studies should incorporate this into the design.

There was a sex-differentiated effect of audience sex on competitive motivation in the online task with women making more attempts for a female audience but there was no effect in men. As discussed, this may suggest that women are more indirectly competitive with other women and thus lend support to the theory of intrasexual competitiveness in women (Fisher, 2013; Fisher, 2015; Hudders et al., 2014). This also supports the point made previously that the format of the online task may be more appealing to a covertly competitive nature, however this is beyond the scope of the thesis.

The lack of support for the hypothesised effect of audience presence, sex (Hypothesis 3) and attractiveness (Hypothesis 4) in men, and the interaction between audience and mating effort (Hypothesis 5) may be due to using artificial audience stimuli in the online task. As discussed, previous research has demonstrated that artificial stimuli are sufficient for inducing a mating mind-set in men. The stimuli used in study six were rated as highly attractive to address the concern raised in study four, therefore the current findings are puzzling. The repeated measures design of study six may have increased error in this study. Mcalvanah (2009) suggests that when primes are used to activate a cognitive concept, a cognitive bias known as the focusing illusion is also activated. The focusing illusion occurs when exposure to the prime results in it being overly attended to so that subsequent primes are not fully successful. In the current context, this suggests participants would be overly focused on the first audience condition and subsequent conditions could not override this. For this reason, an independent groups design may be more effective when examining these effects in future research. However, it is curious that although women were also exposed to all of the audience conditions, they still appeared to be more responsive to a female audience despite this being randomised.

Previous research has also demonstrated an effect of audience presence, sex and attractiveness on testosterone levels as an aspect of mating effort. This is consistent with the challenge hypothesis and indicates mating effort increases when proximate cues suggest reproductive success may benefit from it (Fischer & Hills, 2012; Roney et al., 2007; Roney, 2003). However, the results of studies five and six are inconsistent with these findings as there was no effect of audience presence, sex or attractiveness on competitiveness. The reason for this may be that measuring the physiological response to an interaction with another person would provide a much more nuanced indicator of mating effort as it is beyond conscious control (Loewenstein, 1996). Conversely, examining the behavioural displays *supported* by testosterone introduces more variance due to the variety of behavioural displays testosterone is hypothesised to support and the influence of conscious control. The use of an artificial audience may have compounded the reduced power to detect effects as previous research which has demonstrated audience effects on mating behaviours has often done so following an interaction with a real person (Karremans et al., 2009; Roney, 2003). An actively evaluating audience indicates a signal will be received therefore increasing the likelihood of signalling. Audience evaluation increases competitive motivation (Chen & Garcia, 2010; Ermer et al., 2008) yet, contrary to the suggestion of Zajonc (1965) passive spectators do not (Cottrell et al., 1968). Presenting passive photographs with no other context other than assessing memory may be too passive to induce the feeling of being evaluated and judged in participants. Future studies should address this by presenting additional context alongside the 'audience' photographs. For example, participants could be told their performance in the competitive task is being assessed by the individual in the photograph. This evaluation by an audience has also been incorporated into previous research, which involves men being told their performance is being judged by an attractive female confederate (Ronay & von Hippel, 2010; Slatcher et al., 2011). This therefore suggests that the lack of audience effects on the competitive motivation in men may be due to the passive nature of the audience in online task, and their lack of active, evaluative interest in the rod balancing task. However it must also be considered that due to the complexity of cues which inform the allocation of mating effort, simple priming methods may not be sufficient to elicit the hypothesised effects. The research reported in Chapter 6 discusses the development of a more substantial priming method in order to address this concern, the effectiveness of which will be explored in the research discussed in Chapter 7.

There was no evidence of an audience differentially affecting the competitiveness of men according to their relationship/parental status in either study reported here. In addition to issues discussed, such as the audience and participants in the rod balancing task being familiar with one another, the lack of judgement by the audience in the online task, and the potential cross contamination of the audience conditions in study six, relying on relationship/parental status to indicate mating effort may have contributed to this result. As discussed, relationship/parental status may be crude indicator of mating effort as it sometimes remains higher than expected in people with a partner and/or offspring. Specifically, individuals may follow a fast mating strategy, by maintaining mating effort despite having reproductive resources. For this reason, it is important to isolate and control for the effect of mating strategy on competitiveness in future research. It is expected that individuals who have higher levels of mating effort would increase their mating behaviours in response to an audience regardless of their relationship and parental status.

A final issue to consider here is the potential role of age in these findings. Committed parents were significantly older than the non-parents in this sample; the reduced competitiveness in these participants may be due to them being older. However there was no correlation between age and any measure of competitiveness in either category of the relationship/parental status. It is therefore unlikely that age alone is responsible for the decrease in competitive motivation.

In conclusion, the research presented in this chapter demonstrated an effect of mating effort on competitive motivation in both a natural-field task and an online task. These results are only partially consistent with the evolutionary account of competitiveness because there were no sex differences in this effect. Potential explanations for this include having fewer mated participants leading to reduced power in the research, the format of the online task appealing to the more covert competitive nature of women, a lack of suitable audience stimuli in both tasks and the use of a within subjects design in the online task. Future research should implement an independent groups design and increase the number of participants to address these problems, as well as recruiting more mated participants in order to retain experimental power across the whole spectrum of reproductive energy allocation. The natural-field design of the rod balancing task did not illicit any audience effects on competitiveness, and having considered some issues with this study, it was argued that this is consistent with the suggestion that a known audience reduces the evolutionary need for monitoring (Zajonc, 1980, cited by Uziel, 2007). Likewise, the results from the online task cannot support any effect of an audience on the competitiveness of men. Although the use of the audience stimuli in the online task seemed justified, in retrospect it may have been too passive for use in a male sample, which would not lead to a social facilitation effect on competitiveness

(Cottrell et al., 1968) as it would not be efficient to engage in a costly signal when there is less chance of it being received. It is concluded that in order to examine the proximate effects of audience presence, sex and attractiveness on evolved motivations to increase reproductive success, it is important to utilise an independent groups design and a fully evaluative audience who are unknown to participants.

Chapter 6. Development of Relationship 'Satisfaction' Primes and a Hypothetical Relationship Story

6.1. Study Seven: Relationship 'Satisfaction' Primes

Introduction

As discussed in Chapter 2, it is difficult to measure extra-pair interests. The ExPI was developed in study one with the aim of measuring extra-pair interests and so far has provided some promising results, for example ExPI scores predict competitive motivation (study four). However, the results of studies three and four showed ExPI scores were positively skewed, indicating that individuals typically reported lower levels of extra-pair interests. This may well be a legitimate finding whereby these participants had low extra-pair interests. It may also be due to flaws in the ExPI such as the narrow range of response options. Social desirability may have also contributed to these findings, however, the piloting of the ExPI suggested this was not an issue. While it is possible that this may have been specific to the piloting sample, it is doubtful as the sample size was respectable. Regardless of the reasons for the positively skewed responses on the ExPI in studies three and four, the practicalities of this are that the competitiveness of men with high levels of extra-pair interests has not been able to be confidently examined. Analysis of the relationships between ExPI scores and competitive motivation in studies three and four have used correlational designs, which goes some way to address the issue of positively skewed means. In an effort to further address this issue, the aim of study seven was to develop and pilot substantial priming materials to temporarily manipulate mating strategy in order to examine whether this will affect competitiveness. There is evidence which suggests the experimental manipulation of mating strategy, by having participants read short stories, is successful in temporarily influencing mating behaviours in men (Griskevicius et al., 2006; Griskevicius et al., 2009, 2011; Hill, Rodeheffer, Griskevicius, Durante, & White, 2012; Sundie et al., 2010). This method could potentially reduce issues of social desirability involved in using self-report measures of extra-pair interests and offer a new experimental paradigm to use.

Priming involves subtle manipulations using a particular, well-chosen stimulus which activates a certain concept making it more easily accessible cognitively (Kay & Ross, 2003). This makes it easier to examine how the primed concept influences subsequent behaviours outside of conscious awareness (Kay & Ross, 2003). Different methods of priming participants, such as reading short descriptive stories or being exposed to related words, have previously been used successfully in many different areas of psychology to temporarily modify subsequent behaviours. For example, Kay and Ross (2003) asked participants to engage in a scrambled sentence task in one of two conditions, words related to competition or words related to cooperation. They demonstrated that participants exposed to cooperative words were more likely to judge that their opponents in a prisoner's dilema game would cooperatre rather than defect. Conversely, those primed with competitive words were more likely to judge that their opponents would defect rather than cooperate. A similar priming method was used by Massar and Buunk (2009), who exposed participants to words relating to sex or commitment. They found that when a mating mind-set was activated in men via exposure to words relating to sex, men engaged in mating effort felt more threatened by the presence of a male rival. Men engaged in parenting effort who were then exposed to words related to commitment were less threatened by the presence of a rival. Conversely, the activation of a mating mind-set in men engaged in parenting effort did not cause them to feel more threatened. Such evidence suggests that these cognitive concepts can be artificially primed.

Other priming methods used in psychology research include exposure to images or mocked-up newspaper articles, such as those used by Griskevicius et al. (2013). In the first study reported in this paper, participants were either exposed to images indicating economic decline, such as unemployment lines, or to control images of nature. In the second study they reported, participants viewed one of two newspaper articles, one concerning a recession and the other a control article about spending an afternoon at home searching for lost keys. In both studies, Griskevicius et al. (2013) found that exposure to these primes subsequently affected participants' behaviour consistent with predictions from life history theory. Specifically, they demonstrated that priming life history variables such as economic harshness caused particpants who had previous experience of economic harshness to increase behaviours consistent with a fast life history strategy, such as risk-taking, impulsivity, and spending on luxury items. Conversely, when those who had no previous experience of economic harshness were primed with cues of a recession, they displayed behaviours consistant with a slower life history strategy such as reduced risk taking and impulsivity, and more cautious spending behaviours. This suggests adaptive behaviours can be induced in individuals via priming methods.

Mere exposure to images related to life history variables have also been shown to successfully manipulate subsequent behaviours. Various research studies have exposed participants to photographs of individuals of differing attractiveness levels (for example, Baker & Maner, 2008; Chang, Lu, Li, & Li, 2011; Roney, 2003) which have subsequently altered behaviours consistent with evolutionary theories, such as increasing mating behaviours in men exposed to attractive women. This method of priming inspired the methodology used in study four, which required participants to write about their ideal first date with the individual who they thought was most attractive from a range of images pre-rated as being attractive. However, this did not activate a mating mind-set despite its success in previous research. Furthermore, attractiveness of faces did not influence competitiveness in study six. Study nine, reported in Chapter 7, aims to prime something more complex than a mating mind-set, therefore a more comprehensive priming method than exposure to attractive faces will be required in order to provide additional control.

Griskevicius et al. (2006) also used more complex priming methods by asking participants to read and imagine themselves in one of a number of short stories. These were a short-term mating context, a potential long-term mating context, an established long-term mating context and a control condition which detailed going to a much anticipated concert with a same-sex friend. These scenarios were controlled to be of similar length (approximately 850 words), and participants were to imagine themslves in the scenario to encourage engagement with the primes. The author’s concluded that this method of priming life history variables was successful because men adjusted their mating behaviours according to the scenario and women did not. In a later paper, Griskevicius et al. (2009) used similar priming methods where participants were asked to read and imagine themselves in a short scenario across a series of experiments to prime intrasexual or intersexual motivational states. These scenarios were slightly shorter (approximately 700 words) and, as in the previous experiments, participants were explicitly instructed to imagine themselves in the scenarios presented. This series of studies once again indicated that such priming methods were successful as intrasexual competition primes increased direct aggression in men but not in women, whereas it increased indirect aggression in women but not in men. These primes were then elaborated to examine how aggression was affected by intrasexual and intersexual motives in the presence of an imagined all-female or all-male audience. Again, these primes elicited the hypothesised effects consistent with evolutionary theories because direct aggression did not increase in men the imagined audience were female, but it did when the imagined audience were male. Finally in their paper, Griskevicius et al. (2009) introduced two additional priming conditions of status competition, one was resource scarcity when single, the other was resource scarcity when partnered with offspring. They successfully demonstrated differences in direct aggressive responding following these primes, such that it was elevated in single men and reduced in men with a primed partner and offspring. Cumulatively, the work by Griskevicius and colleagues indicates that behaviour can be successfully manipulated when the necessary cognitive components are activated by suitable primes, consistent with the ultimate evolutionary goal that humans are adapted to respond to the environment in order to increase their reproductive success.

Although the methods of priming in the papers discussed are varied, they all appear able to isolate and induce relevant cognitive components to examine how variation in life history variables can affect behaviour. It is therefore suggested that the priming of ‘relationship satisfaction’ will be able to activate cognitive components related to mating strategy independent of relationship status. This will involve priming participants with either an ‘unsatisfied’ relationship, where individuals would be expected to have extra-pair interests despite being in a relationship, or with a ‘satisfied’ relationship, where participants would be expected to have fewer extra-pair interests. Priming participants in this way may overcome any reluctance to indicate extra-pair interests, and recruiting participants with lower extra-pair interests.

An issue to consider in the development of these primes is how to control for individual differences in order to increase experimental control of the effects of the primes. As discussed, mating strategy is extremely complex, being informed by multiple cues including reproductive resources obtained and the likelihood of securing additional resources. Aspects that contribute to the liklihood of securing additional resources include an individual's age and the presence of rivals and alternative mates in the environment. The complexity of the cognitive construct to be primed means it becomes more important for participants to engage with the prime, so it is reinforced and efficacy is increased (Kay & Ross, 2003). Engagement can be encouraged by asking participants how they believe they would react in a detailed scenario to encourage explicit, deliberative thought about the scenario. This must be considered when designing the new priming materials.

Two textual primes were developed and piloted in study seven with the intention of them temporarily manipulating an individual's mating strategy by either increasing mating effort or increasing parenting effort. The first was an 'unsatisfied' prime which aimed to encourage mating effort; the second prime was a 'satisfied' prime which aimed to encourage parenting effort. As mating strategy is a complex concept informed by multiple cues, the primes were detailed and encouraged participants to consciously consider their own thoughts and actions regarding the prime. The 'satisfied' prime epitomised a man with reduced mating effort who is content with his primary partner and lacks extra-pair interests. The 'unsatisfied' prime characterised the opposite, a man who has extra-pair interests and elevated mating effort despite being in a long-term committed relationship. Measures of relationship satisfaction (M-RAS, Washburn, 2009; section 2.1) and extra-pair interests (ExPI, section 2.1) were distributed to examine convergent validity. It was expected for men in the 'unsatisfied' condition to score lower relationship satisfaction on the M-RAS and higher on the ExPI.

6.2. Method

6.2.1. Participants

Seventy males aged from 18-60 years (*M* = 29.04, *SD* = 11.72), both students and non-students, were recruited face-to-face via opportunity sampling.

6.2.2. Design

This was an experimental, between-subjects design with one independent variable, the condition participants were randomly assigned to, 'satisfied' (*n* = 36) or 'unsatisfied' (*n* = 34). There were two dependent variables, ExPI scores and M-RAS scores (Washburn, 2009).

6.2.3. Materials

Both primes were textual, detailing a man's perspective on his relationship. In the 'satisfied' prime (Appendix 6.A), the man is very committed to his partner with no extra-pair interests, he is about to propose marriage thus signifying his complete satisfaction in the primary relationship. Although offspring are not mentioned in these primes, this prime is expected to encourage parenting effort at the expense of mating effort. In the 'unsatisfied' prime (Appendix 6.B), he is no longer content in his primary relationship and has extra-pair interests. The man reflects on their relationship and how they have grown apart and no longer make each other happy. The contrast between their relationship in the past and present confirms to him that he is no longer committed to his partner and is interested in alternative mates.

The primes were each organised into three sections, interspersed with questions encourage deeper engagement with the scenario, for example, '*Imagine you are the man in the story...how are you feeling at the minute and why?*' These questions (shown in Appendix 6.A and Appendix 6.B) were solely to encourage engagement with the prime and the answers analysed. The structure and content of the two scenarios were kept as similar as possible to control for extraneous variables, both were approximately 800 words long and were interspersed with questions at roughly equal intervals. Participation took 15-20 minutes.

6.2.4. Procedure

Participants read the study information (Appendix 6.C) and provided consent (Appendix 6.D). They read a short story (the prime), and answered the questions presented during it. Participants then completed the two questionnaires (M-RAS and ExPI) as if they were the man in the story they had just read. Both questionnaires were scored on four-point Likert scales (described in section 2.1). Finally, participants provided demographic information (Appendix 6.E). This research was approved by the University of Sunderland Research Ethics Committee (Appendix 6.D).

6.3. Results

Sample demographic characteristics are shown in Table 6.1. Data were analysed for compatibility with parametric assumptions; the assumption of normality was violated for both M-RAS scores (p < .001) and ExPI scores (p = .010), however homogeneity of variance was met for both the M-RAS (p = .624) and the ExPI (p = .641). Independent t-tests demonstrated those in the 'satisfied' condition scored higher on the M-RAS, (t (68) = 20.12, p <. 001, d = 4.88), and lower on the ExPI than those in the 'unsatisfied' condition, (t (68) = 11.14, p < .001, d = 2.70). The descriptive statistics are presented in Table 6.2.

Table 6.1. Sample demographic characteristics

		n = 70	**%**
Sexuality	Heterosexual	65	92.86
	Homosexual	1	1.43
	Bisexual	3	4.29
	Declined to indicate	1	1.43
Relationship status	Single	40	57.14
	Relationship	29	41.43
	Declined to indicate	1	1.43
Nationality	British	65	92.86
	Other	4	5.71
	Declined to indicate	1	1.43
Education	Secondary/high school	10	14.29
	1 + year of university	30	42.89
	University degree	24	34.29
	Postgraduate degree	4	5.71
	Declined to indicate	2	2.86

Table 6.2. Means and standard deviations of M-RAS and ExPI scores

	Condition	*n*	*M*	SD
M-RAS	Satisfied	36	31.75	3.18
	Unsatisfied	34	14.41	3.97
ExPI	Satisfied	36	18.89	5.03
	Unsatisfied	34	32.72	5.36

6.4. Discussion

The aim of study seven was to design and test the efficacy of two primes for use in study nine to experimentally manipulate 'relationship satisfaction' and examine its effect on competitiveness. The analyses here indicate the primes have face and content validity, and successfully differentiate the two groups on subsequent measures of relationship satisfaction and extra-pair interests and show large effect sizes. The effectiveness of the materials has only been explicitly examined in this study, because participants were asked to respond to the ExPI and the M-RAS as if they were the man in the story they had just read. These analyses therefore indicate the materials are provisionally suitable for use in study nine where their implicit effectiveness must also be examined by allowing participants to respond as themselves rather than as the man in the prime text.

6.5. Study Eight: Hypothetical Relationship Story

Introduction

Female mating preferences can provide important information about male mating strategies. This is because female choice often reinforces sexually selected traits (Hunt, Breuker, Sadowski, & Moore, 2009). Hunt et al. (2009) suggests that exploring evidence of evolved mating strategies in men without exploring the role of female mate choice in selecting male mating behaviours can result in an incomplete and potentially biased view. Therefore although male mating behaviours are the focus of the current research, the corresponding role of female mate preferences should be addressed in order to inform this.

There is evidence that men have a baseline of reproductive energy which fluctuates adaptively across the lifespan and individually calibrates in response to cues relevant to reproductive success. If female mate preferences have contributed to the development of this strategy, there should be congruent evidence tn female mate preferences. This literature is discussed more substantially in study ten (reported in Chapter 8), where variation in female mate preferences are tested. However, in order to conduct that study appropriate materials needed to be developed, and this is the aim of study eight reported here.

In order to examine how female mate preferences change over the development of a committed relationship, longitudinal research would be ideal but this is not practical, therefore an alternative method was needed. A hypothetical relationship story was produced which detailed the development of a committed relationship from a woman's point of view at four milestones, from first meeting a mate to the first birthday of their first child. The aim was to ask participants about their mate preferences at each time point in the development of this relationship by asking female participants to rate the importance of the man in the story displaying a range of characteristics, and what kind of activities he should be involved in. Study nine therefore had two aims; to design and test the hypothetical relationship story and to ensure the characteristics and activities that participants were asked to rate were reliable indicators of either mating or parenting effort.

Life history theory suggests that mating effort serves to secure reproductive resources, and therefore this typically decreases as resources are secured. As this decrease in the mating effort of men is suggested to have been sexually selected, there should be evidence of this shift in the mating preferences of women whereby they prefer for long-term mates to engage in less mating effort. Mating and parenting effort are suggested to occupy opposite ends of a spectrum of reproductive effort, therefore investment in one is at the expense of the other. Testosterone has been implicated as the physiological aspect of mating effort, partly due to it being positively associated with many forms of mating behaviours (Ellison, 2001). Higher testosterone supports dominance striving mating behaviours (Mazur & Booth, 1998) which secure reproductive resources. Reduced testosterone and higher levels of parenting effort are conversely associated with a more cooperative temperament and greater potential to provide investment (Buss & Shackelford, 2008; Gangestad & Simpson, 2000; Gangestad et al., 2007). Although men can potentially increase their reproductive success by following a fast mating strategy, success in this is fitness-dependent therefore it is usually adaptive for men to slow their mating strategy and invest in the resources they have secured. A slower mating strategy is evidenced by a reduction in testosterone levels and associated mating behaviours in order to encourage parenting behaviours.

Gangestad et al. (2007) found evidence of two distinct factors important in female mate preferences, ‘indicators of genetic fitness’ and ‘indicators of parenting effort’. These two factors are associated with mating and parenting effort respectively and may therefore reflect women’s preferences of mating strategy in their partner. Indicators of genetic fitness are physical and behavioural traits associated with higher testosterone levels, whereas indicators of parenting effort are those associated with lower testosterone. Testosterone is costly, therefore testosterone-dependent costly signals are fitness dependent. Following a faster mating strategy depended on outcompeting rivals for reproductive resources, therefore this is also fitness dependent. Fitter men were therefore more likely to maintain mating effort at the expense of parenting effort in order to secure more reproductive resources without providing investment. For this reason, it would be adaptive for women to prefer for men to decrease their mating effort as commitment to a relationship increases in order to protect their own reproductive success by securing investment from a partner and reducing the likelihood of being abandoned for an alternative mate.

Study eight is structured in two sections. Firstly, a hypothetical story detailing the development of a relationship was constructed and tested to examine whether it would be suitable in eliciting any variation in the reported mating preferences of women over the development of a relationship. The focus of the second section of the study was ensuring that the characteristics and activities that participants were asked to rate were reliable indicators of mating and parenting effort. To do this, the items which comprised the two factors stated by Gangestad et al. (2007) as being important in female mate choice were used to generate a pool of items to be tested. These items were synonyms of the items in Gangestad et al.'s (2007) research and other closely related words. These items were then distributed to a focus of group of evolutionary psychology undergraduate students who were asked to rate how representative each item was of 'mating effort' and 'parenting effort' in men.

6.6. Method 1: Story

6.6.1. Participants

Ten females aged 20-59 volunteered to participate in the first stage of study eight (examining the efficiency of the story). The study was advertised online on Facebook in 02/2014.

6.6.2. Materials and Procedure

A hypothetical relationship story (Appendix 6.G) was developed, detailing four important milestones in the development of a committed relationship presented as scenarios told from a woman's perspective. The scenarios were: first meeting a partner, the first anniversary, the fifth anniversary, and their first child's first birthday. Participants were asked to imagine that they were the person in the scenario and, following each scenario, they were presented with a list of 20 characteristics and asked; '*Thinking about this particular point in your relationship, please rate the importance of the man in this scenario having the following characteristics (1 = not at all important; 7 = extremely important)*'. They were then shown eight activities and asked: '*Thinking about this particular point in your relationship, please indicate how this man would ideally spend his waking time. Note the percentages must total 100%*'. Asking participants to specify a percentage of time was to prevent participants maximising preferences across all items. Research suggests that women will choose maximum indicators of mating and parenting effort indicators in an ideal scenario (Buss & Shackelford, 2008). Imposing a budget forces participants to demonstrate their preferences for when and where trade-offs between preferences for mating and parenting effort indicators are made (Jonason, Luevano, & Adams, 2012).

Stage one - first meeting**.** The subject of the scenario is a young, independent woman with a strong group of friends and no desire to meet a man and settle down. This section stresses she is happy in her current situation and while she would like to settle down in the future, there is no pressure for that to happen. She meets a man in this scenario, but feels no urgency for this to develop into a long-term commitment or to even see this man again because she is happy. This section indicates her priorities and mate preferences are biased toward mating effort indicators as she is not interested in a long-term relationship.

Stage two – first anniversary. The subject of the story reflects on the past year, following the unexpected development of a relationship with the man in the first scenario. Despite this being unexpected and unpressured, she is happy it happened. This section indicates a preference for mating effort to begin reducing.

***Stage three – fifth anniversary*.** The aim of this section was to exaggerate the feeling of commitment in stage two. Again, the subject reflects on the past five years with her partner and how they have become so integral to each other's lives. She is much more biased toward preferring her partner to reduce mating effort than she was in the previous section.

Stage four – child's first birthday. This section was designed to indicate a much more thorough bias toward parenting effort in the man in the story by introducing offspring into the hypothetical relationship development. Here, the subject of the story is again reflecting on the development of their relationship as they watch their firstborn at their birthday party. This scenario stresses extreme feelings of love and commitment aim between the adults and for their child, exaggerating her preference for her partner's mating effort to reduce.

Five items from Gangestad et al.'s (2007) research were used to generate a pool of items to be included as indicators of mating and parenting effort in this stage of the study. Synonyms of the original items were included as additional characteristics. Further characteristics and activities associated with mating and parenting effort were generated through discussions with supervisors. The complete list of characteristics and activities included in this stage of the study are shown in Table 6.3. Items were presented randomly after each scenario. Following the responses to the fourth scenario, participants were asked for feedback about the scenarios detailed in the study. Participants were provided with open text responses to detail whether they thought the scenarios were clear, and whether they thought there were any ambiguities in the scenarios. Participants were asked to indicate how well they could relate to each scenario on a Likert scale from 1 (*Can't identify with at all'*) to 4 (*Can identify with completely'*). This study was approved by the University of Research Sunderland Ethics Committee (Appendix 6.H).

Table 6.3.Characteristics and activities representing mating or parenting effort.

	Mating Effort	**Parenting Effort**
Characteristics	Attractive*	Faithful*
	Dominant	Warm*
	Extraverted	Kind
	Uninhibited	Loving
	Confident	Emotional
	Self-Assured	Modest
	Adventurous	Loyal
	Confrontational*	Reliable
	Assertive	Sensitive
	Charming	Intelligent*
Activities	Sport/Gym	Household Chores/Duties
	Socialising	Family Time
		Reading/Education
		Contacting you/Spending Time with You

* *taken from* Gangestad et al. (2007)

6.6.3. Design

This was an experimental, repeated measures design with two independent variables; the reproductive energy component (two levels; mating, parenting) and the relationship stage detailed in the scenario (four levels; first meeting, first year anniversary, fifth anniversary, first birthday of their child). Participants rated the importance of the man in each scenario as indicating mating effort (n = 10) and parenting effort (n = 10). The mean ratings were calculated each for mating and parenting effort, this was the first dependent variable. The second dependent variable was the percentage of time which participants had indicated the man in each scenario should ideally spend on activities associated with mating effort.

6.7. Results

A 2 (characteristic) x 4 (relationship stage) repeated measures ANOVA was conducted to analyse whether women indicated that it was less important for the man in the scenarios to indicate mating effort as the relationship progressed, and whether women indicated it was more important for the man to indicate parenting effort as the relationship developed. The means and standard deviations are presented in Table 6.4.

Table 6.4. Means and (standard deviation) of importance ratings (1-7 scale)

	First Meeting	First Anniversary	Fifth Anniversary	Child's First Birthday	Overall
Mating	5.06 (1.11)	4.48 (1.10)	4.21 (1.40)	4.12 (1.66)	4.47
Parenting	4.68 (.64)	5.40 (1.27)	5.71 (1.48)	5.99 (1.62)	5.44
Overall	4.87	4.94	4.96	5.05	4.95

Sphericity was violated for relationship stage, Mauchly's W = .05, χ^2 (5) = 23.01, p < .001, and for the interaction between relationship stage and characteristic type, Mauchly's W = .01, χ^2 (5) = 40.19, p < .001. The Greenhouse-Geisser correction was applied (relationship stage: ε = .41; interaction: ε = .37).

There was no main effect of relationship stage on importance ratings, F (1.22, 11.01) = 3.62, p = .602, η_p^2 = .039. There was a significant main effect of characteristic type on importance ratings, F (1, 9) = 6.09, p = .036, η_p^2 = .403. Characteristics associated with parenting effort (M = 5.44, SD = 0.38) were rated as more important in a partner than traits associated with mating effort (M = 4.47, SD = 0.35) overall. There was a significant interaction between relationship stage and characteristic type on importance ratings, F (1.12, 10.04) = 4.83, p = .034, η_p^2 = .393, shown in Figure 6.1.

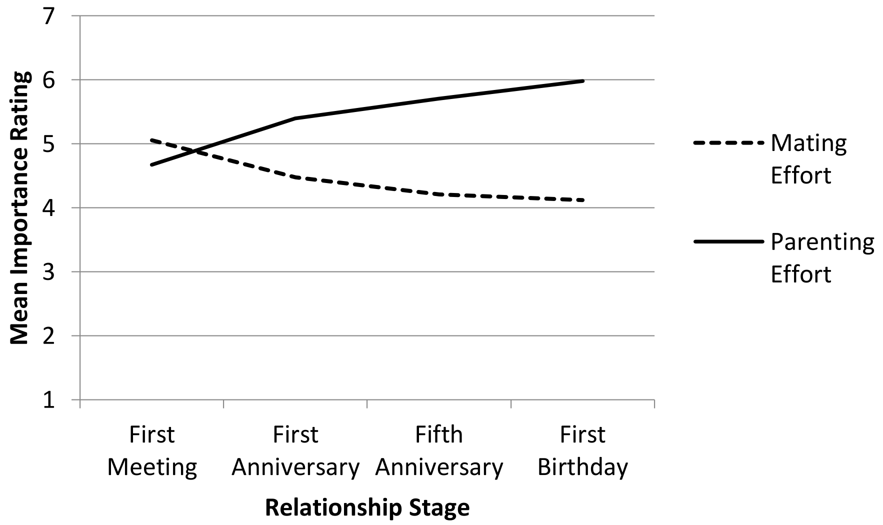


Figure 6.1. Interaction between characteristic type and relationship stage

Simple effects analyses were conducted on the first meeting and on the first birthday stages of the relationship in order to examine the differences in preferences of mating and parenting characteristics at the extremes of the relationship. This was to reduce the familywise error rate when making multiple analyses. There was no significant difference between preferences for indicators of mating effort (M = 5.06, SD = 1.10) and indicators of parenting effort (M = 4.67, SD = 0.64) at the first meeting, t (9) = 1.66, p = .131, d = 0.66, although the effect size is respectable. Characteristics indicating parenting effort (M = 5.98, SD = 1.62) were rated as more important at the child's first birthday than characteristics representing mating effort (M = 4.12, SD = 1.66), t (9) = 2.62, p = .032, d = 0.83.

The second analysis was a one-way repeated measures ANOVA examining the effect of relationship stage on desired time budget allocation into activities representing mating effort. The means and standard deviations are shown in Table 6.5.

Table 6.5. Mean (and standard deviation) of specified time allocated into activities (percentage)

	First Meeting	First Anniversary	Fifth Anniversary	First Birthday
Time (%) Mating Effort Activities	57.50 (12.30)	49.50 (11.65)	40.50 (10.91)	33.10 (10.67)

There was a significant effect of relationship stage on time budget allocation, F (3, 27) = 11.09, p < .001, η_p^2 = .552 (sphericity assumed, Mauchly's W = .37, χ^2 (5) = 7.60, p = .18). Desired time spent in activities associated with mating effort decreased in favour of activities associated with parenting effort as the relationship progressed. Bonferroni pairwise comparisons indicated significant declines from the first meeting to the fifth anniversary and first birthday, and the first anniversary to the first birthday (p < .05 in all cases).

6.8. Method 2: Characteristics and Activities

6.8.1. Participants

Twenty-nine participants (7 male, 22 female) aged 20-33 years (*M* = 21.66, *SD* = 2.65) were recruited as a specialist sample of evolutionary undergraduate psychology students from the University of Sunderland.

6.8.2. Materials and Procedure

The next stage of study eight was to validate items from the pool of items as being associated with mating or parenting effort. As in the first stage of study eight, the characteristics and activities used in this stage of the study were based on the two factors highlighted by Gangestad et al. (2007) as being important in female mate choice. However, the factors identified by Gangestad et al. (2007) included physical features and these were also included in stage one of study eight. Study 10 is concerned with personality and behaviours associated with mating and parenting effort rather than physical features. Physical features knowingly associated with indicators of genetic fitness, such as muscularity and a strong jaw line, were therefore excluded.

Participants rated a list of 30 characteristics and physical features, and 15 activities to indicate how representative they were of mating and parenting effort on a Likert scale of 1-5 (*not at all – completely*). 14 of these items aimed to be void of any connection with the concept of mating or parenting effort (neutral items). These neutral items were generated by consulting dating websites to see what kind of characteristics, features and activities were specified in dating adverts that were not representative of mating or parenting effort. The 30 items are shown in Table 6.6.

Table 6.6. Characteristics and activities rated by participants as how representative they are of mating and parenting effort

	Characteristics and physical features	**Activities**
Mating effort	Competitive	Spending time socialising with friends
	Extroverted	Doing household tasks such as DIY
	Self-Assured	Taking part in competitive sport to be as good as he can be
	Confrontational	Reading to better his career prospects
	Uninhibited	
	Charming	
	Dominant	
	Socially Respected	
	Adventurous	
	Assertive	
	Confident	
Parenting effort	Faithful	Doing household tasks such as grocery shopping
	Warm	Taking part in physical activity to keep fit and healthy
	Cooperative	Working additional hours to earn extra money
	Reliable	Spending time with his immediate family
	Sensitive	Contacting/spending time with you
	Loving	Reading for leisure
	Kind	
	Modest	
	Loyal	
	Intelligent	
Neutral	Funny	Watching films
	Logical	Sightseeing in other cities
	Tattoos	Playing videogames alone
	Tall	Taking photographs of wildlife for personal interest
	Short	Listening to music to relax
	Blue Eyes	
	Dark Hair	
	Green Eyes	
	Freckles	

6.8.3. Design

A repeated measures design was used. The aim was to examine whether each item was perceived to be representative of mating effort, parenting effort or neither, therefore each item used was an independent variable. Ratings of how representative each item were of mating effort, parenting effort, or neither, were provided on a 1-5 scale were the dependent variable.

6.9. Results

A series of repeated measures *t*-tests were conducted on the ratings of each item (for example, the first comparison was the ratings of *funny* as indicating mating effort *and* parenting effort). Items which were not significantly different from one another were excluded from further analyses. These results are shown in Table 6.7 and Table 6.8 and resulted in the exclusion of seven characteristics and physical features and four activities.

Table 6.7. Mean (and standard deviation) ratings of how representative each characteristic is of mating and parenting effort and paired sample t-test results

Item	M (SD) Mating	M (SD) Parenting	*t (df = 29)*	*p*	*d*
Neutral Items					
Funny*	2.10 (1.54)	2.41 (1.57)	-0.89	.380	-0.17
Blue Eyes	2.03 (1.45)	1.28 (0.70)	2.86	.008	0.58
Logical*	3.17 (1.49)	2.52 (1.66)	1.73	.095	0.32
Dark Hair	2.24 (1.50)	1.38 (0.82)	3.36	.002	0.71
Tattoos*	1.38 (0.90)	1.34 (1.08)	0.19	.851	0.05
Green Eyes	1.76 (1.27)	1.28 (0.84)	2.39	.024	0.47
Tall	4.14 (1.25)	1.86 (1.46)	6.49	<.001	1.21
Short*	1.24 (0.58)	1.17 (0.60)	0.53	.602	0.10
Freckles*	1.41 (0.98)	1.10 (0.41)	1.80	.083	0.39
Parenting Indicators					
Faithful	1.69 (1.17)	4.69 (0.60)	-13.19	<.001	-2.67
Loving	1.66 (1.11)	4.45 (0.91)	-12.17	<.001	-1.89
Warm	1.69 (1.23)	3.38 (1.55)	-4.86	<.001	-0.91
Kind	1.66 (1.14)	4.21 (1.11)	-7.88	<.001	-1.47
Cooperative	2.45 (1.52)	4.07 (1.19)	-4.04	<.001	-0.75
Modest	1.48 (0.99)	3.03 (1.40)	-5.40	<.001	-1.00
Reliable	1.72 (1.13)	4.10 (1.40)	-7.64	<.001	-1.45
Loyal	1.69 (1.20)	4.66 (0.86)	-12.07	<.001	-2.29
Sensitive	1.45 (0.83)	4.10 (1.21)	-8.88	<.001	-1.66
Intelligent	4.76 (0.79)	2.93 (1.85)	4.83	<.001	0.96
Genetic Indicators					
Competitive	4.14 (0.99)	2.00 (1.69)	5.01	<.001	0.95
Dominant	3.76 (1.30)	1.86 (1.25)	4.76	<.001	0.89
Extroverted	3.34 (1.34)	1.90 (1.08)	4.53	<.001	0.84
Socially Respected*	2.72 (1.53)	3.24 (1.50)	-1.03	.310	-0.19
Self-Assured*	2.66 (1.14)	2.45 (1.53)	0.57	.573	0.11
Adventurous	3.14 (1.48)	2.10 (1.52)	2.43	.022	0.45
Confrontational	2.59 (1.30)	1.38 (0.90)	5.03	<.001	0.97
Assertive	3.41 (1.45)	2.00 (1.25)	4.65	<.001	0.87
Uninhibited	2.34 (1.47)	1.72 (1.13)	2.16	.039	0.41
Confident	4.31 (1.69)	2.41 (1.74)	3.87	.001	0.72
Charming	3.72 (1.44)	2.45 (1.55)	3.29	.003	0.61

** items excluded from further analyses*

Table 6.8. Mean (and standard deviation) ratings of how representative each activity is of mating and parenting effort and paired sample t-test results

Item	M (SD) Mating	M (SD) Parenting	*t (df = 29)*	*p*	*d*
Neutral Activities					
Watching films	.59 (1.21)	1.07 (1.79)	-2.20	.037	0.46
Sightseeing in other cities*	1.86 (2.01)	1.69 (2.09)	0.50	.620	0.09
Playing videogames*	.48 (0.87)	0.69 (1.23)	-1.36	.184	0.28
Photographs of wildlife	.66 (0.97)	1.10 (1.50)	-2.15	.040	0.43
Listening to music	.79 (1.24)	1.38 (1.76)	-2.49	.019	0.50
Parenting Indicator Activities					
Household tasks (grocery shopping)	1.07 (1.22)	4.14 (1.36)	-12.14	<.001	2.26
Physical activity to keep healthy	4.52 (0.63)	2.38 (2.18)	5.48	<.001	1.26
Overtime to earn extra money	1.48 (1.66)	4.52 (0.69)	-9.38	<.001	1.91
Spending time with immediate family	1.55 (1.76)	3.76 (1.68)	-5.02	<.001	0.94
Contacting/spending time with you	1.28 (1.62)	4.31 (1.44)	-8.69	<.001	1.62
Reading for leisure*	2.03 (1.61)	1.86 (2.05)	0.40	.691	0.07
Genetic Indicator Activities					
Socialising with friends*	2.55 (1.07)	2.07 (1.75)	1.12	.273	0.25
Household tasks (DIY)	2.03 (1.88)	3.34 (2.08)	-2.59	.015	0.48
Competitive Sport	4.41 (1.05)	1.21 (1.47)	9.20	<.001	1.73
Reading to further career	2.17 (1.97)	3.55 (1.79)	-2.73	.011	0.51

** Items excluded from further analyses*

Twenty-three characteristics and traits, and 11 activities remained and were subject to a series of one-sample *t*-tests, using the median (3) as the test value. This highlighted which items were significantly better than the median in representing mating or parenting effort. Items not significantly different from the mean (seven characteristics, three activities) were excluded from further analysis. These results are shown in Table 6.9, 6.10 and 6.11.

Table 6.9. Mean difference from the median (and standard deviation) of the ratings of characteristics and traits representative of mating effort and one-sample t-test results

Item	**Mean difference from median**	***t (df = 28)***	***p***	***d***
Blue Eyes*	-1.52 (1.88)	-1.52	<.001	0.81
Dark Hair*	-1.28 (1.96)	-3.50	.002	0.65
Green Eyes*	-1.86 (1.68)	-5.95	<.001	1.11
Tall	1.03 (1.52)	3.66	.001	0.68
Faithful	-1.86 (1.55)	-3.88	<.001	1.20
Loving	-1.93 (1.51)	-6.89	<.001	1.28
Warm	-1.86 (1.60)	-6.28	<.001	1.17
Kind	-1.90 (1.52)	-6.72	<.001	1.25
Cooperative	-0.93 (1.91)	-2.63	.014	0.49
Modest*	-2.14 (1.36)	-8.49	<.001	1.58
Reliable	-1.86 (1.55)	-6.46	<.001	1.20
Loyal	-1.90 (1.59)	-6.43	.001	1.19
Sensitive	-2.17 (1.23)	-9.54	<.001	1.77
Intelligent	1.72 (0.96)	9.67	<.001	1.80
Competitive	1.10 (1.13)	5.34	<.001	0.98
Dominant	0.69 (1.47)	2.53	.017	0.47
Extroverted	0.75 (1.61)	1.56	.023	0.58
Adventurous*	0.07 (1.81)	-0.21	.839	0.04
Confrontational	-0.66 (1.63)	0.22	.039	0.40
Assertive	0.24 (1.77)	0.74	.468	0.14
Uninhibited*	-1.03 (1.86)	-2.94	.006	0.56
Confident	0.86 (1.51)	3.08	.005	0.57
Charming*	0.62 (1.66)	2.02	.053	0.38

** items excluded from further analyses*

Table 6.10. Mean difference from the median (and standard deviation) of the ratings of characteristics and traits representative of parenting effort and one-sample t-test results

Item	**Mean difference from median**	***t (df = 28)***	***p***	***d***
Blue Eyes*	-2.41 (1.05)	-2.41	<.001	2.29
Dark Hair*	-2.28 (1.19)	10.28	<.001	1.91
Green Eyes*	-2.48 (1.15)	-11.49	<.001	2.15
Tall	-1.70 (1.83)	-4.96	<.001	0.92
Faithful	1.69 (0.60)	15.07	<.001	2.80
Loving	1.41 (1.05)	7.23	<.001	1.34
Warm	1.54 (1.79)	2.73	.026	0.58
Kind	1.17 (1.23)	5.15	<.001	0.96
Cooperative	0.97 (1.48)	3.52	.001	0.65
Modest*	-0.17 (1.73)	-0.54	.596	0.01
Reliable	0.97 (1.72)	3.02	.005	0.56
Loyal	1.62 (1.02)	8.60	<.001	1.60
Sensitive	1.03 (1.40)	3.98	<.001	0.74
Intelligent	-0.52 (2.34)	-1.19	.244	0.22
Competitive	-1.45 (2.01)	-3.88	.001	0.72
Dominant	-1.59 (1.62)	-5.29	<.001	0.98
Extroverted	-1.55 (1.50)	-5.56	<.001	1.03
Adventurous*	-1.45 (1.96)	-3.99	<.001	0.74
Confrontational	-2.17 (1.23)	-9.54	<.001	1.77
Assertive	-2.12 (1.68)	-4.75	.006	0.88
Uninhibited*	-1.83 (1.54)	-6.40	<.001	1.19
Confident	-1.07 (2.17)	-2.65	.013	0.49
Charming*	-0.97 (1.97)	-2.64	.014	0.49

** Items excluded from further analyses*

Table 6.11. Mean difference from the median (and standard deviation) of the ratings of activities representative of mating and parenting effort and one-sample t-test results

	Item	Mean difference from median	*t (df = 28)*	*p*	*d*
Mating effort	**Watching films***	-2.41 (1.21)	-10.74	<.001	1.99
	Photographs of wildlife*	-2.35 (0.97)	-12.97	<.001	2.41
	Listening to music*	-2.21 (1.24)	-9.62	<.001	1.79
	Household tasks (grocery shopping)	-2.41 (1.22)	-8.51	<.001	1.97
	Physical activity to keep healthy	1.52 (0.63)	12.90	<.001	2.39
	Overtime to earn extra money	-1.52 (1.66)	-4.92	<.001	0.91
	Spending time with immediate family	-1.45 (1.76)	-4.42	<.001	0.82
	Contacting/spending time with you	-1.72 (1.62)	-5.72	<.001	1.06
	Household tasks (DIY)	-0.97 (1.88)	-2.77	.010	0.51
	Competitive Sport	1.41 (1.05)	7.23	<.001	1.34
	Reading to further career	-0.83 (1.97)	-2.27	.031	0.42
Parenting effort	**Watching films***	-1.93 (1.79)	-5.81	<.001	1.08
	Photographs of wildlife*	-1.90 (1.50)	-6.83	<.001	1.27
	Listening to music*	-1.62 (1.76)	-4.96	<.001	0.92
	Household tasks (grocery shopping)	-1.93 (1.36)	4.52	<.001	1.42
	Physical activity to keep healthy	-0.62 (2.18)	-1.54	.136	0.29
	Overtime to earn extra money	1.52 (0.69)	11.88	<.001	2.20
	Spending time with immediate family	0.76 (1.68)	2.43	.022	0.45
	Contacting/spending time with you	1.31 (1.44)	4.89	<.001	0.91
	Household tasks (DIY)	0.35 (2.08)	0.90	.378	0.17
	Competitive Sport	-1.79 (1.47)	-6.56	<.001	1.22
	Reading to further career	0.55 (1.79)	1.67	1.07	0.31

**items excluded from further analyses*

A principal components analysis would ideally be conducted on the remaining items to ensure they loaded onto factors representing mating or parenting effort. Due to the small sample size, a principal components analysis could not be conducted. The remaining items (Table 6.12) that were so far suggested to represent mating (*n* = 10) and parenting effort (*n* = 14) were subject to reliability analyses.

Table 6.12. Items remaining in the analyses which so far have been shown to represent mating or parenting effort

	Mating effort	**Parenting effort**
Characteristics and traits	Tall	Faithful
	Intelligent	Loving
	Competitive	Warm
	Assertive	Reliable
	Dominant	Kind
	Extroverted	Cooperative
	Confrontational	Loyal
	Confident	Sensitive
Activities	Physical activity to keep healthy	Spending time with immediate family
	Competitive sport	Spending time with/contacting you
		Household tasks (groceries)
		Household tasks (DIY)
		Overtime
		Reading to further career

'Intelligence' had originally been included as parenting effort, however it was rated representing mating effort. The reliability analysis showed 'intelligence' negatively correlated with the mating effort factor (-.26) and that by removing this item, the Cronbach's alpha of the mating effort items would increase from .58. to .64. This item was therefore excluded. 'Tall' had originally been included as a neutral item but this was rated as representing mating effort. The final items on the 'mating effort’ factor (n = 9) and on the ‘parenting effort’ factor (n = 14) are shown in Table 6.13.

Table 6.13. The final items to be used in study ten, representing indicators of mating and parenting effort, and their Cronbach’s Alpha values

Indicators of Mating Effort (9 items)	**Item-Total Correlation**	**Alpha if Item deleted**
Tall	.313	.62
Competitive	.466	.59
Confident	.665	.52
Assertive	.442	.58
Dominant	.360	.61
Extroverted	.154	.66
Confrontational*	.216	.64
Physical activity to keep healthy	.084	.59
Competitive sport	.215	.57
Final Alpha Value		**.64**
Indicators of Parenting Effort (14 items)		
Faithful*	.406	.68
Loving	.588	.65
Warm*	.301	.68
Kind	.356	.67
Cooperative	.362	.67
Reliable	.257	.69
Sensitive	.226	.69
Loyal	.330	.68
Spending time with immediate family	.109	.71
Spending time with/contacting you	.216	.69
Household tasks (Groceries)	.400	.67
Household tasks (DIY)	.400	.67
Overtime	.318	.68
Reading to further career	.407	.66
Final Alpha Value		**.70**

**taken from Gangestad et al. (2007)*

6.11. Discussion

The aim of study nine was to develop materials to measure variation in women's mating preferences over the development of a relationship (study 10). Firstly, a hypothetical relationship story was developed and its efficacy in studying variation in mate preferences was tested, then the adjectives and activities to be used in the story in study ten were optimised. Results indicated that the story is suitable for use; women rated it more important for men to display parenting effort, both in their characteristics and in how they spend their time, as a relationship developed at the expense of mating effort. There was no effect of relationship stage on overall ratings of importance, as expected. This means ratings of mating effort indicators are not maintained throughout the development of the relationship and indicators of parenting effort increase regardless, but it specifically indicates a trade-off in preferences are occurring as one decreases at the expense of the other. Feedback from this stage of piloting indicated that participants could relate to the story effectively.

In order to optimise the adjectives and activities to be used in study ten, work by Gangestad et al. (2007) was built upon. Gangestad et al. (2007) identified two factors important in female mate choice, indicators of genetic fitness and indicators of investment. Study eight built upon these factors to develop factors representing mating effort and parenting effort. This is because mating and parenting effort occupy opposite ends of the spectrum of reproductive energy and men must make trade-offs between these components. Mating effort must be engaged in by all men, however successful mating effort is fitness dependent and often relies on elevated testosterone levels. The items comprising the two factors identified by Gangestad et al. (2007) were expanded upon using synonyms and closely related words, with neutral characteristics, traits and activities also included. The factor comprising mating effort aimed to encapsulate testosterone dependent traits such as social dominance, whereas the factor representing parenting effort aimed to capture warmth and nurturing of intimate relationships. All of the items tested have face validity, however four items were excluded from the mating effort items, including two from Gangestad et al. (2007), and three items were excluded from the parenting items including a further one from Gangestad et al. (2007). The remaining items were all new additions.

The items excluded from the final mating effort indicators were: *socially respected, self-assured, adventurous, uninhibited and charming*. Three activities were also excluded from the final measure: *spending time socialising with friends*, *doing household tasks such as DIY*, and *reading to better his career prospects*. *Reading to better his career prospects* and *doing household tasks such as DIY* were included on the parenting effort measure. Potential reasons why these items might not have been included on the mating effort measure will now be discussed and a discussion of the parenting effort measure will follow.

Being socially respected seemed integral to achieving social dominance, which Mazur and Booth (1998) suggested was the function of testosterone in men. However it did not significantly differentiate between mating and parenting effort. Although Gangestad et al. (2007) included this item as an indicator of genetic fitness, they also showed that it cross loaded onto indicators of genetic fitness .86) and indicators of parenting effort (.40). It is therefore perhaps not surprising that in study eight, the ratings of *being socially respected* could not reliably differentiate between this representing mating effort and parenting effort. Henrich and Gil-White (2001) and Johnson, Burk and Kirkpatrick (2007) suggest that this can be understood by distinguishing between dominance and prestige. Dominance may lead to social status via competitiveness, supported by elevated testosterone levels, subject to aggression and intimidation if necessary (Ainsworth & Maner, 2012; Henrich & Gil-White, 2001; Johnson et al., 2007; Stulp et al., 2012); thus social respect achieved in this way may be more suggestive of genetic fitness and mating effort. Conversely, prestige is associated with low testosterone and can be achieved cooperatively due to status being freely bestowed upon these individuals. This is therefore more suggestive of parenting effort and favoured by women for long-term relationships (Kruger & Fitzgerald, 2011). This suggests the term 'social respect' may require more context in order to be able to reliably affiliate it with parenting or mating effort.

Being self-assured and charming has been implicated in the dark triad, which is a cluster of three malevolent personality traits (psychopathy, narcissism and Machiavllianism). Men who high in dark triad traits tend to be successful in short mating contexts (Jonason, Li, Webster, & Schmitt, 2009). Analysis of *charming* as an indicator of mating effort showed it was rated not significantly higher than the median The reason for this may be that *charming* is not *explicitly* perceived as attractive because it has a negative connotation. It is related to the Machiavellian strand of the dark triad and exploitative mating strategies (Jonason et al., 2009) which may bias the explicit perception of *charming*. *Charming* may be implicitly perceived as an indicator of mating effort in a more ecologically valid context, such as evaluating male behaviours for example.

Being adventurous and *uninhibited* were expected to indicate mating effort but this was not the case here. This may be due to the lack of context provided. Such traits are suggested to be associated with displays of genetic fitness as their associated risks makes them costly. A man with these traits who can successfully withstand the potential consequences of them will be perceived as genetically fit, however men who are not successful. Regardless of individual success, such behaviours should still indicate a mating oriented allocation of reproductive energy. While more context may have helped provide more nuanced ratings of *being adventurous* and *uninhibited*, traits such as these where their success lies more within their successful execution may suffer more negative bias in self-report scenarios such as this.

The activities *socialising with friends*, *engaging in household tasks such as DIY* and *reading to further his* career were also rejected from the final mating effort factor. *Socialising with friends* was intended to represent a care-free attitude and the directing of resources into one's friends and activities that may involve mating effort, however it was perceived as neutral. Again, this may be due to the lack of contextualising information. It was expected that household DIY would represent mating effort due to the physical effort it requires. Likewise it was expected that 'reading to further his career' would represent mating effort because of the determination and striving this involves. However both of these items were rated as representing parenting effort. In retrospect this is understandable; they both focus on future rewards and provisioning components. Conversely, the activity 'physical activity to keep healthy' had been expected to indicate parenting effort due to the association with longevity, an important factor in parenting effort and a slower life history strategy. However this was rated as representing mating effort, along with taking part in competitive sport. Taking part in physical activity to keep healthy could be likened to intrapersonal competitiveness where there is no explicit competitive element, and the goal is to better oneself. If this was the case, it would support the suggestion that an evolutionary perspective may subsume the interpersonal and intrapersonal competitiveness dichotomy, with both elements ultimately serving the same goal of mating effort.

None of the items identified by Gangestad et al. (2007) as indicating parenting qualities were excluded from the measure developed in this study, however *intelligent* was excluded which Gangestad et al. (2007) had included as an indicator of genetic fitness and study nine tested as an indicator of parenting effort. An additional item that was also expected to indicate parenting effort was *modest,* but this was also excluded. One activity, *reading for leisure,* was excluded from the parenting effort measure. Potential reasons why these might not have been included on the parenting effort measure will now be discussed.

In the parenting effort factor, *modest* was not significantly higher than the median of parenting effort and was therefore excluded. *Intelligent* was expected to indicate parenting effort however it was rated as representing mating effort. Retaining this item compromised the reliability of the mating effort items as it negatively correlated with the other indicators of mating effort, therefore it was removed. There is some discrepancy in the literature regarding whether intelligence is better thought of as indicating mating effort or parenting effort. It might be thought to indicate mating effort because it has a strong heritable component, which suggests genetic fitness (De Fries, McGuffin, McClearn, & Plomin, 2000). However, intelligence is also associated with various indicators of provisioning, such as longevity, health, socioeconomic status, and income (Gangestad et al., 2007) suggesting it represents parenting effort. Thus intelligence could easily be perceived as indicating both mating and parenting effort (Buss & Shackelford, 2008; Gangestad et al., 2007) and this could lead to uncontrolled variance in the data of study ten, therefore it was excluded. This may also apply to *reading for leisure*, which had been expected to indicate parenting effort due to its connotation with intelligence. *Reading for leisure* was rated as neutral, indicating it represented neither mating or parenting effort, therefore it was excluded.

One slight anomaly in these findings was the inclusion of *tall* in the final set of items representing mating effort. This item had been included as a neutral item. Efforts were made when designing the items to be included in this study to exclude physical indicators of genetic fitness in order to focus on inherent traits representative of genetic fitness which may therefore indicate mating effort. However, height has been found to have a curvilinear relationship with reproductive success in men (Stulp, Pollet, Verhulst, & Buunk, 2012), which suggests height can be likened to a costly signal of genetic fitness; it is highly heritable, dependent upon environmental factors such as pathogens and diet, and reproductive success positively correlates up to the average height in men, after which reproductive success reduces so reproductive success negatively correlates in men of average-to-tall height. This suggests height may be sexually selected only until the point where becomes problematic. Height is positively associated with social status (Ellis, 1992; Stulp, Buunk, Verhulst, & Pollet, 2015; Stulp et al., 2012), which Stulp et al. (2015) suggests is due to the increased likelihood of taller men being dominant and successful in intrasexual competition. This seems to challenge the suggestion by Johnson et al. (2007), that dominance is achieved competitively supported by high testosterone levels and prestige is achieved cooperatively, supported by with lower testosterone levels, as ‘social respect’ was not affiliated with either factor yet ‘tall’ has been associated with mating effort. It is suggested here that as height is a physical trait, it is more likely to be perceived as being predominantly genetic, and therefore an indicator of genetic fitness and affiliated with mating effort, and the environmental influences on height may be more likely to be overlooked. As social respect is not physical, this can be more ambiguous and difficult to assign to either factor. This supports the earlier suggestion that more context may be needed for some of these items to be accurately interpreted; tall men may be perceived as more dominant and able to achieve higher status due to this association with competitiveness, whereas shorter men may achieve social status *cooperatively*, a trait that was associated with parenting effort and included on the final set of items.

In conclusion, study eight has developed new materials for use in study ten (Chapter 8) to examine whether female mate preferences of indicators of mating and parenting effort vary over the development of a relationship. Two clusters of items were developed, nine items representing indicators of mating effort, and fourteen items indicating parenting effort. Some items which were expected to be included here (such as being socially-respected and self-assured) were excluded from further use. The suggested reason for this is a lack of context surrounding these terms which may be overtly perceived as unattractive in a self-report scenario but may be covertly perceived as attractive in observable, behavioural contexts. Study ten relies on self-report ratings of mate preferences therefore behaviours and characteristics which may only be perceived as attractive behaviourally would not be suitable. The four-stage hypothetical relationship also appears suitable for use in study ten because overall importance ratings were comparable at each relationship stage, regardless of whether the ratings were of indicators of mating or parenting effort. However the *type* of effort rated changed at each stage, indicating participants were sacrificing importance in one type of effort for another. Ideally, the traits and activities to be used in study ten would have been finalised before testing the suitability of the story, however the fact that this did not happen is not thought to be a problem because the story still appeared able to encourage participants to demonstrate a shift in their mate preferences.

Chapter 7. The Effect of Primed Relationship ‘Satisfaction’ on Competitive Behaviour in Men

7.1. Introduction

This thesis has argued that in men, an adaptive baseline of reproductive energy has been sexually selected, whereby mating effort increases around adolescence and decreases at around the age of 30. This baseline then calibrates with cues relevant to reproductive success in order to ‘speed up’ or ‘slow down’ mating strategy in an individually adaptive way. This means that if men secure reproductive resources such as a partner and/or offspring prior to the age of 30, their mating effort may reduce earlier to encourage provisioning. Conversely, if men have not secured reproductive resources by the age of 30, they should maintain mating effort. However, some men do not reduce their mating effort despite having secured reproductive resources. Men who retain mating effort despite being partnered follow a fast mating strategy characterised by increased mating effort at the expense of parenting effort. Evidence suggests that men following a fast mating strategy have higher testosterone levels than men who reduce their mating effort in favour of parenting effort (Alvergne et al., 2009; Edelstein et al., 2011, 2014; Mcintyre et al., 2006). Testosterone is the biological correlate of mating effort; therefore, this supports the suggestion that these men remain motivated by mating effort. The current research suggests that competitiveness is the behavioural facet of mating effort and should therefore remain elevated in men with extra-pair interests.

Chapters 3 and 4 discussed the robust finding that marriage and fatherhood have a depressive effect on men’s testosterone levels as well as the more recent research which documents anomalies to this. Cumulatively, this research suggests that proximate environmental cues, such as the presence of others who may impact on reproductive success, informs the calibration of reproductive energy in an individually adaptive manner. This sometimes results in men with reproductive resources maintaining mating effort if they unconsciously perceive that this would benefit their reproductive success. For instance, Farrelly et al. (2015) showed testosterone levels do not immediately decrease on entering a relationship, neither are testosterone levels and relationship length correlated. They demonstrated testosterone decreases at around the first anniversary of being in a committed relationship, from being comparable to single men to the level typically reported of men in relationships. The authors interpret this as evidence of a delay in mating effort reduction until the presence of relevant environment cues reach a certain threshold to trigger this. In support of this, research suggests testosterone levels remain elevated to support mating effort in partnered men who maintain extra-pair interests (Anders et al., 2007; Edelstein et al., 2011; Mcintyre et al., 2006), in men who report being less invested and satisfied in their relationship (Edelstein et al., 2014) and in polygynous men (Alvergne et al., 2009). It appears that in these men, the calibration of cues that informs mating strategy indicates that their reproductive success would ultimately benefit from maintaining mating effort at the expense of investing in their relationships. Their testosterone levels therefore remain elevated in order to support mating effort. As competitiveness is implicated as a behavioural facet of mating effort it is suggested this will also remain elevated in men who maintain mating effort regardless of their relationship and/or parental status.

If men are not sensitive to cues relevant to mating strategy, and/or if they fail to calibrate reproductive energy adaptively, they risk maladaptive allocation resources, potentially limiting their reproductive success. For example, if cues indicated that a less-fit partnered man should refrain from pursuing additional mates and invest in existing reproductive resources, then his mating effort (testosterone and competitiveness) should decrease. Failing to decrease his mating effort would be at the expense of provisioning resources, reducing their survival prospects. However, it is also unlikely that he would be able to secure alternative mates as he would be less able outcompete rivals. Failure to provision resources would therefore severely compromise his reproductive success. This would also signal to the primary partner that she may be abandoned and motivate her to seek another in order to protect her own reproductive success. It would therefore be adaptive in this scenario for him to reduce mating effort in favour of parenting effort. Evidence of this has been documented both in testosterone fluctuations (Burnham et al., 2003; Gray et al., 2002) and in many competitive arenas, for example in sport, academia, art and poetry (Farrelly & Nettle, 2007; Kanazawa, 2000, 2003), as discussed in Chapter 3.

The research presented in this thesis supports the suggestion that men must reduce their mating effort as reproductive resources are secured. Studies four, five and six all show that single men are more motivated to compete than committed fathers. This evidence supports life history theory and the suggestion that competitiveness is a form of mating effort which reduces once appropriate resources are secured. However, as discussed, this would not happen in men whose mating effort did not decrease. As discussed in section 6.2, assessing extra-pair interests using the ExPI in studies three and four has been difficult and the competitiveness of men with high extra-pair interests has not been fully examined. There are two potential reasons for this. Firstly, individuals may find it difficult to admit to having extra-pair interests despite the ExPI asking participants to respond to hypothetical scenarios of additional mating interests. Secondly, it may be that the samples in studies three and four genuinely had low levels of extra-pair interests. Study nine uses the relationship ‘satisfaction’ primes developed in study seven (reported in Chapter 6) in an effort to overcome the limitations of relying on self-report measures of extra-pair interests.

The priming methods used in studies four and six (reported in Chapters 4 and 5) were not successful in increasing mating effort in men. There is much evidence which is in favour of mating motives increasing mating effort in men, which is why it was suggested that the mating motives stimuli used in studies four and six were not suitable. Specifically, it is thought that the materials used in studies four and six were too ‘passive’ to induce a mating mind-set. In study four, participants viewed photographs of women then wrote about their ideal first date with one of these women. However, the subjects in the photographs were rated as only moderately attractive, which may not have been able to activate a mating mind-set in men. In study six, participants saw photographs of people at the same time as participating in an online competitive game. However, there was no context to these photographs; participants were informed that this was a memory study and therefore they had to remember details about the subjects in the pictures. This may mean that men were not motivated to engage in mating effort because no-one was actively receiving their signals (Cottrell et al., 1968). Other studies that have used similar visual methods to induce a mating mind-set have told participants that they were being evaluated by the subjects in the photograph. This may be why these studies were successful and study six was not.

As discussed in Chapter 6, priming adjustments to an individual’s mating strategy is extremely complex because it is informed by many cues, such as mate value and the presence of alternative mates. Priming such complex concepts require substantial primes with more control over additional variables and for participants to actively engage with them (Kay & Ross, 2003). The primes which will be used in study nine were designed to address these issues by being textual rather than visual, which allows more detail to be included compared to using passive, visual primes.

The primes, developed in study seven, are detailed scenarios describing the feelings of a male subject about his primary relationship. They are called ‘satisfied’ and ‘unsatisfied’ relationship primes because they provide a more summative account of numerous relevant cues that indicate that the male subject described in each prime is either satisfied in his relationship and does not have additional mating interests, or is unsatisfied in his relationship and does have additional mating interests. Internal cues such as age and senescence are inherently controlled for as both primes imply the subject is of reproductive age. The subject’s mate value is controlled for by the content of the prime which details his feelings about his partner and their relationship. Specifically, in the ‘satisfied’ prime, he emphasises his fulfilment from their relationship whereas in the ‘unsatisfied’ prime he emphasises his lack of commitment to the relationship. This also applies to the issue of relative mate value between the subject and his primary partner by emphasising his feelings towards her. The ‘satisfied’ prime emphasises feelings of warmth, love and contentment and reduced interests in extra-pair opportunities, whereas the ‘unsatisfied’ prime emphasises feelings of unhappiness and despondency with regards to the relationship and higher extra-pair interests. Furthermore, the ‘unsatisfied’ prime includes the presence of a potential alternative mate. Therefore, the ‘unsatisfied’ prime aimed to increase mating effort and the ‘satisfied prime’ aimed to increase parenting effort. Study seven indicated these primes had face and content validity when participants were asked to respond as if they were the subject in the scenario, however whether these materials can implicitly activate the relative cognitive facets of mating effort and parenting effort has not yet been tested and will be examined in study nine.

Four hypotheses were tested in study nine. It is expected that there will be an effect of relationship/parental status on competitive motivation (the number of attempts made on the circles and squares game) but not on competitive performance (the score achieved in the circles and squares game) or on reported extra-pair interests (ExPI scores) (Hypothesis 1). Following exposure to an 'unsatisfied' relationship prime, men are expected to show greater competitive motivation and extra-pair interests than men primed with a 'satisfied' relationship, but there will be no difference in competitive performance (Hypothesis 2). It is also suggested that relationship/parental status will interact with the priming condition, so that the 'satisfied' prime will exaggerate parenting effort in committed fathers, evidenced by reduced competitive motivation; and the 'unsatisfied' prime will exaggerate mating effort in single non-fathers, evidenced by greater competitive motivation. Mating effort and experimental prime should similarly interact for scores on the ExPI; single men in the unsatisfied condition will score higher on the ExPI than single men in the satisfied condition, and committed men in the satisfied condition will have lower ExPI scores than committed men in the unsatisfied condition. Conversely, no interaction between relationship/parental status and prime is expected on competitive performance (Hypothesis 3). Finally, mating strategy (ExPI scores) should positively predict competitive motivation, but not competitive performance (Hypothesis 4).

7.2. Method

7.2.1. Participants

Heterosexual men (n = 128) were recruited for this study through opportunity sampling. Ages ranged from 16-69 (*M* = 26.38 years, *SD* = 10.38). The study was advertised online from 11/2014-02/2015 on social media (such as Facebook and Twitter) and psychology research participation websites (such as Psychological Research on the Net, Hanover College). Students of Sunderland University received partial course credit for participation and non-students received no incentive for participation.

7.2.2. Design

The experimental aspect of this study had two independent-groups independent variables; experimental prime (which participants were randomly allocated to), 'satisfied' or 'unsatisfied', and relationship/parental status with four levels; single fathers, single non-fathers, committed non-fathers and committed fathers. Participants were classified as single if they reported being single or casually dating and participants were categorised as being in committed relationships if they reported being in long-term relationships, cohabiting, or married. There were three dependent variables, ExPI scores, the score on the competitive game, and the total number of attempts made on the competitive game. The correlational aspect used ExPI scores as the predictor variable and the number of attempts made and score on the competitive game as the outcome variable.

7.2.3. Materials and Procedure

Participants accessed the study online, read the study information (Appendix 7.A) and provided consent (Appendix 7.B). Participants were then randomly allocated to one of the experimental conditions and provided demographic information (Appendix 7.D). Participants then read their allocated scenario and completed the three questions embedded in the story. Both primes are written from a man's perspective who is reflecting on his relationship with his partner. In the 'satisfied' prime, the man reflects warmly on his relationship and is about to propose marriage signifying no extra-pair interests. The man in the 'unsatisfied' prime reflects sadly on his relationship, explaining it had been warm but no longer is. He is now interested in pursuing an alternative mate despite being in a relationship. These two primes (Appendix 6.A and Appendix 6.B) were of a similar length (approximately 800 words), used easily readable language, and asked questions of the participants at three points. These questions were appropriate to the preceding section of the scenario in order to encourage engagement with the prime. Following the final section of the prime, participants were presented with the leader board and instructions for the circles and squares game (as in study four). They were informed of the aim of the game and selected a shape then played the game. Once the game was over, participants completed the ExPI (Appendix 2.A). This task was presented last in order to prevent the prime consciously influencing responses on the ExPI. Participants were then debriefed (Appendix 7.E) and reminded of the contact details of the researchers should they have any queries. This study was approved by the University of Sunderland research ethics committee (Appendix 7.C).

7.3. Results

The data from single fathers (*n*=4) were excluded from analysis due to low recruitment rate, therefore mating effort became a three level independent variable (single non-fathers, committed non-fathers and committed fathers). The age range of the final sample was 16-69 (*M* = 25.92 years, *SD* = 10.14). Full demographic characteristics of the final sample are shown in Table 7.1.

Table 7.1. Sample demographic characteristics

		n = 124	**%**
Relationship status	Single	51	41.13
	Casually dating multiple people	4	3.23
	Casually dating a single person	11	8.87
	Long term relationship	26	20.97
	Cohabiting	12	9.68
	Married	20	16.13
Parental status	No children	103	83.06
	Children	21	16.94
Nationality	British	75	60.48
	Other European	14	11.29
	Asian	4	3.23
	North American	28	22.58
	South American	2	1.61
	Antarctica	1	0.81
	Secondary/high school	18	14.52
	1 + year of university	67	54.03
	University degree	25	20.16
	Postgraduate degree	14	11.29

7.3.1. Parametric Assumptions and Data Analysis

The assumption of normality was violated for ExPI scores ($p < .001$), the score on the game ($p < .001$) and the number of attempts made on the game ($p < .001$). Levene's test indicated the assumption of homogeneity of variance was met for the ExPI scores, F (5, 118) = 1.25, $p = .289$; the score on the game, F (5, 118) = 1.63, $p = .157$; and the number of attempts on the game, F (5, 118) = 1.67, $p = .146$.

The effect of relationship/parental status (Hypothesis 1), the effect of experimental prime (Hypothesis 2), and the interaction between the two (Hypothesis 3) were addressed using a single ANOVA for each dependent variable of competitive motivation, competitive performance, ExPI scores. ANCOVAs were not suitable because the assumption of independence between age (covariate) and relationship/parental status was violated (showing committed fathers tended to be older). There was a negative correlation between age and the number of attempts made on the game (r (122) = -.34, $p < .001$), no correlation with score, (r (122) = .03, $p = .777$), and a positive correlation with ExPI scores in committed men only (r (56) = .38, $p = .004$). Analyses proceeded with a two-way, two (relationship prime) x three (relationship/parental status) independent groups ANOVA on each dependent variable. The analysis of Hypothesis 4 is discussed in section 7.4.5.

7.3.2. Hypothesis 1. There will be an effect of relationship/parental status on competitive motivation. Single men will be more motivated to compete than committed fathers. There will be no effect of mating effort on competitive performance or on ExPI scores. There was no effect of relationship/parental status on ExPI scores, F (2, 118) = 1.70, $p = .187$, $\eta_p^2 = .028$; or the score in the competitive game, F (2, 118) = 0.14, $p = .986$, $\eta_p^2 < .001$, however there was a main effect of relationship/parental status on the number of attempts made in the game, F (2, 118) = 5.69, $p = .004$, $\eta_p^2 = .088$. Tukey post hoc tests showed single non-fathers

(M = 336.25, SE = 15.14) made more attempts than committed fathers (M = 236.96, SE = 27.07). The descriptive statistics are shown in Table 7.2.

Table 7.2. Mean (and standard error) for the effect of relationship/parental status on each dependent variable.

Measure	Single Non - Fathers	Committed Non-Fathers	Committed Fathers
ExPI score	18.46 (0.72)	17.44 (0.96)	20.40 (1.23)
Score on the game	9.74 (1.06)	9.71 (1.42)	9.34 (9.34)
Attempts on the game	336.25 (15.14)	286.90 (20.19)	236.96 (27.07)

7.3.3. Hypothesis 2. There will be an effect of experimental prime on competitive motivation and on ExPI scores with 'unsatisfied' men making more attempts on the game and scoring higher on the ExPI than 'satisfied' men. There will be no effect of experimental prime on competitive performance. There was no effect of experimental prime on ExPI scores, F (1, 118) = 0.96, p = .330, η_p^2 = .008; the score obtained on the game, F (1, 118) = 2.15, p = .145, η_p^2 = .018; or the number of attempts made on the game, F (1, 118) = 1.85, p = .177, η_p^2 = .015. The descriptive statistics are shown in Table 7.3.

Table 7.3. Means (and standard error) of the effect of experimental prime on the dependent variables.

Measure	'Satisfied' prime	'Unsatisfied' prime
ExPI score	18.19 (0.86)	19.34 (0.80)
Score on the game	8.34 (1.27)	10.88 (1.18)
Attempts on the game	269.94 (18.12)	303.47 (16.75)

7.3.4. Hypothesis 3. There will be an interaction between relationship/parental status and experimental prime on competitive motivation and ExPI scores.

Single men in the ‘unsatisfied’ condition will make more attempts on the game than single men in the ‘satisfied’ prime, and committed men in the ‘satisfied’ prime will make fewer attempts on the game than committed men in the ‘unsatisfied’ prime. There was no interaction between relationship/parental status and relationship prime on ExPI scores, F (2, 118) = 0.23, p = .797, η_p^2 = .004; the score in the game, F (2, 118) = 0.45, p = .642, η_p^2 = .007; or the number of attempts made, F (2, 118) = 0.40, p = .671, η_p^2 = .007. The descriptive statistics are shown in Figure 7.1, Figure 7.2, and Figure 7.3.

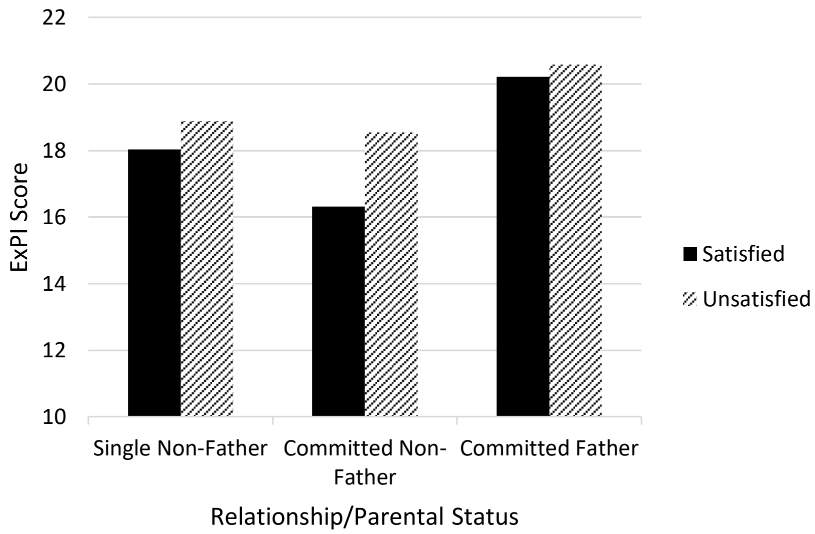


Figure 7.1. Mean ExPI scores for the interaction between relationship/parental status and experimental prime

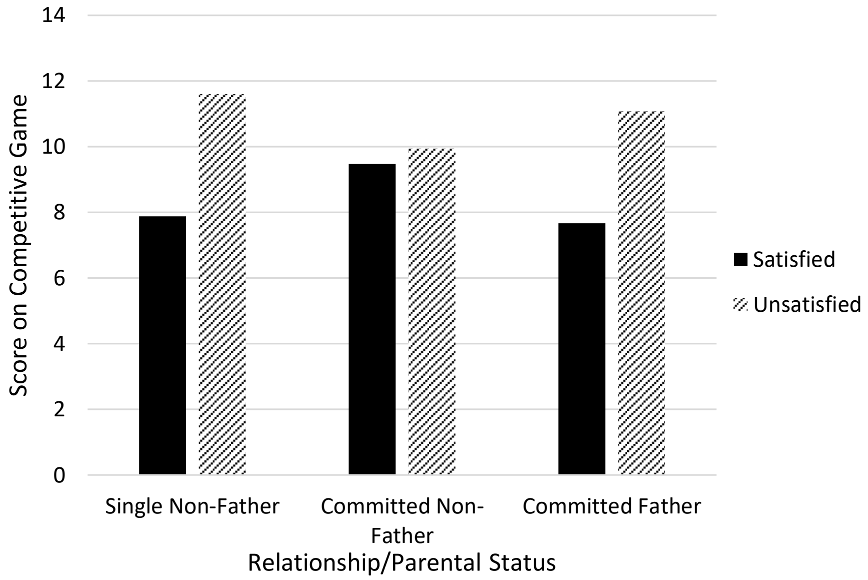


Figure 7.2. Mean score on the game for the interaction between relationship/parental status and experimental prime

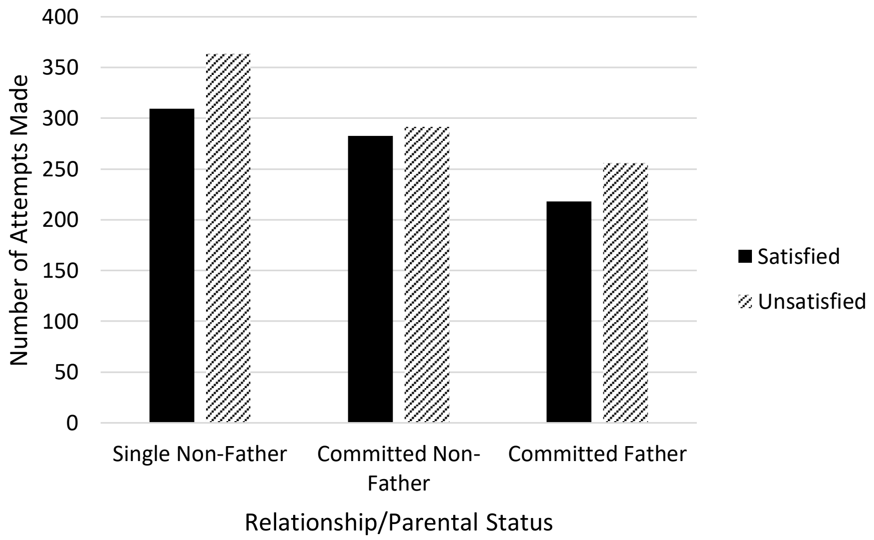


Figure 7.3. Mean number of attempts made for the interaction between relationship/parental status and experimental prime

7.3.5. Hypothesis 4. Mating strategy (ExPI scores) will predict competitive motivation, but not competitive performance. Two simple linear regression analyses were conducted to examine whether ExPI scores (the predictor) predicted competitive performance (score on the game) and motivation (the number of attempts made on the game) (outcome variables). ExPI scores did not significantly predict the number of attempts made, (t = -1.43, p = .159). The final model was not significant, F (1, 56) = 2.04, p = .159, and explained 3.5 percent of the variance in the data. ExPI did not predict score on the game, (t = -1.11, p = .912). The final model was not significant, F (1, 56) = .01, p = .912, and explained none of the variance in the data.

These analyses have not enabled any firm conclusions about the implicit effectiveness of the relationship primes in influencing mating behaviours. This may be because the experimental primes cannot override the effect of relationship/parental status on competitive motivation. In order to explore the implicit effectiveness of the primes in adjusting mating effort, a hierarchical multiple regression analysis was conducted to examine the variance in competitive motivation due to the experimental primes *after* controlling for relationship/parental status. The Tukey post hoc tests in the analysis of Hypothesis 1 indicated that single non-fathers made significantly more attempts on the competitive game than committed fathers. These two levels of the mating effort independent variable were therefore dummy coded and entered into the regression model at step one. The experimental prime was entered at step 2. There was no evidence of multicollinearity between the two predictor variables; the correlation was small (r = .043), the value of VIF was 1.01 and did not approach the cut off of 10, and the value of Tolerance was 0.99 and did not approach the cut off of 0.2. Inspection of the collinearity diagnostics table detected three eigenvectors underlying the dataset, further supporting the absence of multicollinearity. The value of Durbin-Watson was 1.84, which is in the acceptable range of 1.5-2.5, indicating the assumption of independence of errors was met. Inspection of the histogram and P-P plot indicated the residuals were normally distributed. Finally, inspection of the plots of standardised predicted values against standardised and studentised residuals indicated the assumption of homoscedasticity was met.

Relationship status significantly predicted the number of attempts made on the competitive game, $t = 2.68$, $p = .008$, where single men made more attempts than committed fathers, as demonstrated in the analysis of Hypothesis 1. This explained 5.5 percent of the variance in the number of attempts made. The experimental prime did not significantly predict the number of attempts made on the game, $t = 1.77$, $p = .079$, although this did explain a respectable amount of the variance in the data after controlling for the variance explained by mating effort (2.4 percent). The final model was significant, F (2, 120) = 5.21, $p = .007$ and explained 7.9 percent of the variance in the data. The coefficients are shown in Table 7.4.

Table 7.4. Coefficients for the hierarchical multiple regression analysis on competitive motivation (the number of attempts made in the competitive game)

	B	***SE* B**	**β**
Step 1			
Constant	319.52	12.28	
Mating effort	-79.86	29.85	-0.24
Step 2			
Constant	259.91	35.82	
Mating effort	-82.10	29.62	-0.24
Experimental prime	39.36	22.24	0.16

R^2 = .055 at Step 1*, Δ R^2 = .024 at Step 2.

* $p < .01$

7.4. Discussion

The research reported in this thesis supports the suggestion that competitiveness is a male mating behaviour (Wilson & Daly, 1985). Studies four, five and six showed competitive motivation was lower in committed fathers than in single non-fathers. As men secure reproductive resources, their competitiveness decreases allowing them to divert their reproductive energy into parenting effort. This has been shown in various cultural domains such as in sport, art and academia (Farrelly & Nettle, 2007; Kanazawa, 2000, 2003). Testosterone levels are suggested to support this, and have been shown to fluctuate consistent with predictions from life history strategy (Burnham et al., 2003; Gray et al., 2002). Furthermore, research shows testosterone remains high in partnered men if they indicate an interest in pursuing additional mates (Edelstein et al., 2014; Mcintyre et al., 2006). This indicates they are engaged in mating effort, and should also display mating behaviours. Studies three and four highlighted difficulties in measuring extra-pair interests; studies four and six also suggested visual primes of mating motives similar to those used in previous research did not affect competitiveness in men as a hypothesised mating behaviour. Study nine aimed to examine whether more detailed textual primes would influence men's mating behaviours, consistent with the evolutionary theoretical

Four hypotheses were tested in study nine. Relationship/parental status was expected to affect competitive motivation in men, consistent with the theoretical basis and the results of studies four, five and six (Hypothesis 1). This was supported; single non-fathers made significantly more attempts on the game than committed fathers. As in studies four and six, committed non-fathers made non-significantly fewer attempts than single non-fathers and non-significantly more attempts on the game than committed fathers. This provides evidence in support of life history theory and the challenge hypothesis as it indicates the motivation to compete reduces in men as they secure reproductive resources. It was also predicted that there would be no effect of relationship/parent (score obtained in the competitive game), or on ExPI scores, which was also the case here. This further supports the suggestion that competitive motivation is a better indicator of mating effort than competitive performance, and is also consistent with studies four, five and six, was well as previous research (for example, Farrelly & Nettle, 2007; Kanazawa, 2000, 2003; Miller, 2001). This then suggests that competitive motivation is a behavioural facet of mating effort in men which they have been sexually selected to reduce as reproductive resources are acquired.

It was also suggested that there would be an effect of the experimental prime on competitive motivation and ExPI scores, whereby participants allocated to the 'satisfied' prime would be less motivated to compete and core higher on the ExPI than participants in the 'unsatisfied' condition. It was expected that there would be no effect of the experimental prime on competitive performance, as this is not an indicator of mating effort (Hypothesis 2). While the differences in the means of all three of the dependent variables were in the expected directions consistent with the primes, they were not significant and the effect sizes were small ($n_p^2 = .008$ for ExPI scores, $n_p^2 = .015$ for the number of attempts, and $n_p^2 = .018$ for the score). This indicates that the differences between the means was either due to random variation, or that the primes have a very weak influence on participants. One potential reason for this concerns the difficulty in priming complex facets.

Priming multi-faceted and complex concepts is difficult because there will be much variation in the measured responses (Wilson, 2013). Extra-pair interests, as discussed, are informed by many cues including senescence, mate value, relative mate value, the presence of rivals, and the presence and availability of alternative mates. It is a complex concept which makes it difficult to find consistent effects of priming materials on extra-pair interests. Semantic priming is very successful in cognitive psychology research because it primes relatively simple concepts. When attention is directed to a prime, individuals are then quicker to respond to a semantically related target. This process is automatic therefore there is less variation in the response to the prime, it is predictive, and the results are more easily replicable and less disputable (Zwann, 2015). When additional concepts are included in the prime, it introduces more variance in the responding, particularly for concepts that are under conscious control. This was discussed in study four where it was suggested that cues in the environment which indicate reproductive success can ultimately be increased, such as the presence of a potential mate, testosterone levels should increase because they are beyond conscious control (Loewenstein, 1996). However, associated mating behaviours are under conscious control and may be consciously attenuated to engage in relationship maintenance (Frankenhuis & Karremans, 2012). Mating behaviours may be adjusted because the threshold which causes mating effort to increase is not reached, and this threshold is subject to individual variation. For example, if a man is in a relationship with someone who has a much lower mate value than himself, his reproductive success may benefit from seeking alternative mating opportunities. Conversely, as discussed previously, if a man has secured a partner of comparable mate value to himself, pursuing alternative mating opportunities will likely damage his reproductive success. Mate value in turn is based on many cues, including age and the sex ratios in the environment. It is therefore perhaps easier to understand how attempting to artificially influence allocation of reproductive energy is more difficult than anticipated. It is difficult to predict how an individual will respond to such primes because it is difficult to take all of these cues into consideration. Attempting to activate multi-faceted, complex evolved cognitive predispositions such as mating effort will inevitably lead to more variation in the responses due to the increased number of activated cues and their subsequent interactions (Wilson, 2013). Thus in the current study (and those utilising similar priming methods), small effect sizes (if any) would perhaps be expected due to the many cues which inform the calibration of reproductive effort, the myriad interactions between such cues, compounded with individual variation of these aspects when utilising a between subjects design.

Griskevicius has previously utilised many different forms of priming methods as discussed in Chapter 7. In one particular example Griskevicius et al. (2009) reported significant effects of newly developed textual priming materials with partial eta squared values ranging from .010 to .018, which Cohen (1988) suggests to be a small effect. The partial eta squared values reported when analysing the main effect of the priming materials in study nine range from .008 to .018 which are comparable. Likewise, when analysing the influence of the experimental primes after controlling for the influence of external indicators of mating effort, the R^2 value was .024 indicating a small effect (Cohen, 1988). These analyses indicate that the effectiveness of the current priming methods are comparable to those used by Griskevicius et al. (2009), therefore the lack of significant results may be due to the smaller sample size in the current study, in particular the low number of fathers. However, Griskevicius et al. (2009) do not seem to have considered the impact of external indicators of mating effort such as relationship/parental status, instead examining sex differences in the effects of their primes. For the reasons discussed throughout this research, it is important to consider individual differences in the allocation of reproductive effort and how this may influence mating behaviours such as competitive motivation. Therefore, although the effect sizes of the primes in study nine are comparable to those used previously (for example, Griskevicius et al.. 2009), it is suggested priming methods cannot reliably influence allocation of reproductive energy and therefore the results of study nine cannot support the effect of mating motives increasing competitiveness in men.

Further evidence from study nine which supports the suggestion that the relationship primes were not is the small difference in the mean ExPI scores of the 'satisfied' participants and the 'unsatisfied' participants, which is less than 1.5 Likert scale points different. It is therefore perhaps not surprising that there was no main effect of the experimental primes on the measures of competitiveness or on ExPI scores and that the effect sizes were also small. Terrell, Patock-Peckham, and Nagoshi (2009) reported significant priming effects where the difference between the means were less than 0.5 Likert scale points however they did not report effect sizes. This suggests that perhaps small differences in group means as a result of priming can be significant, however it is unlikely that they can be meaningful. Furthermore, the ExPI has a potential scoring range of 10-40 but the mean score of those in the 'unsatisfied' experimental group was only 19. This indicates that even though those in the 'unsatisfied' experimental group had slightly higher lExPI scores than those in the 'satisfied' experimental group, the mean response was still lower than the median of potential ExPI scores. The ExPI is still a new measure, having only been developed in study one, therefore it is possible that it is not an optimal measure of extra-pair interests. This was discussed briefly in study four and is discussed further in Chapter 9. The mean ExPI scores in studies three, four and nine have all been low however, ExPI scores predicted competitive motivation, measured by the number of attempts, in study four, yet this was not replicated in study nine.

This suggests that the samples in studies three, four and nine have genuinely had lower levels of extra-pair interests and as this is a complex construct which is informed by many cues, it is not conducive to priming methods.

It was also expected in this study that the primes would interact with relationship/parental status, so that existing levels of mating effort would be exaggerated. Specifically, it was expected that the ‘satisfied’ prime would exaggerate a parenting-oriented mind set in committed fathers, evidenced by reduced competitiveness and ExPI scores, and the ‘unsatisfied’ prime would exaggerate a mating mind set in single men, evidenced by increased competitiveness and ExPI scores. However, this was not supported here. This may be because of the difficulty in priming the complex concept of extra-pair interests, as discussed. As has been discussed throughout this research, relationship/parental status may not be an optimal indicator of a man’s mating strategy. Therefore, rather than the primes exaggerating an individual’s mating strategy, they may actually be increasing the variance in the data as relationship/parental status may be incongruent with mating strategy. For example, it was expected that committed fathers in the ‘satisfied’ condition would further reduce their mating effort in comparison to committed fathers in the ‘unsatisfied’ condition. However, this response may actually depend on their own levels of relationship satisfaction. This is speculative however, because the primes did not appear successful in affecting subsequent behaviours or responding on the ExPI, and furthermore the ExPI showed relatively low mean responses indicating that the men in this sample who were in relationships were satisfied in them.

An alternative explanation for there being no interaction between relationship/parental status and experimental prime is that the successful priming of complex constructs which are informed by conscious deliberation, such as mating behaviours, may depend upon how developed the cognitive concepts already exist within an individual. For example, Terrell et al. (2009) showed that when participants were provoked artificially using primes, dispositional aggression levels predicted aggressive responding. Individuals with high levels of dispositional aggression were more likely to respond aggressively after provocation than those with low levels. Those participants with low levels of dispositional aggression could not be antagonised in the same way as those with higher levels, whose threshold for aggressive responding was more susceptible to priming methods because it was better developed through experience. It may be that the primes in study nine can only activate a mating or parenting mind-set within an individual to the extent that it already exists within them. This means, for example, attempting to artificially increase parenting effort in a single non-father may be too difficult to unless they have previous experience of being in a committed relationship to draw upon. While it is argued that cognitive adaptations exist to calibrate reproductive energy adaptively, the extent to which this can be done artificially may depend on how developed these cognitive concepts are within individuals. It was intended that by controlling for more cues that inform the allocation of reproductive energy, the effect of the primes would be more precise. However, this may only be the case in individuals with prior experience of the scenarios detailed in the prime because these cognitive concepts would be more developed and complex in these individuals, being reactivated by the primes. Conversely, if individuals have no experience of the detail in the priming materials, their cognitive concepts will not be as receptive to the primes. If the primes were used in naturally occurring situations, for example with men who openly admitted being interested in additional mating opportunities, we may find pre-existing effects exaggerated. However this would not overcome the problem of participant recruitment as it would still rely on recruiting a sample which is difficult to obtain.

The final hypothesis suggested that mating strategy (ExPI scores), would predict competitive motivation, as in study four, however this was not supported. This may be due to the influence of the primes increasing variance in the data. However, it may also be the case that the result in study four was an anomaly. This result supports the result in study three, however the rate of shape presentation has since been adjusted. Therefore three different results regarding ExPI sores predicting competitive motivation have been shown in this research and more research is required to be able to elaborate any further on what this indicates.

Likewise, it may be the case that the circles and squares game is not optimal for use in measuring competitiveness as a mating behaviour. This is a new measure, having only been developed in study two then adjusted in study four. Therefore, although some promising results have been shown, such as lower levels of competitive motivation in committed parents (studies four and six), it may not be an optimal behavioural measure of mating effort (discussed further in Chapter 9).

Finally, a hierarchical multiple regression analysis was conducted on the data in order to examine the implicit effectiveness of the primes. This allowed us to isolate the variance in competitive motivation due to relationship/parental status and quantify the variance due to the primes in isolation. Contrary to previous studies (for example, Griskevicius et al., 2009), these primes did not significantly predict mating effort, as indicated by competitive motivation, but they accounted for 2.5 percent of the variance in the data. This is a small amount of variance in the data attributed to the experimental primes (Cohen, 1988), however it is comparable to previous research which has used similar textual priming materials (for example, Griskevicius et al., 2009). It was initially thought that by constructing priming materials that were very detailed, they would provide greater control over the behaviours of interest, such as competitive motivation. However, in retrospect it appears that the priming of multi-faceted, complex constructs such as extra-pair interests, is extremely difficult to achieve artificially. Artificial priming materials do not adequately take into consideration individual differences (Shanks et al., 2015), therefore there is much variation in how responsive individuals are to primes. It is perhaps unsurprising then that the relationship primes were not successful in influencing competitive motivation. This is discussed further in Chapter 9.

In conclusion, this research provides further support for the effect of relationship/parental status on competitive motivation. Specifically, it shows that committed fathers were less motivated to compete in the circles and squares game than single non-fathers, which was also shown in study four and study six, as well as in the rod balancing task used in study five. This supports life history theory because it suggests that mating effort decreases as reproductive resources are secured. However, the current study cannot support the effectiveness of artificial primes in altering the allocation of reproductive effort, which was also the case in studies four and six. This may be because of the number of cues which inform an individual's relationship 'satisfaction' or 'dissatisfaction', leading to a highly complex cognitive process that cannot easily be disentangled through artificial priming methods. Behaviours are a result of the conscious consideration of many cues, both internal cues and external, and trying to subconsciously activate evolved mental representations in order to examine how this impacts on conscious behaviours is counterintuitive (Shanks et al., 2015). Study seven suggested that the priming materials were suitable in subsequently affecting an individual's responses on measures of extra-pair interests and relationship satisfaction when they were explicitly asked to respond as if they were the man in the scenario. These priming materials may therefore only be suitable for use if participants are explicitly asked to respond to subsequent measures as if they are the subject in the scenario. This may then result in an effect similar to a self-report bias whereby individuals subsequently respond in the manner they *think* they would respond, but this does not necessarily transfer into how they *would* respond.

Chapter 8. Variation in Women's Preferences for Indicators of Mating Effort in Men over the Development of a Relationship

8.1. Introduction

Life history theory suggests that an adaptive baseline of reproductive energy fluctuations into mating and parenting effort has been sexually selected in men. Evidence for this shows indicators of mating effort (both testosterone and behavioural indicators of mating effort) typically increase in men from adolescence and begins to decline from the age of 25-30 years (for example, Kanazawa, 2000; Uchida et al., 2006). It has been argued in this thesis that competitive motivation is a behavioural indicator of mating effort in men, supported by testosterone, reducing as reproductive resources are secured. Studies four, five, six and nine all support this by showing that single non-fathers are more motivated to compete than committed fathers. It is further suggested that allocation of reproductive energy is sensitive to cues relevant to reproductive success and will calibrate to support an individually adaptive deviation from the baseline. This means that if relevant cues, such as perceptions of mate value and the potential availability of alternative mates, indicate that a mated man could ultimately benefit from maintaining mating effort, then his reproductive energy will remain predominantly towards mating effort. Following a faster mating strategy was only successful in men fit enough to withstand prolonged intrasexual competition, furthermore it would have increased risks to women's reproductive success as provisioning was reduced. As women are suggested to have contributed to the development of sexually selected traits (Hunt et al., 2009), women may have selected mates to decrease their mating effort and encourage provisioning, reinforcing the reallocation of men's reproductive energy. If competitiveness in indicates mating effort, women should indicate a preference for competitiveness in men to decrease as a relationship develops. The introduction will now provide more detail of the theories discussed in Chapter 1 relevant to women, discussing adaptive variations in their mating preferences and mating strategies.

Women have a lower fitness variance in comparison to men due to their greater obligation to offspring provisioning. Therefore, while it may be beneficial for men to follow a fast mating strategy under some circumstances, a fast mating strategy cannot directly increase the number of offspring a woman has. Women are therefore more likely to follow a slow mating strategy, characterised by monogamy, fewer offspring, greater offspring provisioning, and the tendency to prioritise potential future gains at the expense of definite immediate gains. This means that women are more inclined to seek fewer, higher quality mates by seeking indicators of a mate's potential and willingness to provide long term provisioning and investment. However, due to the harshness of the ancestral environment, securing a good genetic contribution for her offspring was also important to maximise offspring survival. Therefore, although women primarily needed to secure a mate who would invest in her and her offspring, there was also some motivation for her for her to seek indicators of genetic fitness in a potential mate. Indicators of genetic fitness include well developed secondary sexual traits such as a beard, and muscularity, as well as *successfully* engaging in costly displays of fitness (for example, Folstad & Karter, 1992). However, because genetically fit men are more likely to be successful in following a faster mating strategy (Ermer et al., 2008), there is more incentive for them to maintain mating effort at the expense of parenting effort. This means that mating with a genetically fit man increases the risk of abandonment. So while there was an incentive for women to seek indicators of genetic fitness in potential partners, indicators of a partner's potential and willingness to invest was more important in increasing her reproductive success. Women therefore needed to be sensitive to cues which indicated how potential mates allocate reproductive energy in order to calibrate their own mating strategy, including the potential and willingness of potential mates to provide investment (Sefcek, Brumbach, Vasquez, & Miller, 2005).

Gangestad and Simpson (2000) suggest women evaluate potential mates along two dimensions, namely, according to indicators of good genes and indicators of investment. Indicators of good genes in men, such as charisma, physical attractiveness, social dominance, and an exploitative social nature (Buss & Shackelford, 2008; Gangestad et al., 2007; Gangestad & Simpson, 2000) lead to greater success in testosterone-dependent mating behaviours, such as risk taking, impulsivity, conspicuous consumption, and competing, because mating behaviours are fitness-dependent (Folstad & Karter, 1992). Genetically fit men therefore have a greater incentive to avoid investing in a partner whereas less fit men have more incentive to reduce mating effort once they have secured a partner as they are less likely to be successful in securing more mates (Ermer et al., 2008). Less fit men should demonstrate greater levels of parenting effort via increased warmth, aggreeableness, faithfulness and willingness to invest (Buss & Schmitt, 1993; Folstad & Karter, 1992; Zahavi, 1975) and by reducing indicators of mating effort. While a slower mating strategy may indicate lower fitness in men, it is a safer option for women to secure their reproductive fitness.

Indicators of genetic fitness and mating effort are often seen as attractive to women in short-term mating contexts due to the potential genetic benefits to offspring, but they are seen as less attractive in long-term mating contexts due to the increased risk of abandonment (Campbell, Foster, & Finkel, 2002; Gangestad & Thornhill, 1997; Griskevicius et al., 2007, 2006; Jonason et al., 2009; Jonason & Tost, 2010; Kruger & Fisher, 2003; Sundie et al., 2010; Thornhill & Gangestad, 1994). Conversely, indicators of parenting effort and a willingness to invest increase the attractiveness of potential long-term mates due to the greater likelihood of receiving investment and the decreased likelihood of being abandoned (Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Gangestad et al., 2007; Lancaster & Kaplan, 1992; Li & Kenrick, 2006; Schmitt, 2005; Simpson & Gangestad, 1992). Less fit men may be more constrained to a slower mating strategy as they would be less successful in sustained competition, therefore they should be more likely to provide long-term investment in the reproductive resources they do secure. This strategy would involve delaying immediate gratification and investing in potential future gains (Buss & Schmitt, 1993; Griskevicius et al., 2011; White, Li, Griskevicius, Neuberg, & Kenrick, 2013).

The most preferred mate for a woman would be a man who was both genetically fit and willing and able to invest in her and her offspring (Buss & Shackelford, 2008; Durante, Griskevicius, Simpson, Cantú, & Li, 2012). However, the energetic constraints of a man maximally investing into both mating and parenting effort means this is rare. Ancestral women were therefore required to make trade-offs in potential mates between indicators of genetic fitness via mating effort and indicators of investment via parenting effort. Although there were many variations of mating strategies, there are two that are key here (Pillsworth & Haselton, 2006). Firstly, she could form a long-term monogamous relationship with a man who evidenced his genetic fitness via honest signalling and then reduced his mating effort to invest in her and her offspring. Alternatively, she could form a socially monogamous relationship with a less fit man due to the greater certainty of his ability and willingness to invest whilst simultaneously securing strategically timed, surreptitious additional mating opportunities with fitter men. These strategies will now be outlined, beginning with the second strategy, known as pluralistic mating (Gangestad & Simpson, 2000).

A pluralistic mating strategy involves women forming long-term relationships with less fit, parenting-oriented men while embarking on selective short-term mating encounters (Gangestad & Simpson, 2000; Pillsworth & Haselton, 2006). It would be adaptive for less fit men to display their ability and willingness to provision via parenting effort due to their being less able to successfully compete for more reproductive resources. Research suggests that indicators of parenting effort, such as the ability to provide financial investment (Buss & Schmitt, 1993; Greiling & Buss, 2000) and indicators of parenting qualities, such as altruism (Farrelly, Clemson, & Guthrie, 2016; La Cerra, 1995), are preferred by women in long term mates. Women who form long term partnerships with such men are more assured of their provisioning abilities and their investment in the future, however there is a greater probability that this is at the expense of genetic fitness secured for her offspring.

In order to counteract the likelihood of securing a poorer quality gamete for her offspring, women following a pluralistic mating strategy would engage in short-term mating encounters with genetically fit, fast life history strategist men. This is supported by evidence that women are attracted to indicators of genetic fitness in men in short-term mating scenarios (Gangestad & Simpson, 2000; Li & Kenrick, 2006). Women engaging in short-term matings may seem counterintuitive considering their lower fitness variance. However, if women engaged in short term matings with genetically fit men during the fertile window, it increased the likelihood of conceiving and of securing a better quality gamete for her offspring. However, this strategy was potentially very costly to a woman in the ancestral environment due to retribution by their partner if her infidelities were discovered and the threat of him removing his provisioning (Davies & Shackelford, 2006), therefore timing these illicit encounters to the most optimal time to conceive would also be adaptive. Evidence suggests that women are more attracted to short-term sexual encounters when they are fertile and furthermore, that their mating preferences for indicators of genetic fitness are exaggerated when they are fertile (Gangestad & Haselton, 2015; Gangestad & Thornhill, 2008; Gildersleeve et al., 2014; Pillsworth & Haselton, 2006). Women who successfully employed a pluralistic mating strategy were therefore able to benefit from both high quality gametes for their offspring and a high quality of provisioning from their long term partner, thus maximising their reproductive success.

The second notable mating strategy to discuss is a long-term, monogamous (or serially monogamous) strategy with a man who could provide her with both a reasonable quality gamete and a reasonable chance investment. In this instance, once he has secured mates via elevated mating effort, it is adaptive for him to reduce his mating effort in order to remove himself from engaging in costly mating effort and to provision his reproductive resources. Research has demonstrated that testosterone, as the biological facet of mating effort, decreases when in a committed relationship, and on becoming a father (for example, Burnham et al., 2003; Gettler, McDade, Feranil, et al., 2011; Gray et al., 2002), unless men report decreased satisfaction in the primary relationship and a heightened interest in pursuing additional mating opportunities (Edelstein et al., 2014; Mcintyre et al., 2006). Likewise there is behavioural evidence that mating effort decreases following the acquisition of reproductive resources in order to reduce mating effort and encourage parenting effort (Farrelly & Nettle, 2007; Farrelly et al., 2015; Kanazawa, 2000, 2003), which the results of studies four, five, six and nine also support. Female mate choice would reinforce this decrease in a man's mating effort in favour of provisioning a woman and her offspring because it is also adaptive for her. Furthermore, as there is less certainty in him being able to secure additional reproductive resources, it is best for him to invest in those he has secured. This reduction in mating effort as reproductive resources are secured is therefore mutually adaptive for both parties in the relationship.

It is therefore suggested that female mate choice has contributed to the development of the adaptive baseline of reproductive energy allocation into mating and parenting in men because this strategy is mutually adaptive (Hunt et al., 2009). If so, this should be evident by changes in female mating preferences over the development of a relationship. Women should prefer for men to indicate mating effort in short-term mating contexts, when the likelihood of investment from a mate is unlikely or unknown. As the relationship develops and commitment to it increases, women should prefer their mate to indicate a larger proportion of their reproductive energy is directed toward parenting effort at the expense of mating effort.

The current study used the hypothetical relationship story and indicators of mating and parenting effort that were developed and tested in study eight to examine whether female mate preferences for these indicators change as a relationship develops. Conception probability at the time of participation was controlled for because women typically report greater preferences for indicators of genetic fitness when they are more fertile (for example, Gildersleeve et al., 2014). To do this, participants provided information about their menstrual cycles which was used to calculate the day of their menstrual cycle on the day of participating in study ten, using the reverse counting method which was then assigned a conception probability (calculated by Royston, 1982) to provide the conception probability. Three hypotheses were tested in study ten. Firstly, it was suggested that women place greater importance on the man in the story indicating parenting effort overall rather than mating effort (Hypothesis 1). This is because of the greater priority of provisioning to the reproductive success of women. Secondly, it was expected that importance ratings of parenting effort indicators would increase as the relationship develops (from scenario one through to scenario four). The increase in importance of characteristics associated with parenting effort would be at the expense of indicators of mating effort, therefore importance ratings mating effort indicators will decrease (Hypothesis 2). Finally, it is suggested that women will prefer for men to decrease their involvement in activities associated with mating effort as the relationship develops in favour of spending more time in activities associated with parenting effort (Hypothesis 3).

8.2. Method

8.2.1. Participants

Heterosexual women (*n* = 154) aged 17-70 (*M* = 28.48, *SD* = 10.88) self-selected to participate in this study which was advertised online during 06/2014-07/2014 on social media sites (Facebook and Twitter) and psychology participation sites (such as Psychological Research on the Net, Hanover College). There was no incentive for participation.

8.2.2. Design

This was a repeated measures, experimental design, with two independent variables, both of which are fully described in study eight. The first independent variable was the stage of the hypothetical relationship with four levels; first meeting, first year, fifth year, child's first birthday. The second independent variable was what the characteristics rated by participants represented, with two levels; mating effort and parenting effort. There were two dependent variables; the importance ratings, and the percentage of time.

8.2.3. Materials

Participants were provided with a study information sheet (Appendix 8.A) and a consent (Appendix 8.B). They completed demographic information (Appendix 8.C) and provided information about their menstrual cycle (Appendix 8.D) for calculating conception probability at the time of participating. Participants completed the study using the materials developed in study eight which involved reading a hypothetical relationship from a woman's perspective separated into four scenarios; when the couple first met, their first anniversary, their fifth anniversary and finally, the first birthday of their first child. After each scenario, participants rated the importance of the man in the study having the characteristics that were rated in the second analysis of study eight as representing mating (n = 7) or parenting effort (n = 8) on a Likert scale of 1 (*not at all important*) - 7 (*extremely important*). Participants indicated the percent of time (totalling 100 percent) the man in each scenario should spend involved in activities representing mating (n = 2) or parenting activities (n = 5). The characteristics and activities were randomised following each scenario and are shown in Table 8.1.

Table 8.1. Characteristics and activities representing mating and parenting effort

	Characteristics	Activities
Mating Effort	Tall Competitive Confident Assertive Dominant Extroverted Confrontational	Taking part in physical activity to keep healthy Taking part in competitive sport to be as good as he can be
Parenting Effort	Faithful Warm Cooperative Reliable Sensitive Loving Kind Loyal	Doing household tasks such as grocery shopping Working additional hours to earn extra money Spending time with his immediate family Contacting/spending time with you Reading to further his career

8.2.4. Procedure

The study was presented in SurveyMonkey which initially presented participants accessed study ten via a web link which with the study information. Participants provided consent, completed the demographic information then completed the study. Menstrual cycle information was collected after providing the fourth set of ratings; participation lasted 20-30 minutes. Participants were debriefed (Appendix 8.E). This research was approved by the University of Sunderland research ethics committee (Appendix 6.H).

8.3. Results

Firstly, the influence of conception probability on the responses provided in study ten were analysed, then compliance with the parametric assumptions was tested. Eight incomplete data sets were removed leaving a total of 146 data sets in the analysis. The sample demographic characteristics are shown in Table 8.1.

Table 8.1. Sample demographic characteristics

		n	***%***
Age	17-63 years, M = 28.56, SD = 10.45		
Nationality	British	94	64.38
	Other	52	35.62
Relationship status	Single	57	39.04
	Casually dating multiple people	2	1.37
	Casually dating one person	17	11.64
	Long term relationship	33	22.60
	Cohabiting	11	7.53
	Married	26	17.80
Parent	Yes	48	32.88
	No	98	67.12

8.3.1. Fertility Status

There is evidence suggesting female mate preferences vary over the course of their menstrual cycle. This shows women find ‘masculine’ features and traits more attractive when fertile, and ‘feminine’ features and traits are more attractive when not fertile (for example, Gangestad & Haselton, 2015). As study ten was concerned with female mate preferences, it was important to control for any influence of the participant’s menstrual cycle. Participants were asked to provide the necessary information to enable calculation of their conception probability at the time of participation using the reverse counting method. The reverse counting method is more accurate than forward counting methods as it takes into consideration variation in cycle lengths between different women (Haselton & Miller, 2006). According to Haselton and Miller (2006), conception risk is highest five days prior to ovulation (17.7 percent - 32.6 percent) and peaks on the day of ovulation (day 15 using the reverse counting method) to 40.8 percent after which conception risk decreases sharply. Royston (1982) provided probability of conception values for normally cycling women at each day of their cycle. Using conception probability values to analyse the impact of fertility on the data in study ten retains as much variance as possible in the data. Conception probability was included as a covariate in a two-way 2 (characteristic type, mating and parenting) x 4 (relationship stage, each of the four scenarios) repeated measures ANCOVA on the importance ratings which showed there was no effect, F (1, 89) = 1.04, p = .311, η_p^2 = .012. A one-way (relationship stage on four levels) repeated measures ANCOVA on the percent of time allocated into activities representing mating effort also showed no effect of conception probability, F (1, 89) = 1.16, p = .285, η_p^2 = .013, and no interaction between conception probability and relationship stage on time allocation into mating activities, F (3, 67) = .22, p = .884, η_p^2 = .002. Conception probability was therefore excluded from subsequent analyses.

8.3.2. Parametric Assumptions and Data Analysis

Data were examined to analyse compliance with parametric assumptions. The assumption of normality was violated in all conditions except the importance of parenting indicators in the first relationship stage (p = .200), therefore analyses proceeded with parametric statistics.

The main effect of characteristic type (Hypothesis 1) and the interaction between relationship stage and characteristic type on importance ratings from 1-7 (Hypothesis 2) were analysed together using a two-way 2 (characteristic type) x 4 (relationship stage, 1-4) repeated measures ANOVA. Sphericity was violated for the interaction, $W = .23$, X (5) = 208.88, $p < .001$, therefore the Greenhouse-Geisser correction was applied ($\varepsilon = .53$). The effect of relationship stage on the proportion (percent) of time the man in the story should allocate to activities associated with mating effort (Hypothesis 3) was analysed using a one-way (relationship stage) repeated measures ANOVA on the percent of time allocated to indicators of mating effort; sphericity was violated; $W = .16$, X (5) = 266.65, $p < .001$, and the Greenhouse-Geisser correction was applied ($\varepsilon = .47$).

8.3.3. Hypothesis 1. Women will rate indicators of parenting effort as being more important overall than indicators of mating effort in potential mates. There was a significant main effect of the characteristic type displayed by a man, F (1, 145) = 525.63, $p < .001$, $\eta_p^2 = .784$, with characteristics representing parenting effort ($M = 6.11$, $SE = .04$) being rated higher overall to characteristics representing mating effort ($M = 4.08$, $SE = .08$).

8.3.4. Hypothesis 2. Importance ratings of indicators of parenting effort will increase as the 'relationship' progresses and importance ratings of indicators of mating effort will decrease. Analysis of ratings showed a significant interaction between the type of characteristic displayed and the relationship stage, F (1.58, 228.52) = 163.93, $p < .001$, $\eta_p^2 = .531$, shown in Figure 8.1.

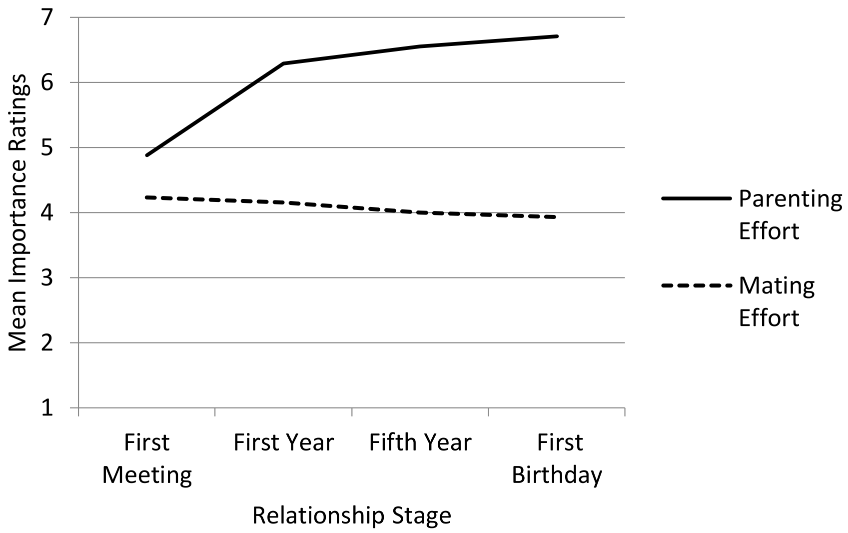


Figure 8.1. Interaction between characteristic type and relationship stage on importance ratings (1-7)

Simple effects analyses were conducted on each characteristic type to see if the importance ratings differed significantly across the relationship stages. Sphericity was violated for mating effort indicators, $W = .43$, X (5) = 120.96, $p < .001$, and for parenting effort indicators, $W = .07$, X (5) = 375.39, $p < .001$, therefore the Greenhouse-Geisser correction was applied to both (ε = .64; ε = .44 respectively). There was a significant effect of relationship stage on the importance of mating effort indicators, F (1.92, 278.76) = 7.58, $p = .001$, $\eta_p^2 = .050$, and on the importance of parenting effort indicators, F (1.33, 192.23) = 243.95, $p < .001$, $\eta_p^2 = .627$. Bonferroni pairwise comparisons showed the importance of mating effort indicators decreased significantly from the second stage (first anniversary) to the third stage (fifth anniversary), and from the second stage (first anniversary) to the fourth stage (child's first birthday) ($p < .05$ in both cases), and the importance of parenting effort indicators significantly increased at each stage of the relationship ($p < .05$ in all cases). The descriptive statistics are shown in Table 8.2.

Table 8.2. Mean (and standard deviation) of importance ratings (1-7) of indicators of mating and parenting effort across the development of the 'relationship'

	Stage one (first meeting)	Stage two (first anniversary)	Stage three (fifth anniversary)	Stage four (child's first birthday)	Overall
Mating effort	4.23 (1.04)	4.16 (1.03)	4.00 (1.19)	3.93 (1.23)	4.08
Parenting effort	4.88 (1.23)	6.29 (0.58)	6.55 (0.46)	6.70 (0.41)	6.11
Overall	4.56	5.22	5.27	5.32	5.09

8.3.5. Hypothesis 3. As the 'relationship' develops (from stage one to stage four) women will specify that the man in the story should decrease the proportion of his time (percent) involved in activities associated with mating effort. There was a significant effect of relationship stage on the time spent in activities associated with mating effort, F (1.42, 205.56) = 66.75, p < .001, $\eta_p{}^2$ = .315. Bonferroni pairwise comparisons showed that the percent of time involved in activities associated with mating effort decreased significantly at each stage of the relationship (p < .05 in all cases). The descriptive statistics are shown in Table 8.3.

Table 8.3. Mean and standard deviation of time spent (percent) in activities associated with mating and parenting effort

	Stage one (first meeting)	Stage two (first anniversary)	Stage three (fifth anniversary)	Stage four (child's first birthday)
Mating effort	25.67	19.93	13.49	10.42
Parenting effort	74.33	83.07	86.51	89.58
Standard deviation	18.33	9.26	8.34	7.65

8.4. Discussion

The research presented in this thesis has argued that in men, the motivation to compete in various domains is a sexually selected form of mating effort which typically decreases in men as they secure reproductive resources. Studies four, five, six and nine have provided support for this by showing that the motivation to compete in committed fathers is significantly lower than that of single non-fathers. However, this is only one mechanism that contributes to the development of sexually selected adaptations (Hunt et al., 2009) and both the mechanisms must be examined to fully understand them. Study ten therefore examined whether the mate preferences of women would change as a relationship develops.

It was expected that women would rate parenting effort as more important than mating effort overall (Hypothesis 1) because of the importance of provisioning to survival in the ancestral environment. It was also expected that the importance of parenting effort indicators would increase as the relationship developed from the first to the fourth scenario, at the expense of mating effort indicators (Hypothesis 2). This is because research indicates that women rate indicators of parenting quality as more important in a long term mate than indicators of genetic fitness (Buss & Schmitt, 1993; Gangestad et al., 2007; Gangestad & Simpson, 2000; Li & Kenrick, 2006). Indicators of genetic fitness are, in turn, associated with mating effort as genetically fit men are more able to successfully pursue a faster mating strategy than less fit men (Ermer et al., 2008). Finally, it was also expected that women would indicate a preference for the man in the story to increase time spent in activities associated with parenting effort as the relationship developed at the expense of decreasing his time spent in activities associated with mating effort (Hypothesis 3), as this would provide further evidence of his reduction in mating effort. All three hypotheses were supported here, however due to the prevalence of pluralistic mating strategies in ancestral women exaggerating the preferences for indicators of genetic fitness when women are fertile, it was expected that conception probability at the time of participation would influence ratings, but this was not the case. Potential reasons for this will now be discussed before discussing the results of the three hypotheses.

The reverse counting method was used to estimate participants' conception probability at the time of participation. However, Gildersleeve et al. (2014) suggest that while the reverse counting method is a more than the forward counting method, it is still relatively unreliable without seeking confirmation of menstruation start date from participants after participation. The reverse counting method goes some way towards controlling for variation in the menstrual cycle between women by considering differences in average cycle length, however counting methods cannot control for the substantial variation in the menstrual cycle *within* individual women. For example, stress has been implicated in delaying ovulation in female mammals (Wasser & Barash, 1983) which causes variation in the typical cycle length of an individual, therefore counting methods to establish conception probability are flawed. Gildersleeve et al. (2014) recommends measuring the concentration of urine luteinising hormone to establish conception probability. Luteinising hormone rises 24-48 hours prior to ovulation (Testart & Frydman, 1982) and has been shown to be 97% accurate in detecting ovulation (Guermandi et al., 2001). Future research that examines, or controls for, the effect of the menstrual cycle on the mating preferences of women should ideally measure the concentration of urine luteinising hormone to establish conception probability. If this is not practical, participants could be asked to follow up participation with confirmation of the start date of their next menstruation to validate the reverse counting method.

In addition to the unreliability of counting methods in establishing conception probability, Gildersleeve et al. (2014) question the reliability of women's self-reports of average cycle length. They suggest that although the accuracy of this has not yet been tested, inaccurate estimations of menstruation dates would dramatically impact on the results because of the narrow window of peak fertility, and this should therefore be considered. Study ten controlled for this by asking participants about their level of confidence in the information they provided relating to their menstrual cycle. All participants who indicated that they were normally cycling and free from hormonal contraceptives indicated they were either completely confident or confident to within a day in the information they provided here, however even one day out would have a large impact on the conception probability rates. This is a concern and would compound the sub-optimal use of counting methods to establish fertility. If the methods used to detect the conception probability of participants during participation in study ten resulted in a Type II error, then this would increase the variance in the ratings of characteristic indicators of mating effort and the amount of time spent in associated with activities associated with mating effort. All three hypotheses were supported in study ten, therefore if future research uses more accurate methods to control for conception probability, this would result in a clearer pattern of results, particularly around the first relationship scenario (first meeting). This will be discussed in more detail shortly.

It was suggested that women would prioritise indicators of parenting effort in men overall rather than indicators of mating effort. This was supported in study ten and is consistent with the suggestion that ancestrally, a mate's provisioning ability and willingness had the greatest direct impact on women's reproductive success. Women needed to prioritise parenting indicators in potential mates in order to protect their relatively limited reproductive success (Davies & Shackelford, 2006). However, it is possible that this finding is due to the self-report nature of the study. This is because indicators of mating effort are often viewed as unattractive (as discussed in study eight), therefore this may have led to participants reporting indicators of mating effort in a mate as less important. An example of this comes from perceptions of the dark triad, Machiavellianism, psychopathy and narcissism. These traits are not overtly deemed as attractive, however men high in these traits tend to be successful in following a fast mating strategy. Research suggests that this is because covertly and behaviourally, dark triad men are perceived as attractive (Babiak & Hare, 2006; Back, Schmukle, & Egloff, 2010; Holtzman & Strube, 2012), but it is unlikely that such socially undesirable traits would be explicitly rated as attractive. Babiak and Hare (2006) claim psychopaths intentionally misrepresent themselves to individuals in order to access self-benefitting resources and only reveal their true selves once they have secured what they wanted from the relationship. Back et al. (2010) highlight discrepancies in the evidence regarding how narcissists are viewed. They cite previous research which suggests initial impressions of narcissists are negative (Colvin, Block, & Funder, 1995) but their own research suggests initial impressions are positive and become negative over time. Cumulatively, these findings raise questions about how accurate self-reported preferences of mating effort/genetic fitness indicators in potential mates may be, in particular when they are socially undesirable, which may be the case for some of the items used in study ten. This may have also resulted in some additional indicators of mating effort which were tested in study eight being excluded from use in study ten (as discussed in Chapter 6). This undesirable connotation is often associated with manipulation and an exploitative nature, as is the case for the dark triad, meaning it would not be self-reported as attractive or desirable but behaviourally it may be perceived as attractive.

However, although the first hypothesis was supported in study ten, there is another potential reason for the finding that indicators of parenting effort were rated as more important in a mate overall before conclusions about this finding can be made. In the instructions provided to participants, they were informed that participation involved reading about the *development* of a hypothetical relationship. This may have inadvertently indicated to participants too early that commitment to the relationship would develop rather than encouraging the participants to consider each scenario independently such that at the early stages of the story they would not have known how the story would develop. For example, the encounter in the first scenario was specifically designed to detail the initial meeting of a mate who the participant was romantically interested in regardless of whether this would be a short-term encounter or whether it would develop into a long-term relationship. Therefore, although the intention was to maximise the potential range in female mating preferences in the course of the story from a one night stand to a long term committed relationship, the maximum preferences for potential mating effort indicators may have been compromised by the instructions provided, leading to an overall preference for indicators of parenting effort due to the implication that the relationship would be developing into a longer-term partnership. Thus, although the first hypothesis is supported, this study should be conducted again with the instructions amended to ask participants to indicate their mate preferences in different relationship scenarios, although this would actually be the same scenarios used in study ten, so as not to bias participant's perceptions of the relationship.

It was also suggested that women would prefer for a mate to decrease mating effort as the 'relationship' developed in favour of increasing their parenting effort. This was supported by the results of both Hypothesis 2 and 3 when examining importance ratings of traits representing mating and parenting effort and time allocated to activities associated with mating and parenting effort. These results are consistent with research suggesting indicators of parenting effort demonstrate suitability as a long-term mate (Buss & Schmitt, 1993; Gangestad & Simpson, 2000; Gangestad et al., 2007; Lancaster & Kaplan, 1992; Li & Kenrick, 2006; Schmitt, 2005; Simpson & Gangestad, 1992) whereas indicators of mating effort show a lack of suitability as a long-term mate but greater suitability in short-term mating encounters (Campbell et al., 2002; Gangestad & Thornhill, 1997; Griskevicius et al., 2007, 2006; Jonason et al., 2009; Jonason & Tost, 2010; Kruger & Fisher, 2003; Sundie et al., 2010; Thornhill & Gangestad, 1994). These findings also support the suggestion that female mate choice has contributed to the reduction of mating effort in men as they secure reproductive resources. Women rated it more important for the man in each scenario to indicate parenting effort as the relationship developed through each of the four scenarios. Although indicators of mating effort were rated as less important as the relationship progressed, the decrease in importance was less substantial than the increase in the importance of parenting indicators as the relationship developed. This further supports the suggestion that indicators of parenting effort in potential partners were more important to ancestral women as securing provisioning from a partner would be more beneficial to her reproductive success than mating with a genetically fit man. This also suggests that the task instructions may not have biased participants to perceive the relationship as one which *would* develop because the importance of the man having characteristics associated with mating and parenting effort still changed across the development of the relationship. If the task instructions had confounded the aim of the first scenario, then rectifying the instructions should provide stronger support for these findings. If women perceive the first scenario as a one night stand with no chance of the relationship developing into something long term, as was intended, then the importance of indicators of mating effort should be higher in the first scenario consistent with previous research which shows women are more attracted to indicators of genetic fitness in short term mates. In turn, this would mean there would be a greater discrepancy between the importance ratings of indicators of mating and parenting effort in the first scenario, and therefore there would be a larger reduction in the ratings of the importance of mating effort and a larger increase in the importance of indicators of parenting effort as the relationship developed across the scenarios.

Despite this potential flaw, the results of study ten showed the largest shifts in mate preferences were around the second scenario (the first anniversary). Importance ratings of mating effort indicators decreased significantly from scenario two (first anniversary) to scenario three (fifth anniversary), and from scenario two (first anniversary) to scenario four (child's first birthday). This coincides with the increase in importance ratings of parenting effort which, although these increased significantly at each stage of the relationship, the sharpest increase was between scenario one (first meeting) and scenario two (first anniversary). The shift in the reported time spent into activities associated with mating and parenting effort was also most pronounced from scenario one (first meeting) to scenario two (first anniversary). This indicates that at around the 12 month point of a relationship, it is most important for a woman's reproductive success for a man to evidence that he has reduced his mating effort. This is consistent with research by Farrelly et al. (2015), who found that men in relationships of less than a year maintained their levels of testosterone at a level comparable to single men, indicating their reproductive energy was primarily oriented toward mating effort until this point. Conversely, the testosterone levels of men in relationships of longer than one year were significantly lower than the testosterone levels of single men and of men in relationships for less than one year. This result was strengthened by there being no linear relationship between testosterone levels and relationship length (Farrelly et al., 2015). The authors suggest that up until approximately one year, men maintain a proportion of their reproductive energy directed toward mating effort. Study ten supports the research by Farrelly et al. (2015) by showing that women indicate men should decrease behavioural indicators of mating effort as a relationship develops but in particular after being in a relationship for approximately one year.

Overall, the findings of study ten are consistent with the theoretical framework adopted in this thesis, suggesting that men and women make adaptive trade-offs in their mate preferences to increase their reproductive success. The research discussed throughout this thesis and the results of studies four, five, six and nine, suggest that men make adaptive trade-offs by reducing their mating effort as they gain reproductive resources. The results of study ten support this by highlighting how female mate preferences of behavioural indicators of men's mating and parenting effort change as a relationship develops. This provides another perspective to the suggestion that it was adaptive for men to reduce their mating effort in the ancestral environment because successfully pursuing more mates was fitness dependent by showing female mate choice has contributed to the development of this sexually selected adaptation.

Chapter 9. General Discussion

9.1. Summary of findings

The research reported in this thesis was presented in a theoretical framework informed by an evolutionary perspective. The aim was to extend the understanding of competitiveness in men because existing accounts focus on proximate levels of explanation, such as the role of self-perception (Vallerand & Losier, 1999) and socialised gender norms (Hibbard & Buhrmester, 2010). There is a strong negative perception of competitiveness in society, however without consideration of the ultimate evolutionary motivations which underlie these behaviours (Tinbergen, 1963), the understanding of competitiveness is incomplete.

The research presented here provides some evidence for the need of the evolutionary perspective of competitiveness in men. It is consistent with the framework of evolutionary theories discussed in Chapter 1 as it indicates that competitive motivation in men can relate to mating effort that functions to increase reproductive success. This is because study three showed that single non-fathers scored more points in a novel online competitive game than committed fathers, suggesting single non-fathers performed better on the task than committed fathers without being more motivated to do so. It was expected that this would be shown in the motivation to compete because costly signalling theory suggests that successful performance is more fitness dependent. The competitive task was adjusted to make successful performance more difficult to achieve, which is more in line with costly signalling theory. Results following the adjustment to the online competitive task then showed that single non-fathers were more motivated to succeed in the task than committed fathers in studies four, six, and nine, and this was also shown in a natural field competitive task (study five). However, contrary to the predictions made by parental investment theory, this effect of mating effort in reducing competitive performance (in study three) and competitive motivation (in studies five and six) was not sex-differentiated. Nevertheless, this research does support the suggestion from costly signalling theory that the motivation to compete for reproductive resources is independent of the success in doing so (studies three, four, five and six). Finally, the variation in female mate preferences across the development of a relationship (study ten) provides further support for the importance of the variation in male competitive motivation in increasing reproductive success (Hunt et al., 2009). Study ten showed that women prefer for a man to decrease his mating effort and increase his parenting effort as commitment to a relationship increases. The research presented in this thesis will now be discussed in more depth with reference to the research questions and the theoretical basis presented in Chapter 1.

9.1.1. Research Question 1. What are the effects of variation in mating effort on the competitive behaviour of men? Specifically, will single men demonstrate greater competitiveness than men who are committed to relationships and/or involved in offspring care, consistent with predictions made from the challenge hypothesis? Will there be congruent differences in the testosterone levels of men? Will men who are still motivated to pursue additional mating opportunities despite being in relationships be more competitive than men who are not motivated to pursue additional mates? And will testosterone levels be associated with competitiveness? Overall, the results of the studies reported in this thesis supports the suggestion that, in terms of competitive behaviour, *motivation to compete* varies due to how men allocate their reproductive effort (studies four, five, six and nine). The results of study three suggests that this variation in reproductive effort may be evident in competitive *performance* when the task is easier to succeed in. These findings are consistent with costly signalling theory which states that the quality of costly signals will reflect the genetic fitness of the signaller, therefore the signal *quality* will vary due to individual fitness rather than motivation to secure reproductive resources. When examining the effect of mating effort on competitive performance using specialist samples, the effect of mating effort may well be evident because genetic fitness is essentially controlled by using a niche sample of individuals similar in quality. When expanding the sample to include non-specialists, the variation in competitiveness due to mating effort should therefore become evident in the motivation to compete rather than in competitive performance, as shown in studies four, five, six and nine (this point will be discussed further soon).

It was expected that men would reduce their mating effort, evidenced by reducing competitive motivation, as they secured reproductive resources consistent with predictions made by the challenge hypothesis. This research has consistently demonstrated an effect of external indicators of mating effort (relationship and parental status) on the motivation to compete, with results showing that single non-parents were more motivated to compete than committed parents (studies four, five, six and nine). However, this effect was not always sex-differentiated, as predicted (studies five and six). The results of study three showed there was a large effect of mating effort on competitive performance rather than motivation. It is argued that this is due to the rate at which the shapes in the competitive task were presented in study three, which was adjusted in study four (from one second to 0.5 second intervals). There was also a small, non-significant interaction between mating effort and sex. On further inspection of the interaction, it was shown that there were sex differences in the competitive performance of single participants whereas there were no sex differences in the performance of committed participants. Likewise, the results of studies five and six showed an effect of mating effort on competitive motivation but not the hypothesised interaction between mating effort and sex. However, there was a sex-differentiated decrease in competitive motivation when this was examined separately for men and women. This showed that the decrease in competitive motivation as mating effort reduced was more pronounced in men than in women. This is consistent with the findings of Kanazawa (2000, 2003), who suggested that this reflected the adaptive variation in men to compete for reproductive resources which is much stronger than in women. While these studies support the notion that there is a reduction in mating behaviours such as competitiveness as reproductive resources are secured, studies three, five and six do not support the suggestion that these decreases are sex-differentiated. This may be due to a lack of power because of the small number of fathers who participated, however the effect sizes were often also small. Alternatively, as discussed in Chapter 5, this may be due to the nature of female competitiveness.

It has been suggested that, like men, women are also competitive but in more covert, indirect ways than men due to the risks overt competition would bring to their reproductive success (Fisher, 2015). The design of study six (participating in the online competitive task while a photograph was also presented on the screen) may have appealed to the indirect, covert nature of female competition, leading to more variation in the competitiveness of women and therefore reducing the sex differences found in the study. Men provide substantial offspring provisioning in comparison to males of other species which is beneficial to women, leading to intrasexual competition in women for suitable mates or to retain mates (Hudders et al., 2014; Wang & Griskevicius, 2014). This may therefore increase on having offspring in order to retain a mate who provisions and reduce the risk of being abandoned. This would also explain why in study six women were more motivated to compete in the online task when the ‘audience’ was female. Examining sex differences in these processes are important because sex differences in mating behaviours are an important foundation in the evolutionary framework discussed in Chapter 1.

Studies three and six showed men were more motivated to compete in an online competition than women and this sex difference was primarily driven by sex differences in single participants. This suggests that single men are more motivated to compete than single women. Furthermore, it was argued that ratings of competitiveness would provide a measure of competitive motivation because this may reflect how people wish to be perceived. Study three also showed that single men rated themselves as feeling more competitive following the task than single women did, yet this sex difference was not shown in the behavioural measure of competitive motivation (number of attempts made on the task). It is argued that this is due to the rate of shape presentation in the competitive game, as discussed previously. The results of study three also supported the suggestion that risk taking is a form of mating effort which is engaged in more by men than women as men were more likely to select the hard option (squares) in the game than women, who were more likely to select the easier option (circles). The studies reported in this thesis therefore provide some support for the evolutionary account of competitiveness as men were more competitive than women overall. However, the effect of mating effort in decreasing competitiveness was expected to be sex-differentiated, whereby men reduced their competitiveness but women did not. The results of studies three, five and six show sex-differentiated relationships between competitiveness and mating but not as expected, suggesting that the effect of mating effort on female competitiveness needs to be explored further.

As discussed, costly signalling theory suggests that competitive performance should be more indicative of individual fitness than the motivation to compete. Less fit men should still be motivated to compete for reproductive resources though they may be less successful in doing so. Success in a given competitive domain may therefore be more indicative of individual fitness and dominance rather than the motivation to compete for resources in that domain. Consistent with this suggestion, study three found men performed non-significantly better than women on the competitive task. Although the effect was not statistically significant, the effect size was large (Cohen, 1988) indicating this result is meaningful. However, when the competitive game was adjusted to align more with costly signalling theory by reducing the rate of shape presentation, there was no longer a sex difference in competitive performance (study six). Therefore, studies four, five, six and nine support the suggestion that competitive motivation reflects mating effort rather than successful competitive performance. It is argued here that when using non-specialist samples, this is an important consideration because it is likely that specialist samples (such as recording artists, published academics, Kanazawa, 2000, 2003, and professional sports players Farrelly & Nettle, 2007) comprise fitter men than non-specialist samples, therefore evidence of their mating effort would also be demonstrated in their competitive performance.

In addition to within-sex variation in the impact of external indicators of mating effort (such as relationship and parental status) on competitiveness, the first research question aimed to consider the impact of mating strategy on competitiveness were this inconsistent with mating effort. Mating strategy was measured using the ExPI developed in study one, which aimed to measure the interest men in relationships had in extra-pair matings. It was found that ExPI scores successfully predicted the competitive motivation of committed men in studies three, four and nine better than it predicted competitive performance. This provides further support for the suggestion of costly signalling theory that competitive motivation relates to mating effort more so than competitive performance. This also supports the challenge hypothesis as it shows that men will maintain mating effort despite having secured reproductive resources (such as a partner and offspring) if they desire extra-pair mates. Furthermore, ExPI scores did not predict competitive motivation in women. This suggests that although mating effort, in terms of having a partner and/or offspring, reduces competitive motivation in women in a similar way as it does men, competitive motivation does not reflect mating strategy in women. This provides further support for the suggestion that competitiveness in women serves a different function than in men. This may be due to the lower fitness variance of women than men, meaning that pursuing additional mating opportunities cannot increase their reproductive success yet maintaining competitive motivation may secure alternative benefits such as resources, or it may help retain mates. The research reported here cannot provide evidence for the sex-differentiated influence of mating effort in reducing competitive motivation, but it does provide support for sex differences in adaptive mating strategies consistent with the theoretical basis outlined in Chapter 1. These results are consistent with life history theory, indicating that a faster mating strategy in men is associated with greater competitive motivation.

As discussed throughout this thesis, levels of fluctuating testosterone are suggested to be the biological component of reproductive effort. Evidence shows that testosterone levels fluctuate to support mating strategy and related behaviours, such as competitiveness, in men. Study four examined whether there was an effect of mating effort on testosterone levels in male participants. Consistent with previous research, it was expected that single men would have higher testosterone levels than committed non-fathers, who in turn would have higher testosterone levels than committed fathers. This is because testosterone levels are suggested to support mating effort and therefore should reduce as reproductive resources are secured, consistent with life history theory. This was not supported in study four. Analyses showed that the participants in study four had higher testosterone levels than typically reported in testosterone research. This may have been due to the presence of female experimenters study four leading to higher testosterone levels in some participants and increasing the variance within the levels of the independent variable (mating effort), therefore reducing the variance between levels. Testosterone fluctuations are beyond conscious control but mating behaviours are not, therefore participants may have been able to consciously attenuate the behavioural aspect of their mating effort, but not the biological aspect (testosterone levels), leading to incongruence between mating behaviours and testosterone levels. This may have led to error due to individual differences in mating strategy. For example, committed men may engage in relationship maintenance and reduce their mating effort, but committed men who are motivated by mating effort may experience increases in testosterone (possibly due to female interaction) but may attempt to conceal this by reducing their competitive motivation leading to error within the levels of the independent variable. This was an unforeseen fault in the design of this study which must be addressed in future research. Study four therefore did not provide support the hypothesised effect of mating effort on testosterone levels in men and therefore these results cannot support role of testosterone in supporting mating effort. However, the testosterone levels of the participants in study four were very unusual, and there is robust evidence in the literature of an effect of mating effort on testosterone levels. For this reason it cannot be confidently concluded based on the results of study four that there is no effect of mating effort on the testosterone levels of men.

A final aspect to consider in the variation of hypothesised mating behaviours in men is the role of female mate preferences. The development of sexually selected adaptations operates via two mechanisms, intrasexual competition in men and female mate choice. This means that, if it is adaptive for men to reduce their mating effort as reproductive resources are secured, then female mate preferences have contributed to this. Study ten therefore aimed to examine whether women indicated a preference for men to reduce their mating effort, and to increase their parenting effort, as commitment to a relationship increased. The results of study ten support this, as women rated indicators of mating effort in a male partner as less important as commitment to a relationship increased. Furthermore, women rated it more important for a male partner to increase indicators of parenting effort as commitment to the relationship increased. This is consistent with the results of studies four, five, six and nine which show men reduce their mating effort, evidenced by a reduction in competitive motivation, as reproductive resources increase. For men, prolonged engagement in mating behaviours such as competitiveness prolongs their exposure to the associated risks, therefore it is beneficial for them to reduce mating behaviours as reproductive resources are secured. Likewise it is beneficial for women to encourage parenting behaviours in men in order to increase the likelihood of being provisioned, particularly when offspring are present in order to protect their reproductive success.

The findings of the research presented in this thesis can therefore only provide partial support for the theoretical basis discussed in Chapter 1. The current research provides evidence for men being more competitive than women consistent with the existing view of competitiveness as being due to socialisation, however this is also consistent with predictions from parental investment theory. The research in this thesis extends the finding of sex differences in competitiveness by providing support for the suggestion that competitive motivation relates to mating effort in men, consistent with costly signalling theory, as single non-fathers demonstrated greater competitiveness than single non-mothers as well as committed non-fathers and committed fathers. This evidence also supports the challenge hypothesis as applied to humans as it suggests that mating effort evidenced by competitive motivation in men reduces as reproductive resources are gained. This reduction in mating effort is because mating and parenting effort lie at opposite ends of the spectrum of reproductive energy allocation, as stated by life history theory. This means mating effort must decrease in men in order to provision their reproductive resources via parenting effort. However, the evolutionary account of competitiveness also suggested that competitiveness would not decrease in women as they gained reproductive resources because they do not compete for reproductive resources in the same way that costly signalling theory suggests men do. The findings presented in this thesis suggest that competitive motivation in women does fluctuate due to mating effort, however there is also evidence to suggest that this is not a reflection of their mating strategy, as it is in men. The research discussed here therefore provides depth to the existing view of sex differences in competitiveness being due to socialisation by applying an evolutionary framework. This then suggests that sex differences reproduction have led to sex differences in adaptive mating strategies, which may well become exaggerated through socialisation.

9.1.2. Research Question 2. How will external factors, such as the presence of an audience, impact on the competitive behaviour of men? Specifically, if competitiveness serves both intrasexual and intersexual means, then will it be increased when an audience is viewing the competitive interaction rather than when an individual competes alone? Furthermore, will the impact of these external factors on the competitiveness of men in committed relationships depend upon whether they remain motivated to pursue additional mates? The current research examined the influence of mating motivations and potential rivals on competitiveness as a potential external factor which may affect competitiveness. This is because the challenge hypothesis indicates that mating effort will increase in men when external factors indicate that by doing so, reproductive success could ultimately be increased. Study four used photographs to induce mating motives in male participants, and study six used photographs to act as an audience which may indicate that mating opportunity (a female audience) or a rival (a male audience) is present in the environment. Study five also examined the effect of the sex of an audience on competitiveness in a natural field scenario (the rod balancing task). However, there was little evidence in these studies for these factors influencing competitiveness because there was no effect of mating motives (study four) or audience sex (studies five and six) on competitive motivation or performance. This is despite using a method to induce mating motives which has previously been shown to affect mating behaviours in men (study four, for example Greitemeyer et al., 2012; Greitemeyer, 2007). It was suggested in Chapter 4 that the photographs used to induce mating motives in study four may not have been attractive enough to increase mating behaviours in men. This is because they were pre-rated as only moderately attractive whereas previously used photographs were rated as highly attractive (Greitemeyer et al., 2012; Greitemeyer, 2007). The lower attractiveness ratings of the photographs used in study four may indicate that they were insufficient to increase mating behaviours in men, in particular in an artificial scenario. Study six attempted to re-examine this by including photographs of an 'audience' who were rated as highly attractive, yet this still had no influence on competitive motivation. It could be concluded that the attractiveness of potential mates does not influence the mating behaviours of men. This would be supported by the finding in study six that competitive motivation in men was increased when an audience was present from when no audience was present regardless of the audience sex or their attractiveness. However, due to the methodological limitations of these studies discussed in Chapters 4 and 5, this conclusion is unlikely. As discussed in Chapter 5, the increased competitive motivation of men in study six seemingly due to audience presence is more likely due to a practice effect. This is because participants always completed the no audience condition before any of the audience conditions. However, female participants were more competitive when the 'audience' in study six was female. This therefore suggests that the methodology used in study six was not suitable for examining the effect of mating motives in the competitiveness of men. This may be because the 'audience' was too subtle to engage male competitiveness but was more suited to the nature of female competitiveness. As discussed, women compete intrasexually for better quality mates. Aggression is a form of mating behaviour (Wilson & Daly, 2004), and women are more likely to engage in indirect acts than direct acts of aggression (Stockley & Campbell, 2013). The results of study six suggests this may extend into female competitiveness as a mating behaviour whereby women are more susceptible to intrasexual competition in covert, indirect forms of competition such as the format of the online task used in study six.

Study nine used more detailed priming materials than those used in studies four and six in the form of detailed textual primes, developed in study seven. The aim of these primes was to provide more control of other variables which may affect a man's mating strategy, for example whether alternative mates were available and obtainable. However, despite previous research indicating primes can be successful in affecting mating motives in men, the priming materials used in study nine were unsuccessful but yielded comparable effect sizes to those used in previous research (for example, Griskevicius et al., 2009). Therefore, studies four, five, six and nine cannot provide evidence for the role of the presence of other people in the environment affecting the mating effort of men as suggested by the challenge hypothesis. As discussed in Chapters 5 and 7, it is suggested that this lack of observed effect is due to the reliance on artificial cues and scenarios. Since studies four, five, six, seven and nine were conducted, research has suggested that using artificial cues to affect mating effort is problematic (Shanks et al., 2015). It is suggested that artificial priming cannot be successful in manipulating behaviours which are informed by many cues, as mating strategy is. Priming relies on subtle cues unconsciously activating relevant mental representations, yet this contradicts well established findings suggesting behaviours are consciously considered in the relevant contexts. Shanks et al. (2015) instead suggest that the results reported in previously published research which have demonstrated a significant effect of behavioural primes on mating behaviours in men may be a result of *p*-hacking, a publication bias or both. The results of studies four, five, six and nine therefore support this research by Shanks et al. (2015), particularly when considering that textual primes used in study nine showed no significant effect on mating behaviours evidenced by competitive motivation, but they had effect sizes comparable to previous research where the effects were also shown to be significant (for example, Griskevicius et al., 2009). Furthermore, Shanks et al. (2015) suggest that examining how mating motives affect testosterone levels, such as in Ronay and von Hippel's (2010) study, can help inform the evolutionary theories regarding fluctuations in mating effort because testosterone fluctuations are beyond conscious control. However, the conscious control of behaviour means there is much more variance in how or if the associated mating behaviours are exhibited. Future research must attempt to study the influence of mating motives on mating behaviours such as competitiveness by accessing more real-world methods, as in Ronay and von Hippel's (2010) study examining the behaviour of skateboarders, and by considering the influence of individual variation in the mating strategies of participants in order to explore this with greater validity.

9.2. Limitations and Future Research

While this thesis was able to explore the role of competitiveness in men and has yielded some consistent results across the studies, there are some methodological limitations which must be acknowledged and discussed. It is also important to consider the potential impact of using newly designed materials, such as those employed in this research.

9.2.1. ExPI

The ExPI was designed and tested in study one. It employed ten hypothetical scenarios describing opportunities for engaging in extra-pair matings and asked participants how likely they would be to engage in these scenarios on a four point

Likert scale. Total scores on the ExPI ranged from 10-40 and provided a measure of an individual's *mating strategy*, specifically, a measure of an individual's mating effort when partnered. Higher scores on the ExPI indicate higher mating effort and a faster mating strategy. The results of study one suggested that the ExPI was suitable for use in this research and was not subject to socially desirable responding. However, in studies three, four, and nine, mean ExPI scores never exceeded the median point. There are two plausible explanations for this. The first is that the samples of men recruited in studies three, four, and nine did not have high levels of extra-pair interests. This is supported by the results of studies three, four, and nine which showed that ExPI scores predicted competitive motivation, measured by the number of attempts made on the circles and squares game. A quadratic model was used in both studies three and nine which showed that ExPI scores positively predicted the number of attempts made on the game until approximately the median point, after which ExPI scores negatively predicted the number of attempts made on the game. The results of study four indicated that ExPI scores positively predicted number of attempts made on the game. The correlational design of studies three, four and nine go some way toward addressing the potential issues caused by positively skewed means because correlational designs consider all of the variation in the data. However, it would have been interesting to explore the differences in the number of attempts made on the game between individuals with high and low ExPI scores using a quasi-experimental design. Nevertheless, the data from studies three, four and nine do suggest that mating effort relates to competitive motivation in men.

The second reason for the low mean ExPI scores in studies three, four and nine is that the ExPI scale developed in study one may be too simple to accurately measure the complexities of extra-pair interests in committed men. Mcintyre et al.

(2006) incorporated the sociosexual orientation inventory (SOI, discussed in Chapter 2, Simpson & Gangestad, 1991) in their research to examine variation in the testosterone levels (as the biological aspect of mating effort) of committed men due to differences in mating strategy. The SOI is a measure of *sociosexuality*, which is an individual's propensity for uncommitted sex. Scores on the SOI range from being unrestricted in sociosexuality, which means individuals are more in favour of having uncommitted sexual relations, to being restricted in sociosexuality, where individual's specify a need for warmth and commitment in a relationship before engaging in sexual relations. As discussed in Chapter 2, the SOI was a unidimensional construct which was criticised for attempting to measure the complexities of sociosexuality too simplistically. The research by Mcintyre et al. (2006) acknowledged this and distributed the SOI to participants, as well as asking "*would you ever consider having an affair behind your partner's back?*" Their results showed that scores on the SOI were not related with testosterone levels in participants overall, but those who's scores suggested they had an unrestricted sociosexuality also had higher levels of testosterone. Edelstein et al. (2011), using the multi-faceted revised sociosexual orientation inventory (SOI-R, discussed in Chapter 2, Penke, 2011) showed that this was upheld only for the facet of sociosexual desires. Sociosexual desires, an individual's desire for uncommitted sexual encounters independent of their previous sociosexual behaviours or sociosexual attitudes, had been underrepresented on the original SOI. Here, men in relationships with unrestricted sociosexual desires maintained testosterone levels that were comparable to those of single men whereas committed men with restricted sociosexual desires had reduced testosterone levels. This finding was further supported and extended by Puts et al. (2015). Puts et al. (2015) totalled participants' scores on the attitude and desire subscales of the SOI-R to create a ‘sociosexual psychology’ variable. They found testosterone levels positively predicted sociosexual psychology, and after controlling for this, sociosexual behaviour negatively predicted testosterone levels. They suggested that testosterone fluctuates in order to support mating behaviours by encouraging a sociosexual psychology, but once mated, testosterone decreases in order to reduce the costs associated with mating effort (Edelstein et al., 2011; Puts et al., 2015). This means that sexual behaviour would indicate a successful mating strategy and encourage mating effort to decrease, for example, in committed men. Conversely, reduced engagement in sexual behaviours indicates that an individual’s mating strategy is not optimised and therefore encourages an increase in testosterone to support mating behaviours (Puts et al., 2015). This more recent research suggests that the association between mating behaviours and mating biology is more complex than originally thought, and therefore it may be that the ExPI is too simplistic to measure extra-pair interests in men.

The ExPI may be a crude measure of sociosexual behaviours, because it asks participants the likelihood of engaging in specific behaviours in briefly detailed scenarios. This negates the complex relationship between sociosexual attitudes, desires and behaviours discussed above as it does not fully incorporate and differentiate sociosexual desire and attitudes. It is therefore unlikely that the ExPI is appropriate to measure extra-pair interests in committed men. On the other hand, the SOI-R is multi-faceted and equipped to consider all aspects of this relationship, in a way that is more consistent with analysing ultimate motivations, making it a more suitable instrument for gauging levels of mating effort beyond external labels. Furthermore, although use of the ExPI has yielded some interesting results which are consistent with the theoretical basis adopted in this research, a four-point Likert scale is too small to adequately capture a wide variation in responses. Using a larger response range, such as the nine-point scale of the SOI-R, may have provided more informative data. Another potential issue with the ExPI is that it may still be sensitive to socially desirable responding. Although the results of study one suggested this was not the case, this may have been a problem for subsequent samples and contributed to the lower ExPI scores. This is because the items on the ExPI are phrased in way which is inconsistent with societal norms of monogamy which may also be inconsistent with how individuals perceive themselves. In contrast, the SOI-R gauges interests in extra-pair mating in a more latent manner which may be less susceptible to biased responding. It is therefore suggested that using the SOI-R in future research will yield more efficient and reliable data, leading to a better understanding of the function of competitive behaviour.

9.2.2. Primes

Multiple priming methods were used in the current research in order to examine how potential mates or rivals may affect competitiveness in men, consistent with ultimate motivations. Study four used a method which has previously been used successfully to increase mating behaviours in men. This involved participants viewing photographs of attractive women then writing about their ideal first date with one of the women. Study six presented photographs of men and women on the computer screen while participants were completing the online competitive task with the aim of the people in the photographs being perceived by participants as an audience. Study five employed research assistants to collect data in a natural field task with the intention that participants would perceive the research assistants as an audience. Finally, study seven developed more detailed textual primes which were used in study nine. There was no evidence in studies four, five, six or nine that any of these priming methods affected mating behaviours in men, measured by changes in their competitive motivation. However, as discussed above, there was evidence in study six that the competitive motivation of women may have been affected by the primes. As discussed in section 9.1.2, the results of study nine indicate that the textual primes affect mating behaviours in men to a comparable level as primes used in previous research (for example, Griskevicius et al., 2009). However, they explain a very small amount of the variance in the data of study nine, which is perhaps unsurprising in retrospect when considering the complexity of the cues inform mating effort.

It is argued that the concept of ‘extra-pair mating’ is too complex to prime artificially. Whereas studies four and six used relatively simple priming methods, the textual primes attempted to reflect the complex nature of extra-pair interests. As discussed in Chapter 7, it has been suggested that if there has been no prior experience of a particular cognitive facet, it may be unavailable for activation by a prime (Wilson, 2013). This means that the prime may be unwittingly introducing error variance because they would be unsuccessful in activating the cognitive concept which the primed scenario relates to in people who have never had this concept activated before. On the other hand, for people who have prior experience of the scenarios detailed in the primes, the necessary cognitive concepts have been activated and strengthened and therefore are more susceptible to priming methods. This may mean that priming methods would only be successful in naturalistic samples who can relate to the content of the primes. This is not helpful in studies such as those reported here where the purpose of the primes is to overcome the difficulties in recruiting participants with extra-pair interests and, additionally who will admit to having extra-pair interests. If it is the case that priming complex concepts is only effective when individuals have had prior experience of the concept, this would negate the purpose of priming participants. As discussed above, recent research has highlighted how problematic social priming methods may be (Shanks et al., 2015). In order to increase control in future research, participants could be allocated to conditions in a quasi-experimental design based on their previous experiences. This would allow the activation of cognitive concepts in participants that had previously been activated and may therefore increase the strength of the prime. However, this would not address the difficulty of recruiting participants with past or current extra-pair interests. Previous research has recruited participants who appear to have elevated mating effort (evidenced by higher testosterone levels, reporting being interested in additional mating opportunities, and scoring high in sociosexual psychology, Edelstein et al., 2014; Mcintyre et al., 2006; Puts et al., 2015) therefore it is possible to recruit these participants, particularly when using the SOI-R to measure extra-pair interests in a more covert manner.

9.2.3. Measures of Competitiveness

In order to proceed with the research in this thesis, it was necessary to identify appropriate measures of competitiveness. Existing measures of competitiveness were investigated and evaluated for use in these studies. It was suggested that self-report measures of competitiveness would not be suitable as they measure trait competitiveness which ignores state competitiveness, that is how individual's respond to competition. Previous research regarding competitiveness has used naturalistic samples of experts in various areas of competition which would not have been suitable in this research. Measures of risk in competition, competitive performance and competitive motivation were all informative to this research. This is because risk taking is related to mating effort and is therefore associated more so with men than women. Previous research using specialist samples to examine competitiveness have typically measured competitive performance, however it was suggested that, with reference to costly signalling theory, a measure of competitive performance would not be an optimal indicator of how motivated an individual is to engage in mating effort. This is because costly signals are fitness dependent, meaning the quality of signals are graded dependent upon the signaller's fitness. For example, a less fit individual must be motivated to secure reproductive effort, however he may not be successful in doing so, resulting in occupying a lower position in the dominance hierarchy. For this reason, it was expected that competitive motivation would be a more informative measure of how motivated an individual was to engage in mating behaviours.

Study two investigated potentially suitable tasks, before concluding that the circles and squares game would be most appropriate in the research. The game provided two measures of competitiveness. Competitive performance was shown by the score achieved on the task, and competitive motivation was evidenced by the number of attempts made on the task. A measure of risk was also provided, which was whether participants chose to play 'circles' which was the easier option, or 'squares' which was the harder option. As well as these measures, participants were asked to provide a rating of how competitive they felt after completing the game (1-9). It was suggested that post-task ratings of competitiveness would provide a measure of competitive motivation because these ratings could be easily biased to reflect how individual's wanted to portray, being either more or less competitive.

Ratings of post-task competitiveness were measured in studies three and four, but were omitted in studies five, six and nine. This is because the results of studies three and four showed there were sex differences in ratings of competitiveness, with men rating themselves as more competitive than women, however there was no within-sex variation of competitiveness ratings due to mating effort. Self-ratings of competitiveness will at least partially reflect gender stereotypical socialised norms (Hibbard & Buhrmester, 2010), however this measure could not reliably provide any additional insights into variation in competitiveness according to ultimate motivations. It has been suggested that sex differences in physical size and strength have led to sex differences in competitiveness (Wood & Eagly, 2002), however, it is the sex differences in adaptive mating strategies which have led to sex differences in physical size and strength.

The results of studies four, six and nine supports the discussed distinction between competitive *performance* and competitive *motivation* by showing an effect of external indicators of mating effort on competitive motivation, but not on competitive performance. The results of these studies showed that men reduced their competitive motivation (evidence by the number of attempts made on the game) as their reproductive resources increased; single non-fathers made the most attempts on the game, followed by committed non-fathers, and committed fathers made the fewest attempts on the game. However, there was no evidence of mating effort affecting competitive performance (the score on the game) in studies four, six and nine. Furthermore, the *mating strategy* of committed men, measured by ExPI scores, predicted their motivation to compete as well as their competitive performance in study four. This indicates that fitter men are more inclined to follow a faster mating strategy than less fit men because there was an effect of mating effort on competitive motivation but not on competitive performance, suggesting that fitter men made fewer, more successful attempts on the game. This provides further support for the suggestion that competitive motivation in men relates to mating effort.

However, consistent with predictions from parental investment theory and costly signalling theory, it was expected that this effect of mating effort on competitive motivation would be sex-differentiated, yet this was not the case. Although the results of studies three, four, five, six and nine support the suggestion that men typically reduce their mating effort as they secure reproductive resources (a partner and/or children), evidenced by a reduction in competitive motivation, there was also evidence in studies three, five and six for a reduction in competitive motivation in women as they secure reproductive resources. This may be because the rod balancing task (study five) and the circles and squares game (studies three and six) were free of physical risk and furthermore, the online tasks were more covert in nature. It was argued in Chapter 5 that these aspects may appeal to women's indirect competitiveness (Fisher, 2013; Fisher, 2015; Stockley & Campbell, 2013) and this may explain why women engaged more in the competitive task than what had been expected. Although further discussion of this is beyond the scope of this thesis, it is important for future research to further explore the function of female competitiveness as this may provide a greater understanding of sex differences in adaptive motivations. Future research could incorporate the nature of the competitive game, specifically whether it is overt or covert, as an additional independent variable. An overt competitive condition could introduce an evaluative audience and examine how this affects competitive motivation. As men are suggested to be more motivated by overt competition and women by covert competition, an audience who is actively evaluating participant's engagement and performance in the game may encourage men to compete and discourage women.

9.2.4. The Circles and Squares Game

A final point to consider is whether the circles and squares game, the competitive task used in studies three, four, six and nine, was appropriate for use. The circles and squares game was specifically designed for the research presented in this thesis and provided measures of competitive motivation and competitive performance, as well as a measure of risk (analysed in study three). It was developed in study two and implemented in studies three, four, six and nine. Participant's selected to play either 'circles' or 'squares' with the aim of collecting as many points as possible in a three minute time frame by correctly clicking on their chosen shape. The chosen shape appeared in random places on the computer screen at 0.5 second intervals. Points were scored by correctly clicking on the shape before it disappeared. Circles appeared on the screen relatively larger than squares, making the circles easier to click and the squares more difficult to click. Each circle clicked was therefore worth one point and each square clicked was worth three points. The choice of which shape to play related to the competitive risk in the game; one strategy would likely be easier to play but result in a lower score, whereas the other strategy may result in a poorer performance due to it being more difficult but there was also the potential to score more points. Participants were presented with a leader board of 'current performance' on the task, however these scores were not genuine. The purpose of the leader board was to provide individuals with a standard of comparison against which to compare their own performance, encouraging them to compete. However, it is possible that this game did not optimally meet the intended requirements for assessing competitiveness. Referring back to Chapter 1, Martens (1976) states *competition* is where an individual's performance is evaluated in comparison to at least one other individual when there is a standard against which to assess the comparison, and that *competitiveness* is where an individual has an innate disposition to strive for success in these comparisons. Arguably, the number of attempts (rather than the actual score) made on the circles and squares game was suitable to assess competitiveness, namely the desire to strive for success in the game with the leader board serving as the standard for evaluating individual competitiveness. However, there was no direct competitor in the game, and no form of direct evaluation of competitiveness by an observer (such as an experimenter monitoring participants' performance). This game may therefore be improved for future use by introducing a confederate competitor in order for the participant to make more direct comparisons and evaluations. This would also allow an assessment of audience effects (with the confederate competitor or experimenter as the audience) and an investigation of how the competitive motivation of men differs as a function of the sex and attractiveness of their 'competitor' or observer. Incorporating a more direct form of competition by introducing a 'competitor' may therefore appeal to the direct competitiveness of men more than the current format of the game. Adjusting the game in this way would help to elucidate the interaction between sex and mating effort on competitive motivation by differentiating between overt, direct competition and covert, indirect competition, as discussed previously.

9.2.5. Sample Sizes

Throughout the research reported in this thesis, sample sizes have been quite low. Recruitment of fathers was particularly difficult. This means there are often non-significant findings with respectable effect sizes, indicating a lack of power in the current research to detect effects. This research has relied on null hypothesis significance testing and effect sizes simultaneously and complimentarily. This means that although the low sample sizes are problematic, some conclusions can be drawn from the data, although tentatively in places. However, single fathers were excluded from analyses in all of the studies due to particularly low numbers. Many fathers, both single and committed, were recruited in study six however their data were unanalysable because of a computer programming error. The challenge hypothesis suggests a negative association between mating effort and offspring presence in bi-parental species. This is supported by research which suggests greater involvement in offspring care reduces mating effort in men (Gettler, McDade, Feranil, et al., 2011). It would be interesting to explore how single fathers negotiate their allocation of reproductive energy into mating and parenting behaviours to examine whether mating motivations would be neutralised by the presence of offspring. This may be achieved by examining the competitive motivation of residential single fathers in comparison to non-residential single fathers or single fathers with little or no offspring involvement. It is suggested that, in conjunction with the challenge hypothesis and research regarding testosterone fluctuations in fatherhood (Gettler et al., 2013, 2012), there will be a negative association between competitive motivation and offspring involvement, so that residential single fathers will have lower mating effort because of they need a greater level of parenting effort. On the other hand, non-residential single fathers, or single fathers who provide very little direct offspring care, should be more motivated to engage in mating behaviours.

9.3. Conclusion

In conclusion, the research presented in this thesis provides some support for the evolutionary account of competitiveness as the results suggest that the motivation of men to compete is a form of mating effort. Furthermore, these results suggest that mating effort fluctuates adaptively as a function of mating effort and mating strategy in men, and these fluctuations have been reinforced by female mate preferences. Although the motivation to compete can indicate mating effort, successful competition (as measured by competitive performance) may indicate genetic fitness. This would be particularly attractive to women, but not essential in a mate. It was suggested that men and women have different adaptive baselines of reproductive energy allocated into life history components. The sex differences in competitive motivation (studies three and six) were primarily due to sex differences in the motivation of single participants, which is consistent with this. This supports the evolutionary theories discussed in Chapter 1 as it indicates a greater desire in single men (than single women) to engage in mating effort because they have no reproductive resources. However, as men gained reproductive resources, their competitive motivation reduced, resulting in no sex differences in the competitive motivation of committed non-parents or committed parents. This research therefore also supports life history theory and the challenge hypothesis, as it provides evidence of decreasing competitive motivation in men as they gain reproductive resources. This indicates their mating effort has reduced in order to engage in parenting effort. In further support of this, evidence was presented that shows levels of mating effort predicted competitive motivation even though the participants in this research did not indicate particularly high levels of extra-pair interests. Consistent with life history theory which suggests there are sex differences in the baseline allocation of reproductive energy, there were no notable relationships between indicators of mating effort and measures of competitiveness in women.

This research cannot provide support for the role of external cues (represented by an audience) influencing competitiveness consistent with predictions from the challenge hypothesis. However this may be due to methodological limitations in the design of the primes. The highly variable, multi-faceted nature of extra-pair interests means this is a particularly difficult concept to investigate and would therefore benefit from further exploration in samples with naturally varying mating strategies. However this research does provide another perspective to existing accounts of competitiveness. Whereas existing accounts suggest that sex differences in competitiveness are socialised, it does not acknowledge the variation in competitiveness *within* men, as discussed in Chapter 1. This research provides evidence of an evolutionary function of competitiveness, which is to secure reproductive resources. This explains where the origins of sex differences in competitiveness originate and also highlights the variation in competitiveness within men according to their mating strategy, suggesting it served an adaptive function in the ancestral environment.

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Appendix 2.A: Extra-Pair Interests Scale (ExPI)

Please imagine yourself in the following scenarios and indicate how likely you would be to respond in the ways detailed on a scale of 1 (extremely unlikely) to 4 (extremely likely) **as if you are in a relationship (even if you are not)**:

1. Imagine you are on a night out with your friends without your partner. You notice an attractive member of the opposite sex. A conversation starts between you both and although **you have a partner**, you don't do anything to end the conversation, in fact, you encourage it.

1 2 3 4

Extremely unlikely Extremely likely

2. Imagine you are in the gym just finishing off your usual routine. You feel tired and are about to leave when an attractive member of the opposite sex enters the room. Although **you have a partner**, you decide to stay for an extra five minutes and behave in a manner so that you can try to impress this person.

1 2 3 4

Extremely unlikely Extremely likely

3. Imagine you have made plans **with your partner** to spend some quality time together tonight but one of your single friends has invited you along to a party where lots of members of the opposite sex will be present. However you decide to decline your friend's offer so that you can do what you planned with your partner.

1 2 3 4

Extremely unlikely Extremely likely

4. Imagine you are getting ready for work and you make an extra effort to look nice. Although **you are in a relationship**, this extra effort is to impress an attractive colleague who has recently started working with you.

1 2 3 4

Extremely unlikely Extremely likely

5. Imagine you are on a social networking site and you receive a message from an attractive stranger. It's clear that they have mistaken you for someone else. Although **you are in a relationship**, you reply and attempt to strike up a flirtatious conversation with them.

1 2 3 4

Extremely unlikely Extremely likely

6. Imagine you are in a car with a friend and you have stopped at some traffic lights. You see an attractive member of the opposite sex about to walk past the car. Although **you are in a relationship**, you roll down your window and subtly try to get their attention.

1 2 3 4

Extremely unlikely Extremely likely

7. Imagine you have just arrived home from the supermarket and you realise you have lost your mobile phone. Fortunately, at that point your home phone rings. The caller is a member of the opposite sex and identifies themselves as the person behind you in the checkout queue. They say they have your phone and ask if you would like to meet in a nearby cafe to collect it from them. You immediately remember this individual as you noticed they were very attractive at the time. Although **you have a partner**, you are excited at the prospect of meeting them and happily agree to this. You go alone, hoping it may lead to more.

1 2 3 4

Extremely unlikely Extremely likely

8. Imagine you are on a social night out with friends while your partner is at home. An attractive member of the opposite sex starts kissing you. Although **you have a partner**, you don't stop the kiss, in fact you enjoy it.

1 2 3 4

Extremely unlikely Extremely likely

9. Imagine you have to leave early for work one day and you have a chance encounter with an attractive member of the opposite sex. You find yourself thinking

about them during the day and although **you have a partner**, you decide to leave at that time every day with the hope of bumping into the attractive stranger again.

1 2 3 4

Extremely unlikely *Extremely likely*

10. Imagine you are walking down the street and you notice an attractive member of the opposite sex looking at you approvingly. Although **you have a partner**, you smile back encouragingly.

1 2 3 4

Extremely unlikely *Extremely likely*

Removed Items

- Imagine it is Valentine's Day and you have given your partner a card and breakfast in bed to show how much they mean to you. You get ready for work and arrive at the usual time to find an anonymous Valentine's Day card has been left for you. You are a little shocked and also flattered, but at the same time you have no interest in establishing who sent it (*reverse scored item*).

  1 2 3 4

  Extremely unlikely *Extremely likely*

- Imagine you are away from your partner in a different city. You meet an attractive member of the opposite sex. One thing leads to another and the opportunity to have a one night stand arises. However, you decline due to being in a relationship (*reverse scored item*).

  1 2 3 4

  Extremely unlikely *Extremely likely*

Appendix 2.B: Marlowe-Crowne Short Form C

Please answer the following questions by indicating either ‘true’ or ‘false’ as applicable to you personally.

1. It is sometimes hard for me to get on with my work if I am not encouraged. T/F
2. I sometimes feel resentful when I don’t get my own way. T/F
3. On a few occasions, I have given up doing something because I thought too little of my ability. T/F
4. There have been times when I have felt like rebelling against people in authority even though I knew they were right. T/F
5. No matter who I’m talking to I’m always a good listener. T/F
6. There have been occasions when I took advantage of someone. T/F
7. I’m always willing to admit when I make a mistake. T/F
8. I sometimes try to get even rather than forgive and forget. T/F
9. I am always courteous, even to people who are disagreeable. T/F
10. I have never been irked when people expressed ideas very different from my own. T/F
11. There have been times when I was quite jealous of the good fortune of others. T/F
12. I am sometimes irritated by people who ask favours of me. T/F
13. I have never deliberately said something that hurt someone’s feelings. T/F

Appendix 2.C: The Revised Sociosexual Orientation Inventory (SOI-R)

Please respond honestly to all of the following questions. Your responses will be treated confidentially and anonymously.

1. With how many different partners have you had sex within the past 12 months?

   0 1 2 3 4 5-6 7-9 10-19 20+

2. With how many different partners have you had sexual intercourse on one and only one occasion?

   0 1 2 3 4 5-6 7-9 10-19 20+

3. With how many different partners have you had sexual intercourse without having an interest in a long-term committed relationship with this person?

   0 1 2 3 4 5-6 7-9 10-19 20+

4. Sex without love is OK

   1 2 3 4 5 6 7 8 9

Strongly Agree Strongly Disagree

5. I can imagine myself being comfortable and enjoying "casual" sex with different partners.

   1 2 3 4 5 6 7 8 9

Strongly Agree Strongly Disagree

6. I do not want to have sex with a person until I am sure that we will have a long-term, serious relationship.

   1 2 3 4 5 6 7 8 9

Strongly Agree Strongly Disagree

7. How often do you have fantasies about having sex with someone you are not in a committed romantic relationship with?
   1. Never
   2. Very seldom
   3. About once every two – three months
   4. About once a month
   5. About once every two weeks
   6. About once a week

7. Several times a week
8. Nearly every day
9. At least once a day

8. How often do you experience sexual arousal when you are in contact with someone you are not in a committed romantic relationship with?

    1. Never
    2. Very seldom
    3. About once every two – three months
    4. About once a month
    5. About once every two weeks
    6. About once a week
    7. Several times a week
    8. Nearly every day
    9. At least once a day

9. In everyday life, how often do you have spontaneous fantasies about having sex with someone you have just met?

    1. Never
    2. Very seldom
    3. About once every two – three months
    4. About once a month
    5. About once every two weeks
    6. About once a week
    7. Several times a week
    8. Nearly every day
    9. At least once a day

Appendix 2.D: The Modified Relationship Assessment Scale (M-RAS)

Please mark on the answer sheet the number for each item which best answers that item for you.

1. In general, how satisfied are you with your relationship?

1	2	3	4
Extremely Unsatisfied	Unsatisfied	Satisfied	Extremely Satisfied

2. Are you glad you got into this relationship?

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

3. To what extent has your relationship met your original expectations:

1	2	3	4
A lot worse than expected	Worse than expected	Better than expected	A lot better than expected

4. How much do you love your partner?

1	2	3	4
Not at all	Not much	A lot	Completely

5. My relationship is problem free?

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

6. Do you think of your relationship as perfect?

1	2	3	4

Strongly Disagree	Disagree	Agree	Strongly Agree

7. Do you think of yourself as the happiest couple in world?

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

8. Do you like spending time with you partner?

1	2	3	4
Never	Infequently	Often	Always

9. Do you think your relationship has changed your life for the better?

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

Removed Item:

Do you ever think of other people as possible romantic interests?

1	2	3	4
Never	Infrequently	Often	Always

Appendix 2.E: Demographic Questionnaire fot Study One

1. What is your date of birth? (Please enter in six digits, e.g. DD/MM/YY)

   __/__/__

2. Are you currently in a relationship? (If 'No' please go to question 5)

   Yes No

3. Is this relationship exclusive?

   1 2 3 4 5 6 7 8 9

   Extremely Comitted *Neither Committed or Uncommitted* *Extremely Uncommitted*

4. How long have you been in this relationship? (In months)

   ____

5. Do you have any children? (If 'No' please go to question 8)

   Yes No

6. How many children do you have?

   ____

7. How old are your children? (Please list, separate with commas)

   ____

8. What is your nationality?

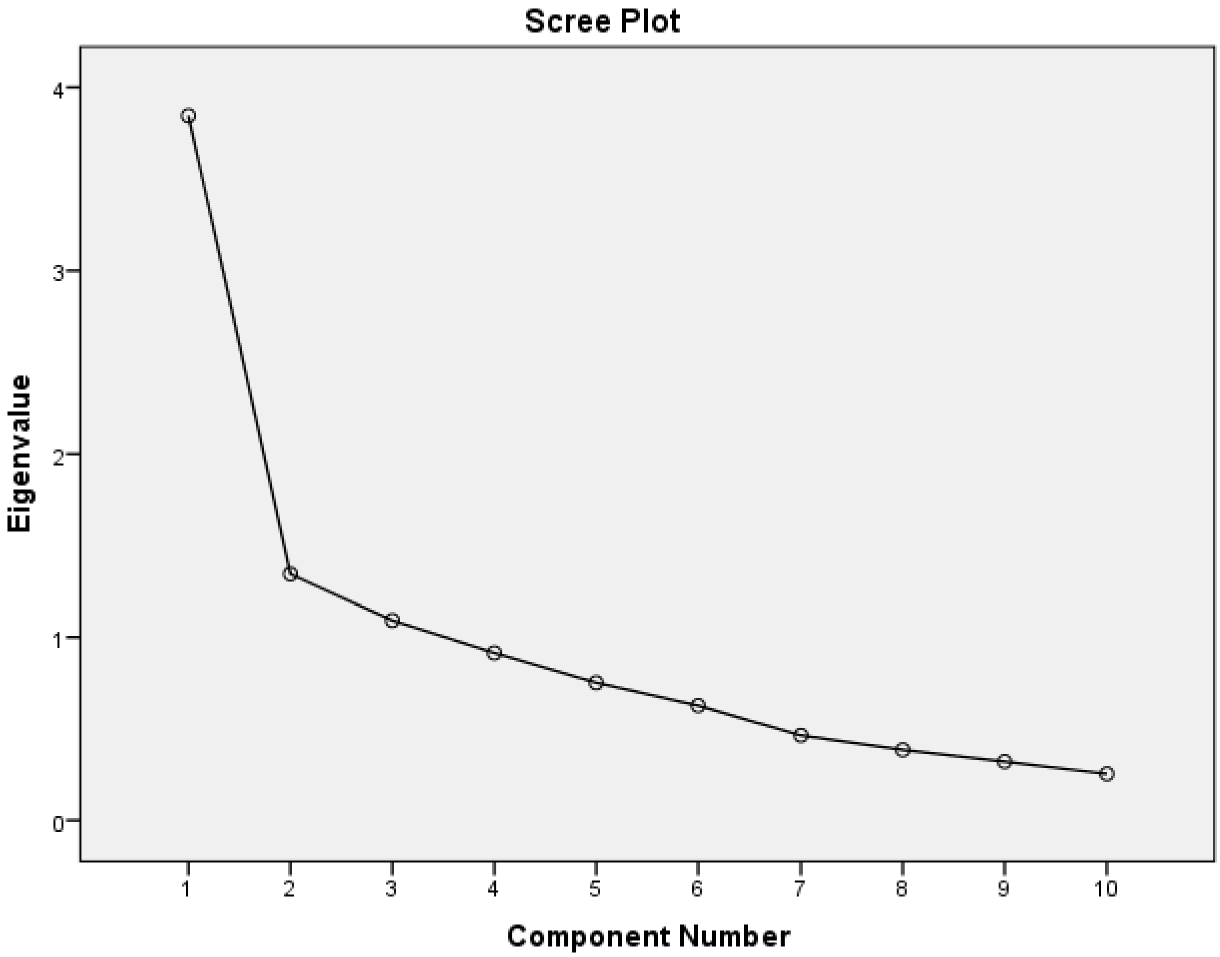
   ____

9. What is your highest level of education?

   - No formal education

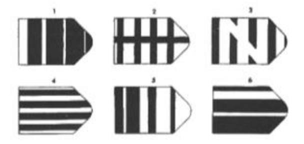
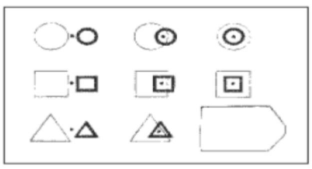
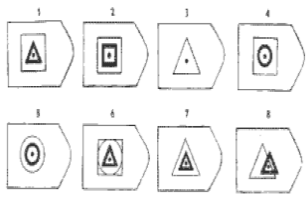
- ☐ Primary/grade school
- ☐ Secondary/high school
- ☐ One or more years of university/college
- ☐ A university/college degree/diploma
- ☐ A postgraduate qualification or diploma

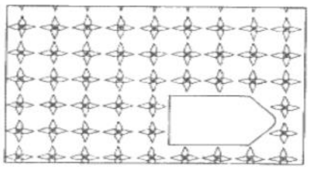
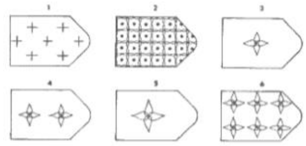
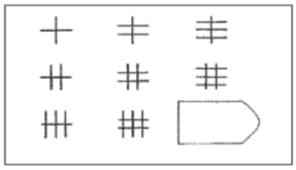
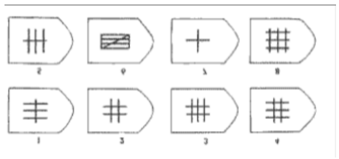
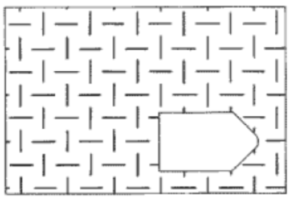
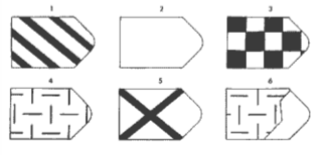
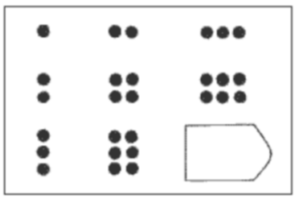
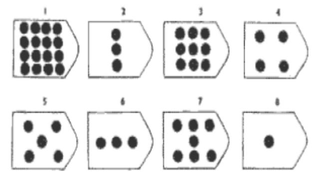
Appendix 2.F: Principal Components Analysis Scree Plot for the Development of the ExPI

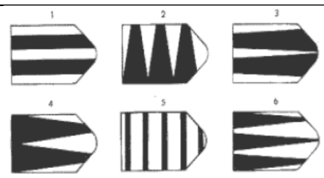
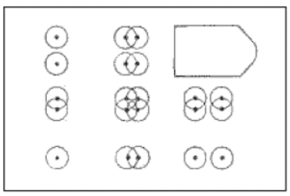
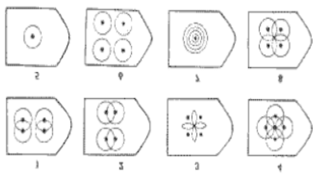


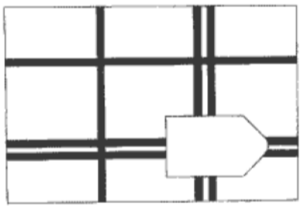
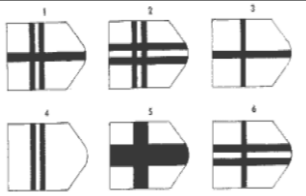
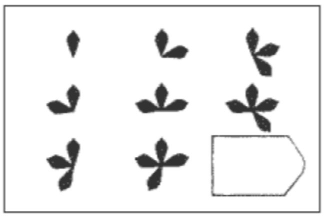
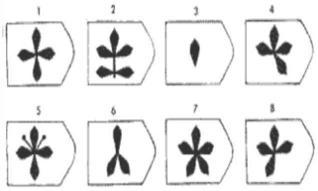
Appendix 2.G: 'Questions' Task

*Table 2.G.1. Easy and hard option questions used in the 'Questions' task (correct answers in **Bold**)*

	Option	Question	Answers
1.		**Answer the following mathematical problem:**	
	Easy	3/5 of a class of 30 were girls. What percentage were boys?	30%, **40%**, 60%, 70%
	Hard	Three-fifths of a class of thirty were girls. What percentage were boys?	Thirty, **Forty**, Sixty, Seventy percent
2.		**Indicate whether the following statement is 'valid' or 'invalid':**	
	Easy	All patriots are voters; Some citizens are not voters; Ergo, some citizens are not patriots.	**Valid,** Invalid
	Hard	All P's are V's; Some C's are not V's; Ergo, some C's are not P's	**Valid**, Invalid
3.		**Answer the following mathematical problem:**	
	Easy	A test had 40 questions, each worth 1 mark. If the pass mark is 70%, what was the minimum number of questions that must be answered correctly in order to pass the test?	5.7, 12, 17.5, **28**
	Hard	A test had forty questions, each worth one mark. If the pass mark is seventy per-cent, what was the minimum number of questions that must be answered correctly in order to pass the test?	Five point seven, Twelve, Seventeen point five, **Twenty eight**
4.		**Indicate which option fills the space:**	
	Easy		 1
	Hard		 7
5.		**Answer the following question:**	
	Easy	In the Old Testament, who is the twin brother of Jacob?	Adam, **Esau**, Methuelah, Jonah
	Hard	Niagara Falls, on the border between the USA and Canada, are situated on which river?	**Niagara**, Erie, Ontario, St Lawrence

6.		**Indicate which option fills the space:**	
	Easy		 6
	Hard		 8
7.		**What word has been jumbled here?**	(Open response)
	Easy	TRIAST	ARTIST/TRAITS
	Hard	LUPUGERSE	SUPERGLUE
8.		**Indicate which option fills the space:**	
	Easy		 4
	Hard		 3
9.		**What word has been jumbled here?**	(Open response)
	Easy	DHTRAE	DEARTH/THREAD/HATRED
	Hard	CATFAINTS	FANTASTIC
10.		**Indicate which is the correct definition of the following word:**	
	Easy	ANTAGONISTIC	Friendly, Peaceful, **Hostile**, Agonise
	Hard	PHILARGYRIST	A womaniser, **Someone who loves money**, Someone who does good to others, An ignorant person
11.		**Indicate which is the correct definition of the following word:**	
	Easy	DEDUCE	**Assume**, Make less, Make more, Doubt
	Hard	MALEOLENT	To harden and aggravate, To de-purify, Having a bad nature, **Having a foul smell**
12.		**Answer the following question:**	
	Easy	Where was Leonardo Da Vinci born?	

	Hard	Who painted the ceiling of the Banqueting House of the Whitehall Palace?	Palermo, Milan, Leonardo, **Vinci** Rubens, **Rembrandt**, Renoir, Raphael
13.		**Answer the following mathematical problem:**	
	Easy	3/7 of a year group of 280 pupils were boys. How many of the group were girls?	40, 93, **160**, 187
	Hard	Three-sevenths of a year group of two hundred and eighty pupils were boys. How many of the group were girls?	Forty, Ninety three, **One hundred and sixty**, One hundred and eighty seven
14.		**Answer the following mathematical problem:**	**£212.50**, £225.00, £225.50, £2125.00
	Easy	The entrance fee for an exhibition is £4.25. What will be the total entrance fee for a school party of 50 pupils?	**Two hundred and twelve pounds fifty pence,** Two hundred
	Hard	The entrance fee for an exhibition is four pounds and twenty five pence. What will be the total entrance fee for a school party of fifty pupils?	and twenty five pounds, Two hundred and twenty five pounds fifty pence, two thousand one hundred and twenty five pounds
15.		Indicate which option fills the space:	
	Easy		 3
	Hard		 6
16		**Indicate whether the following statement is valid:**	
	Easy	All that is good is pleasant; All eating is pleasant; Ergo, all eating is good	Valid, **Invalid**
	Hard	All that is G is P; All E is P; Ergo, all E is G	Valid, **Invalid**
17.		**Indicate which is the correct definition of the following word:**	
	Easy	AUSPICIOUS	Unhappy, **Promising**, Wary, Trusting
	Hard	BOREISM	Someone who has been to Borstal, A chemical element, **The behaviour of a boring**

			person, A human breast
18.		**Indicate which option fills the space:**	
	Easy		 2
	Hard		 7
19.		**Indicate which is the correct definition of the following word:**	
	Easy	COMMENSURATE	Imperfect, Absolute, Mate with, **Complete**
	Hard	SCAEVITY	Vitamin C deficiency, To search for, **Unluckiness**, Uncommon
20.		**Answer the following question:**	
	Easy	Which of these parts of the body is most important for the sense of balance?	Mouth, Nose, Chin, **Ear**
	Hard	Which vowel in Morse Code is represented by a single dot?	A, **E**, I, O
21.		**Which word has been jumbled here?**	
	Easy	LPSAEE	PLEASE
	Hard	LUNACYINN	UNCANNILY
22.		**Indicate whether the following statement is 'valid' or 'invalid':**	
	Easy	All Canadians are people: John is a person: Ergo, John is a Canadian	Valid, **Invalid**
	Hard	All C's are P's; J is a P; Ergo, J is a C	Valid, **Invalid**
23.		**Indicate whether the following statement is 'valid' or 'invalid':**	
	Easy	No man is perfect; Some men are presidents; Ergo, some presidents are not perfect	**Valid**, Invalid
	Hard	No M's are P's; Some M's are Q's; Ergo, some Q's are not P's	**Valid**, Invalid
24.		**What word has been jumbled up here?**	
	Easy	MERAIN	REMAIN
	Hard	MARTINROS	RAINSTORM
25.		**Answer the following question:**	
	Easy	The clarinet belongs to which section of the orchestra?	String, Percussion, Brass, **Woodwind**

	Hard	Which of these people were alive in the year 100BC?	Hannibal, **Julius Caesar**, Confucius, Cleopatra
26.		**Indicate whether the following statement is 'valid' or 'invalid':**	
	Easy	All potatoes are round; some balls are round; Ergo, all balls are potatoes	Valid, **Invalid**
	Hard	All P's are R's; some B's are R's; Ergo, all B's are P's	Valid, **Invalid**
27.		**Indicate which is the correct definition of the following word:**	Under nourished, **Bad natured**, Flourish,
	Easy	MALEVOLENT	Aggressive
	Hard	VETERATORIAN	Someone who practices animal medicine, someone who has served for a long time, someone who does not eat meat, **to be subtle**
28.		**Answer the following question:**	
	Easy	In which city was Joan of Arc burned at the stake in 1431?	Reykjavik, **Rouen**, Rochdale, Rome
	Hard	Which religious movement was founded by Mary Baker Eddy?	Jehovah's Witnesses, **Christian Science**, Salvation Army, 7th-Day Adventists
29.		**What word has been jumbled here?**	
	Easy	RATNLE	ANTLER
	Hard	VACSEDANS	CANVASSED
30.	Easy Hard	**Answer the following mathematical question:**	
		25% of the pupils in a school with 340 pupils have free school meals. How many pupils is this?	14, 75, **85**, 255
		Twenty-five per-cent of the pupils in a school with three hundred and forty pupils have free school meals. How many pupils is this?	Fourteen, Seventy five, **Eighty five**, Two hundred and fifty five

Appendix 2.H: Number Grid

You will be presented with a 4x4 number grid. Your task is to find the highest number in the grid and click on each occurrence of it, which will then complete the grid and reset it. If you click on any number that is NOT the highest number, you must click on it again to unselect it (the grid will only be completed when ONLY the highest numbers are selected. You will receive 1 point for each grid you correctly complete. Your task is to collect as many points (i.e. complete as many grids) as possible in three minutes (180 seconds). When you have read and understood these instructions and are ready to proceed to the task, please click ‘continue’.

6	**8**	**9**	**8**
8	**5**	**3**	**3**
5	**6**	**9**	**5**
9	**7**	**5**	**3**

Appendix 2.I: Circles and Squares Game

You have a choice regarding the nature of the task you take part in; you can either play ‘circles’ or play ‘squares’. In this task, you will be presented with the shape you choose at random points on your computer screen at 0.5 second intervals. You have to successfully click as many shapes as possible to collect as many points as you can. The circles are larger than the squares and are therefore worth one point each; as the squares are smaller, they are worth three points each. If you do not click on the shape before it disappears you get no points. You have three minutes to collect as many points as possible in this task.

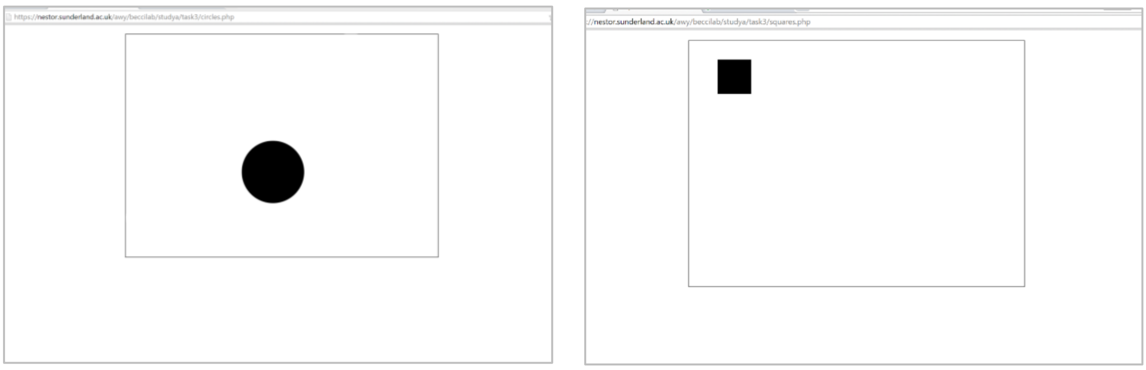


Figure 2.I.1. Screen shot of ‘circles’ play and ‘squares’ play

Appendix 2.J: Marbles Task

You will be presented with a virtual bag, which contains ten marbles; nine red and one black. Each red marble you withdraw from the bag is worth one point, and you need to collect as many points as you can. However, if you withdraw the black marble, you will lose the points you have collected in this game and the game will end. You can withdraw as many marbles as you like from the bag. When you have read and understood these instructions and are ready to proceed to the task, please click ‘continue’.

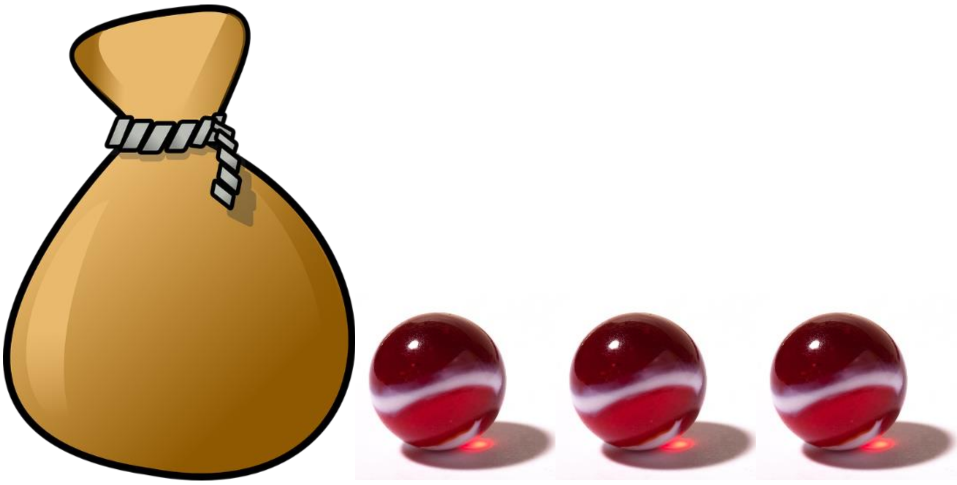


Figure 2.J.1. Example of the ‘bag’ presented to participants with three marbles withdrawn

Appendix 2.K. Demographic Questionnaire used in Task Development

1. What is your date of birth? (Please enter in six digits, e.g. DD/MM/YY)

   __/__/__

2. Are you make or female?

   Male Female

3. How would you describe your sexuality?

   Heterosexual Homosexual Bisexual

4. What is your nationality?

   ____

5. What is your highest level of education?

   - ☐ No formal education
   - ☐ Primary/grade school
   - ☐ Secondary/high school
   - ☐ One or more years of university/college
   - ☐ A university/college degree/diploma
   - ☐ A postgraduate qualification or diploma

6. What is your current relationship status?

   Single Casually Dating

   Long term relationship Cohabiting

   Married

7. Do you have any children?

   Yes No

Appendix 2.L: Study Two Information Sheet and Consent Form (Screen Shots)

University of Sunderland

Study Information
My name is Rebecca Slater and I am a postgraduate PhD student at the University of Sunderland. I would like to invite you to take part in this study, but before doing so it is important that you understand why the research is being conducted and what participation will involve. Please take the time to read this information sheet and email either myself or my Director of Studies (details at the end) if anything is unclear.

What is the study about?
The current study aims to test the effectiveness of performance tasks.

Who can participate?
I am looking for participants aged 18 or over.

What does participation involve?
In order to participate, you will be required to provide consent and provide some demographic information. You will then be asked to take part in four online based tasks, full instructions will be given prior to each one, with the aim of collecting as many points as you can in each task. Once these tasks are completed, you will be asked a few questions regarding how you felt about this task.

What will happen to my data?
No one will have access to any of your responses except for myself and my supervisors. Your date of birth in a six digit format (e.g. 010190) will be your unique reference number and you will not be identifiable from your responses. Likewise, participants will not be identifiable from any published work.

Can I withdraw from the study?
As participation is entirely voluntary, you are free to withdraw at any time without giving reason and without penalty. You can do this by not giving consent to participate when prompted, at which point you will be exited from the study. You can also exit the questionnaire at any point, or you can contact myself or my Director of Studies to withdraw your information using your unique reference number.

Contact details:
If you have any questions, or if you require additional information, please contact either myself (rbb5rgo@student.sunderland.ac.uk) or my Director of Studies Dr. Daniel Farrelly (daniel.farrelly@sunderland.ac.uk).

This study has been approved by the University of Sunderland Ethics Committee. Should you have any concerns regarding the study, you may contact the Chairperson of the Ethics Committee of the University of Sunderland, Dr. Robert Pullen, on robert.pullen@sunderland.ac.uk.

Thank you for your assistance,
Rebecca Slater.

1. In order to participate in this study, it is necessary that you give your informed consent. By clicking the 'Next' button below, you are indicating that you understand the nature of the study and your role as participant, and that you agree to take part in the research. Please consider the following points before proceeding:

As an informed participant of this study, I understand that:
1. My participation is voluntary and I may cease to take part in the study at any time, without penalty
2. I am aware of what my participation involves
3. I understand that my participation will be anonymous
4. If I have any questions, I will contact Rebecca Slater or Daniel Farrelly

I consent to take part in this study

- Yes
- No

Appendix 2.M: Ethics Statement for the Development of the Competitive Task and Chapter 3

University of Sunderland

RESEARCH ETHICS COMMITTEE

Application Number: 277

Project Title: How attitudes relate to task performance

Chief Investigator: R. Slater

YOUR RESEARCH PROJECT DECISION IS LISTED BELOW

APPROVED WITH NO CONDITIONS: *This means you may start the project immediately.*	✓
PRE-CONDITIONS: *This means you must complete the conditions listed below before you start the project. However, you DO NOT have to send any information back to the Committee. The Committee will assume completion of these conditions.*	
COMMITTEE-CONDITIONAL: *This means you must complete the conditions listed below before you start the project. You MUST send the information requested back to the Committee before you start the project.*	

Once the committee has received this information, it will contact you again about its decision.	
REJECTION: *This means the committee does not wish this research to commence. You should not start this research. The Research Ethics Committee will explain why it has reached this view. Please contact the Committee Chair if you have any questions.*	
RECOMMENDATIONS: *These are simply points of advice from the committee. They are OPTIONAL. You do not have to undertake them or contact the committee about them.* • The information sheet says that the participant will be asked some questions about how they felt about the task – perhaps this could be explained a little more ? • The information sheet says that the participant can withdraw their information – but it should be pointed out that there will be a time limit for this – I guess ?	

Signed by the Committee Chairperson

Appendix 2.N: Participant Feedback on the Piloting of the New Competitive Tasks

Task	Feedback
Questions	The test made me feel competitive in terms of choosing hard questions to get more points, but also choosing my strategy as to when to choose easy questions and when to choose hard questions to attempt to get the maximum number of points. I took the easy test so didn't feel terribly pushed or competitive, though it was an enjoyable survey, particularly the cognitive problems, the second part. I started to feel competitive. And a little frustrated The instructions were clear, but it did not make me feel competitive, but the word anagrams were fun :) It was effective in inducing competitiveness, I felt under pressure to do just as well as others The questions made the task feel competitive because you feel you are answering questions to be graded for a high score at the end. The selection of easy or hard makes you feel as if you are choosing an easy way out It didn't make me feel very competitive because it was not face-to-face which I normally feel important. Also as its online people could get the answers from the internet and feel more calm about the answers. It made me feel very competitive - I found myself feeling irritated at distractions around me and then annoyed that I didn't get a result at the end. The instructions were clear. The task was effective, it made me feel competitive. The instructions were very clear and the task did draw out my competitive side, I did feel slight pressure to get a good score in a short time period which I found frustrating It made me feel competitive but I mostly got impatient with the word scrambling ones so I wrote that I didn't know and moved on. I didn’t feel competitive because most of my answers was based on my social life, at the very end academic aspect came up and my response totally opposed it- based on my response, it does showed that I strongly like to compete with others. Anyway, socially I'm not a strong fan of competition but academically I am. I did not feel as if I were in competition with others. Perhaps you could stress in the intro that you are interested in how I would rank in comparison to others. The instructions were quite clear. I did not feel like I was competing against someone else, more the clock and myself. It was fun. Instructions were clear however I did not feel competitive as there was no indication that I was actually in competition with anyone. I felt competitive, instructions were clear and I was made to think Competitive

Mental and Everyday competitiveness it assess well but it's not the same as physical competitiveness that is experienced whilst playing sports

Didn't really feel competitive at all it would need some sort of update of other people's times and performances to make me feel under any competitive urge

It was clear. I did not feel competitive. I was interested in the questions but not in the final score. I picked the harder questions because they were more interesting, not because I wanted to compete.

I was competitive against the clock, yes. If I was told I was competing against another person (who can get the higher score) I probably wouldn't have been as competitive. I like to achieve things, and improve upon my best, but don't like 'stepping over' or 'beating' someone else in the process. I believe the instructions were clear, I understood what I was to do.

I don't know if this was effective. The task often made me feel more dogged than competitive**.** I didn't want to choose the easy ones, because I made the assumption I could do them without difficulty, so I sacrificed the time element and mostly chose the hard ones, which I suppose means I am less competitive and the test may measure that. However, what the questionnaire did not ask was whether I am competitive with myself--or with the task itself rather than others who may be doing it. I do think there is a different form of 'competitiveness' that has less relevance to others. I wanted to do the best I was capable of, and to me that was working on the hard ones rather than dashing through the easy ones. But then I am not at all sure of how well I did on some of the hard questions. Of course I thought I was answering correctly....I paused for a long long time on 'superglue' because I didn't see that I could just give up and click next. Maybe if it isn't blocked I'll go and do the test again doing all the easy ones.

Yes the task was effective for its purpose. I felt I had to try a bit harder to do well based on the preceding questions

Instructions were clear and the task will be fit for purpose. I did feel competitive, but was surprised at which tasks I found easy.

A visual cue as to how long had elapsed would have been handy; sometimes the competition is against oneself and this would help gauge how effectively one is performing.

Instructions clear. I am most competitive with myself, which this task most certainly brought out. However, I didn't see it as assessing my overall competitiveness anymore than other timed multi-subject tests. Also, I think it's important to differentiate between being competitive with yourself versus others, in the real-world versus in a play environment, and between games/mental activities versus sports. Good luck!

Fine... think I'm less competitive than I thought though.

I believe the task was effective. I felt pressured. However, I do not like to the feeling.

NO, because you didn't tell how it was competitive. Thus, I competed only against myself. If I had known that I would be compared with

	others or able to reap some type of reward, it would have been more competitive in nature I believe. very effective instructions were clear, hindered by slow internet connection It did not make me feel competitive as such but for some reason I always wanted to complete the 'hard' questions, perhaps to test my own ability. You need a clock. To be honest I got bored half way through, looked at something else then finished the survey. The instructions were clear. It would have made me feel more competitive if I'd known other people's performance on the task, but this felt more like competing with myself i.e. challenging myself. Did not make me feel competitive. There was no competitor. The instructions were clear. I'm not sure about competitiveness: I picked the hard questions all the time, but mainly out of curiosity to see what they were. Since I am unlikely to know what scores anyone else got, I don't feel I was competing with anyone. Would not say I felt competitive...just wanted to get a good score. It did not make me feel competitive against anyone else, only competitive with myself and my own expectations. Yes instructions were clear. It did succeed in making me feel competitive, but would probably have made me feel a bit more competitive if I knew I would see my score immediately afterwards :) Instructions were very clear, and it made me feel very competitive, there was no way I was going to go for the easy questions, even though I found some of the questions very difficult. A well designed and effective test; and quite good fun to have a bit of a challenge again. Though I'd have liked to see the correct answers after the test.
Number Square	
	Frustrating Difficult to get it to work Annoying Frustrating Good-it felt like it was working my brain! Struggled to get the numbers to click Too long Very annoying Struggled to concentrate with looking at numbers for so long I didn’t fully understand this but soon got the hang of it Frustrating as the numbers did not register straight away Competitive but frustrating Stressed Easy but frustrating Agitated and angry, very repetitive and made me frustrated Competitive, irritated. Competitive Difficult to understand what to do It was difficult to keep focused

Circles and Squares	Squares hurt my eyes but it was not too difficult
	I felt competitive and more alert Boring Boring after a while, it went on too long A little competitive Too long A little competitive, a score counter would have been good competitive but when I felt I wasn't getting anywhere I became frustrated. It was a little too long, it maybe shouldn't of been 3 minutes long but it did make me feel more competitive when i wasnt able to get the squares in time, was quite difficult made me feel competitive in the beginning but soon became bored Competitive but boring Difficult task I went for squares as 3pts would mean I only had to hit a third of the number I would if I chose circles but I still felt I had to try and get them all no just tedious competitive and easy, should be more challenging Tired. Frustrated. Repetitive competitive at the beginning of the task but tiring towards the end Motivated, a little competitive tired. wanted to do well. Competitive,I wanted to do well on them. This one was more competitive than the others Bored towards the end I felt competitive because I wanted the highest score, which is why I chose the square. motivated and competitive Motivated to get points Other tasks were boring but the square task was very competitive Competitive and motivated to try and get best score possible
Marbles	Stressful Seemed odd Easy Competitive Pressured Easy I was cringing incase I got a black marble!

Appendix 3.A: Study Information Sheet

Study Information

My name is Rebecca Slater and I am a postgraduate PhD student at the University of Sunderland. I would like to invite you to take part in this study, but before doing so it is important that you understand why the research is being conducted and what participation will involve. Please take the time to read this information sheet and email either myself or my Director of Studies (details at the end) if anything is unclear.

What is the study about?

The current study aims to understand how attitudes relate to subsequent performance on a task.

Who can participate?

I am looking for both male and female participants aged 16 or over.

What does participation involve?

In order to participate, you will be required to provide consent and fill in some demographic information. You will then be asked to complete two short questionnaires, then you will proceed to a performance task. You will be given instructions for the task before it starts, and the aim is to collect as many points as possible. After the task, there will be some additional questions about the task.

IMPORTANT

It is of vital importance to the completion of the study that you ensure your browser and Java are up to date, otherwise the task may not display. Please do this before proceeding.

It is also preferred that you use a mouse to complete the task rather than a touchpad, however you can proceed with a touch pad, although the task is not compatible with tablets or smart phones and therefore you will not be able to complete the task if using these devices.

What will happen to my data?

No one will have access to any of your responses except for myself and my supervisors. You will be asked to enter a user ID at the beginning of participation which cannot be replicated. This will be your unique reference ID. You will not be identifiable from your responses and likewise, you will not be identifiable from any published work.

Can I withdraw from the study?

As participation is entirely voluntary, you are free to withdraw at any time without giving reason and without penalty. You can do this by not giving consent to participate when prompted, at which point you will exit the study. Otherwise, you can exit the study at any point, or if you have submitted your responses and would like to withdraw your data at a later date, you can contact myself or my Director of Studies requesting the withdrawal of your information using the unique reference ID you provided at the beginning of participation.

Contact details:

If you have any questions, or if you require additional information, please contact either myself (rebecca.slater@research.sunderland.ac.uk) or my Director of Studies Dr Daniel Farrelly (daniel.farrelly@sunderland.ac.uk).

This study has been approved by the University of Sunderland Ethics Committee. Should you have any concerns regarding the study, you may contact the Chairperson of the Ethics Committee of the University of Sunderland, Dr Robert Pullen, or robert.pullen@sunderland.ac.uk.

Thank you for your assistance,

Rebecca Slater.

Appendix 3.B: Consent Form

Consent

In order to participate in this study, it is necessary that you give your informed consent. By clicking the 'Next' button below, you are indicating that you understand the nature of the study and your role as participant, and that you agree to take part in the research. Please consider the following points before proceeding:

As an informed participant of this study, I understand that:

1. My participation is voluntary and I may cease to take part in the study at any time, without penalty
2. I am aware of what my participation involves
3. I understand that my participation will be anonymous
4. If I have any questions, I will contact the researchers.

I consent to take part in this study

- ☐ Yes
- ☐ No

Appendix 3.C: Demographic Questionnaire

Demographic Information

1. Are you:

   - ☐ Male
   - ☐ Female

2. What is your date of birth?

   __/__/__

3. What is your nationality?

____

4. What is your highest level of education?

   - ☐ No formal education
   - ☐ Primary/grade school
   - ☐ Secondary/high school
   - ☐ One or more years of university/college
   - ☐ A university/college degree/diploma
   - ☐ A postgraduate qualification or diploma

5. How would you describe your sexuality?

   - ☐ Heterosexual
   - ☐ Homosexual
   - ☐ Bisexual

6. What is your current relationship status?

   - ☐ Single
   - ☐ Casually dating
   - ☐ Long term relationship
   - ☐ Co-habiting
   - ☐ Married

7. Do you have any children?
   - ☐ Yes
   - ☐ No

Appendix 3.D: Own Mate Value Measure (OMV; adapted from Philips 2010)

Below are a range of characteristics. Please rate yourself on a scale of 0-10 (extremely below average to extremely above average) on all of the characteristics:

1. Intelligent

0	1	2	3	4	5	6	7	8	9	10
0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

2. Socially skilled/competent

0	1	2	3	4	5	6	7	8	9	10
0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

3. Good athletic ability

0	1	2	3	4	5	6	7	8	9	10
0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

4. Physically attractive

0	1	2	3	4	5	6	7	8	9	10
0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

5. Good leadership ability

0	1	2	3	4	5	6	7	8	9	10
0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

6. Good common sense

0	1	2	3	4	5	6	7	8	9	10
0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

7. Popular

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

8. Ambitious/industrious

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

9. Good financial prospects

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

10. Kind and understanding

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

11. Exciting personality

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

12. Healthy

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

13. Easy going

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

14. Creative

0	1	2	3	4	5	6	7	8	9	10
0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

Appendix 3.E: Partner Mate Value Measure (PMV; adapted from Philips 2010)

Now please rate your *partner* on the same range of characteristics, on a scale of 0-10 (extremely below average to extremely above average):

Please note: If you do not currently have a partner, please complete this as characteristics you would desire in a partner.

1. Intelligent

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

2. Socially skilled/competent

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

3. Good athletic ability

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

4. Physically attractive

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

5. Good leadership ability

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

6. Good common sense

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

7. Popular

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

8. Ambitious/industrious

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

9. Good financial prospects

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

10. Kind and understanding

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

11. Exciting personality

1 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

12. Healthy

0 1 2 3 4 5 6 7 8 9 10

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Extremely below average *Extremely above average*

13. Easy going

0 1 2 3 4 5 6 7 8 9 10

0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

14. Creative

0	1	2	3	4	5	6	7	8	9	10
0%	*10%*	*20%*	*30%*	*40%*	*50%*	*60%*	*70%*	*80%*	*90%*	*100%*

Extremely below average *Extremely above average*

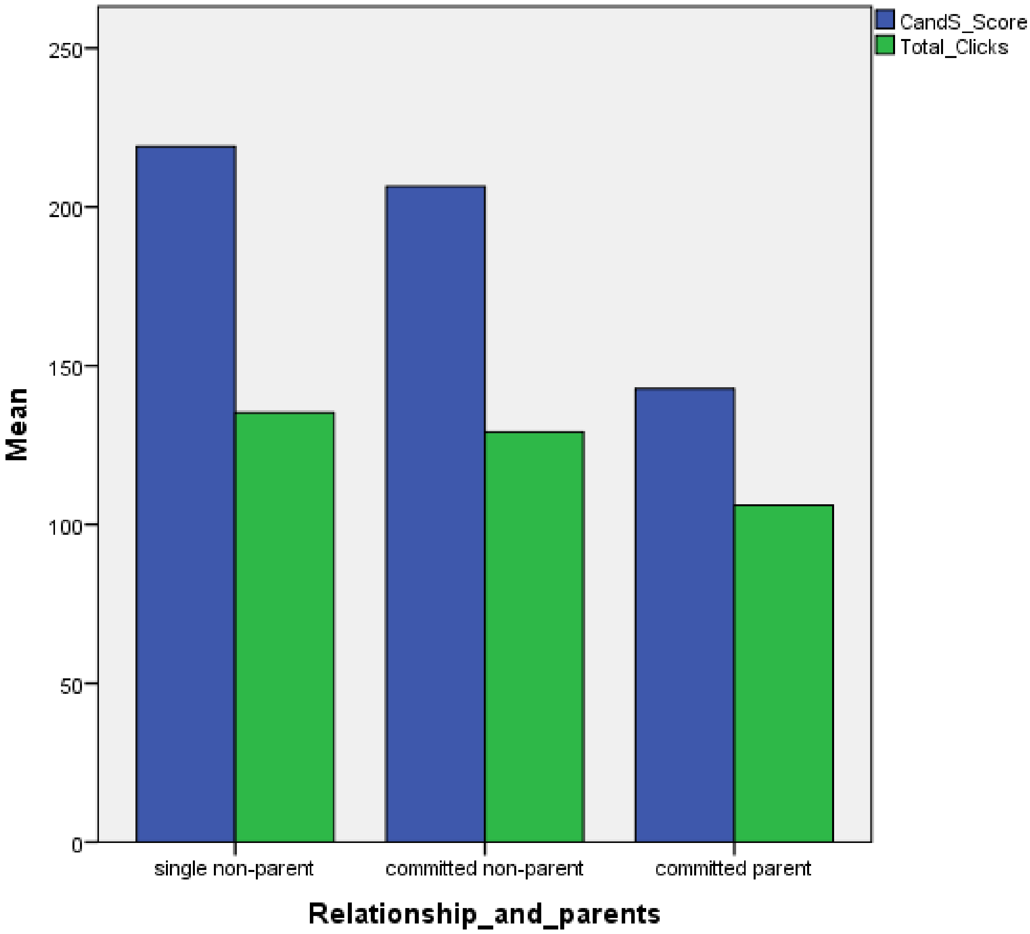
Appendix 3.F: MANOVA and Discriminant Function Analysis

There was a non-significant multivariate effect of reproductive energy allocation on competitive performance and motivation, V = 0.06, F (4, 3.4) = 2.31, p = .058, η_p^2 = .029. The MANOVA was followed up with discriminant function analysis and indicated two discriminant functions. The first discriminant function explained 99.6 percent of the variance (canonical R^2 = .24) and the second discriminant function explained 0.4 percent of the variance (canonical R^2 = .02). Together the two functions did not significantly differentiate the levels of reproductive energy allocation, Δ = .94, X^2 (4) = 9.20, p = .056. When the first function was removed the second function did not significantly differentiate levels of reproductive energy allocation, Δ = 1.00, X^2 (1) = 0.04, p = .845.

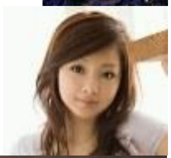
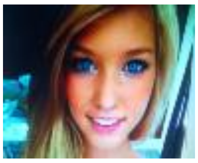
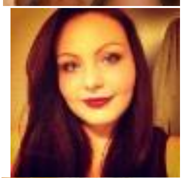
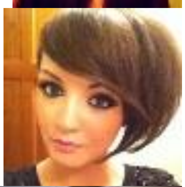
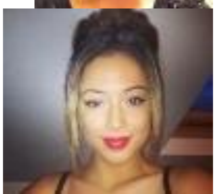
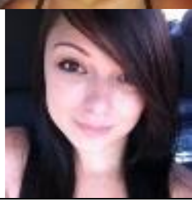
The correlations between the dependent variables and the functions indicated the number of attempts made loaded moderately onto function 1 (r = .49) and highly on function 2 (r = 1.28). Competitive performance loaded highly onto function one (r = .60) and highly negatively onto function 2 (r = -1.23). This indicates some multicollinearity.

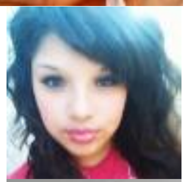
The first function discriminates between being a parent; there is a weak positive relationship with single non-parents, no relationship with committed non-parents and a moderate negative relationship with committed parents. This indicates that both competitive performance and motivation decreases as reproductive energy allocation reallocates toward parenting effort.

The second function shows no notable relationships with either level of the independent variable. The bar chart shows the mean measures of competitiveness.


CandS_Score
Total_Clicks
250
200
150
100
50
0
Mean
single non-parent
committed non-parent
committed parent
Relationship_and_parents

Appendix 4.A: Piloted Photographs and Mean Attractiveness Ratings

Image	Mean Rating (1-10)	Image	Mean Rating (1-10)
	5.5		3.50
	5.13		5.34
	4.63		3.13
	6.63		5.00
	6.38		5.75
	7.25		4.75
	5.50		5.25
	6.38		5.00
	6.00		5.25

	4.88		4.88
	5.00		4.13
	5.13		6.00
	5.13		

Appendix 4.B: Salivary Samples Testosterone Raw Data

	1	2	3	4	5	6	7	8	9	10	11	12	
A	0.173	0.156	0.367	0.329	0.252	0.244	0.398	0.407	0.381	0.386	0.335	0.329	450
B	0.288	0.278	0.317	0.293	0.377	0.333	0.234	0.211	0.802	0.838	0.335	0.33	450
C	0.471	0.46	0.331	0.316	0.232	0.204	0.38	0.347	0.306	0.374	0.442	0.447	450
D	0.596	0.562	0.287	0.26	0.332	0.295	0.308	0.294	0.313	0.301	0.307	0.292	450
E	0.687	0.66	0.251	0.239	0.283	0.228	0.216	0.228	0.365	0.388	0.384	0.358	450
F	0.713	0.717	0.175	0.166	0.3	0.299	0.316	0.344	0.154	0.163	0.294	0.291	450
G	0.718	0.735	0.278	0.264	0.301	0.281	0.236	0.231	0.348	0.341	0.266	0.269	450
H	0.692	0.313	0.425	0.474	0.432	0.428	0.223	0.211	0.27	0.285	0.314	0.312	450

	1	2	3	4	5	6	7	8	9	10	11	12	
A	0.165	0.179	0.275	0.261	0.327	0.097	0.345	0.335	0.367	0.395	0.329	0.343	450
B	0.281	0.274	0.281	0.276	0.356	0.332	0.294	0.304	0.254	0.253	0.342	0.35	450
C	0.459	0.44	0.255	0.238	0.337	0.353	0.289	0.284	0.263	0.264	0.238	0.276	450
D	0.607	0.588	0.327	0.314	0.237	0.224	0.35	0.33	0.181	0.169	0.368	0.362	450
E	0.687	0.669	0.28	0.27	0.237	0.231	0.268	0.257	0.286	0.318	0.373	0.357	450
F	0.736	0.693	0.395	0.4	0.277	0.259	0.21	0.208	0.16	0.16	0.331	0.511	450
G	0.737	0.736	0.25	0.239	0.356	0.357	0.224	0.225	0.317	0.323	0.366	0.371	450
H	0.677	0.324	0.302	0.293	0.364	0.356	0.366	0.353	0.282	0.295	0.313	0.304	450

4-parameter non-linear regression line was fit using:
http://www.elisaanalysis.com/app

Appendix 4.C: Demographic Questionnaire

1. What is your nationality?

____

2. What is your age?

____

3. What is your highest level of education?

- ☐ No formal education
- ☐ Primary/grade school
- ☐ Secondary/high school
- ☐ One or more years of university/college
- ☐ A university/college degree/diploma
- ☐ A postgraduate qualification or diploma

4. What is your current relationship status?

- ☐ Single
- ☐ Casually dating (multiple people)
- ☐ Casually dating (one person exclusively)
- ☐ Long term relationship
- ☐ Co-habiting
- ☐ Married

If you have indicated above that you are currently in a relationship, please state for how long (in months):

____

5. Do you have any children under the age of 18?
- ☐ No, I have no children
- ☐ Yes, I live with my biological children
- ☐ Yes, I have biological children who live elsewhere
- ☐ Yes, I live with non-biological children (e.g. step children, adopted children, foster children)

6. Are you currently a student at the University of Sunderland?
- ☐ Yes
- ☐ No

Appendix 4.D: Study Information Sheet

University of Sunderland

Study Information

Study title: Creativity, personality and male task performance

Thank you for agreeing to take part in this study. Before you proceed, it is important that you understand why the research is being conducted and what participation will involve. Please take the time to read this information sheet and email either myself or my Director of Studies (details at the end) if anything is unclear.

What is the study about?

The current study aims to understand how attitudes, personality and testosterone levels relate to each other, and to subsequent performance on a task, and how aspects of personality and testosterone are related to each other

Who can participate?

We are looking for heterosexual male participants aged 16-40.

What does participation involve?

In order to participate, you will be required to provide consent. You will be asked to provide a sample of saliva, which will be used to calculate your levels of circulating testosterone **only.** This is a simple, harmless procedure which involves participants dribbling into a small tube. This will take place privately under supervision of the experimenter. You will be asked to complete some demographic information followed by six short questionnaires. You will then view some images and be asked to write a story about these. You will then proceed to a performance task. You will be given instructions for the task before it starts. The aim is to collect as many points as possible. After the task, there are feedback questions to complete, and you will be asked to provide another sample of saliva. Again, this is to calculate levels of circulating testosterone **only**.

What are the benefits of participating?

Upon successful completion of the study, you will receive a £5.00 Love to Shop high street voucher.

What will happen to my data?

No one will have access to any of your data except for the researchers. You will not be identifiable from your data and likewise, you will not be identifiable from any published work. Once your saliva sample has been analysed for circulating testosterone levels, it will be disposed of.

Can I withdraw from the study?

As participation is entirely voluntary, you are free to withdraw at any time without giving reason and without penalty. You can do this by not giving consent to participate when prompted, at which point you will exit the study. Otherwise, you can exit the study at any point, or if you have submitted your data and would like to withdraw your data at a later date, you can contact the researchers requesting the withdrawal of your information using the unique reference ID you provided at the beginning of participation.

Contact details:

If you have any questions, or if you require additional information, please contact either myself (rebecca.slater@research.sunderland.ac.uk) or my co-researcher Dr. Helen Driscoll (helen.driscoll@sunderland.ac.uk).

This study has been approved by the University of Sunderland Ethics Committee. Should you have any concerns regarding the study, you may contact the Chairperson of the Ethics Committee of the University of Sunderland, Dr Etta Drews, etta.drews@sunderland.ac.uk.

Thank you for your assistance,

Rebecca Slater.

This study is approved by the University of Sunderland Ethics Committee

Appendix 4.E: Consent Form

Consent

In order to participate in this study, it is necessary that you give your informed consent. By clicking the ‘Next’ button below, you are indicating that you understand the nature of the study and your role as participant, and that you agree to take part in the research. Please consider the following points before proceeding:

As an informed participant of this study, I understand that:

1. My participation is voluntary and I may cease to take part in the study at any time, without penalty
2. I am aware of what my participation involves and that my data will remain anonymous
3. I am over the age of 16
4. If I have any questions, I will contact the researchers.

I consent to take part in this study

- ☐ Yes
- ☐ No

Appendix 4.F: Ethics Statement

RESEARCH ETHICS COMMITTEE

DECISION STATEMENT

Application Number: 202 Amendment (additional co-workers, amend co-worker's affiliation) 2nd Amendment (data collection will also take place at Sunderland College at St. Peter's and in researchers' private homes)
Project Title: Personality, testosterone, attractiveness and mate choice
Chief Investigator: Helen Driscoll
Co workers: Daniel Farrelly (Worcester University), Rebecca Slater (University of Sunderland), Hannah Walden (Northumbria University), Mark Wetherell (Northumbria University)
Date: 08-11-2013 amended 31-01-2014, amended 07-02-2014

YOUR RESEARCH PROJECT DECISION IS LISTED BELOW

APPROVED WITH NO CONDITIONS: This means you may start the project immediately.	

PRE-CONDITIONS: This means you must complete the conditions listed below before you start the project. However, you DO NOT have to send any information back to the Committee. The Committee will assume completion of these conditions. • Include separate consent form for photographs, which should contain the conditions specified in the participant information sheet plus YES/NO tick boxes to allow participants to participate in this particular study but opt out of storage of their photographs in a data base for future research. • Provide participants with the opportunity to withdraw their photograph from the data base as long as the data base will exist. Amend study information sheet accordingly. • Change contact details for Chairperson of the University Research Ethics Committee on both study information sheets. • Consent Forms: Remove the address section because the research does not require participants to be contacted via their postal address.	✓
COMMITTEE-CONDITIONAL: This means you must complete the conditions listed below before you start the project. You MUST send the information	

requested back to the Committee before you start the project. Once the committee has received this information, it will contact you again about its decision.	
REJECTION: This means the committee does not wish this research to commence. You should not start this research. The Research Ethics Committee will explain why it has reached this view. Please contact the Committee Chair if you have any questions.	
RECOMMENDATIONS: These are simply points of advice from the committee. They are OPTIONAL. You do not have to undertake them or contact the committee about them.	

Signed by the Committee Chair:

E. Evans

Dr Etta Evans
Chair of the University of Sunderland Research Ethics Committee

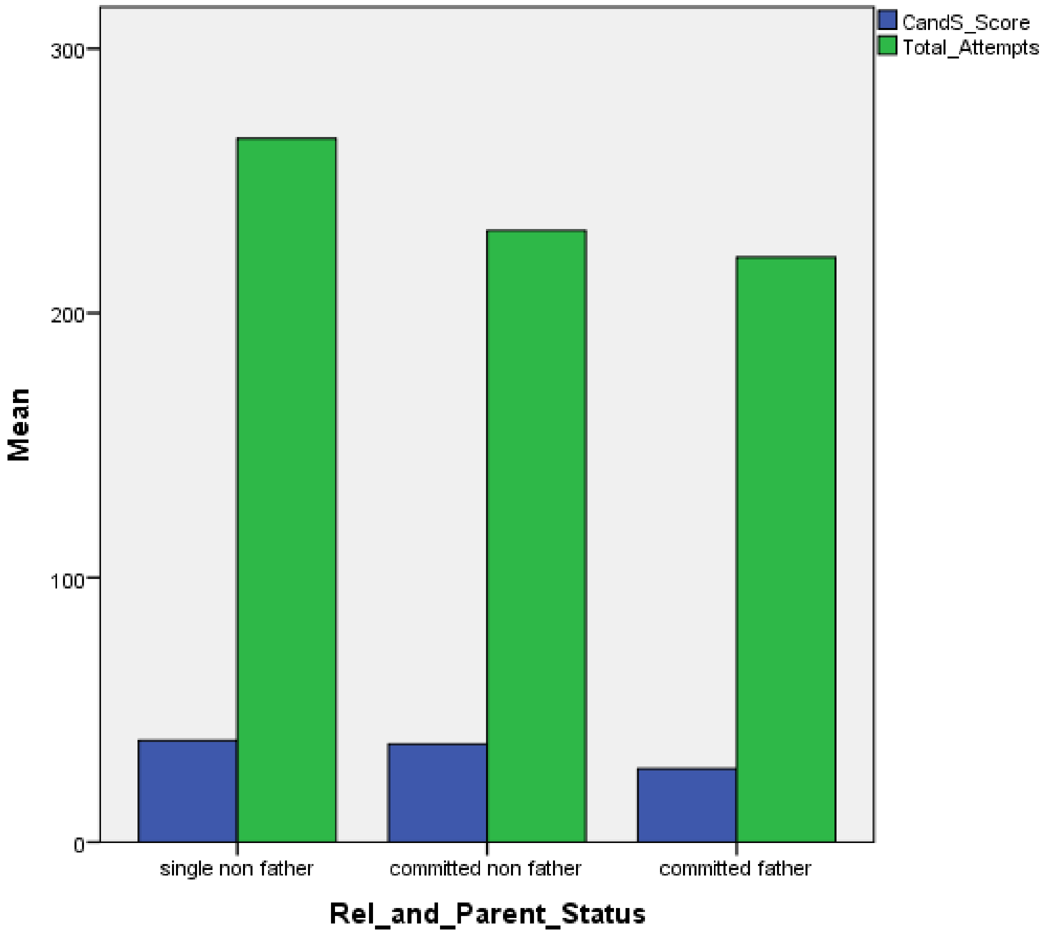
Appendix 4.G: MANOVA and Discriminant Function Analysis

There was a significant multivariate effect of reproductive energy allocation on competitive performance and motivation, $V = 0.15$, $F\ (4, 128) = 2.61$, $p = .038$, $\eta_p^2 = .075$. The MANOVA was followed up with discriminant function analysis and indicated two discriminant functions. The first discriminant function explained 81.3 percent of the variance (canonical $R^2 = .35$) and the second discriminant function explained 18.7 percent of the variance (canonical $R^2 = .18$). Together the two functions significantly differentiated levels of reproductive energy allocation, $\Delta = .85$, $X^2\ (4) = 10.12$, $p = .039$, but when the first function was removed the second function did not significantly differentiate levels of reproductive energy allocation, $\Delta = .97$, $X^2\ (1) = 1.96$, $p = .161$.

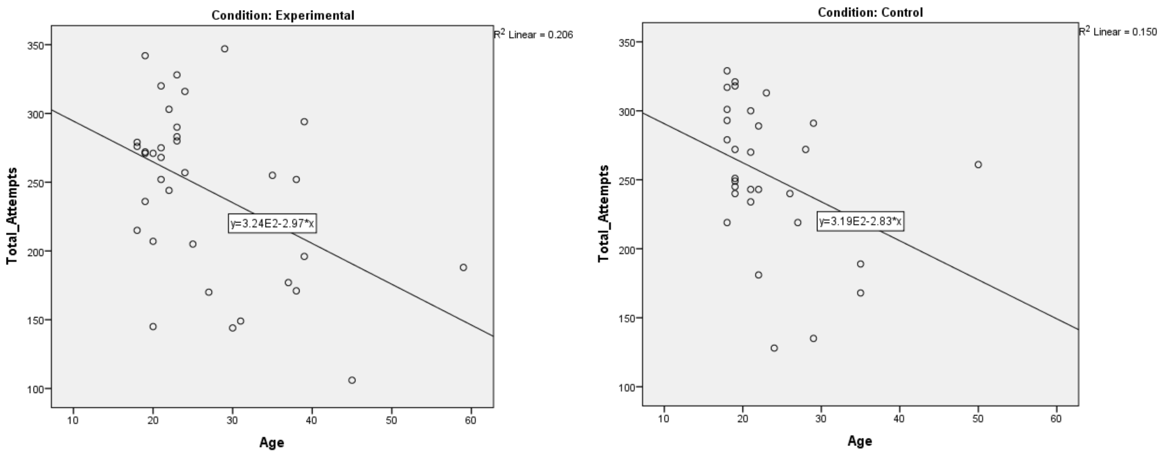
The correlations between the dependent variables and the functions indicated the number of attempts made loaded highly onto function 1 ($r = .93$) and moderately negatively on function 2 ($r = -.57$). Competitive performance did not load well onto the first function ($r = .16$) but well onto function 2 ($r = 1.07$) indicating some multicollinearity.

The first function discriminates between being in a committed relationship from being a single non-father, suggesting a difference between them, and the negative relationship with committed fathers is stronger than that for committed non-fathers suggesting a difference due to parental status too. This indicates that competitive motivation decreases from single non-fathers to committed non-fathers, then there is a further decrease in committed fathers.

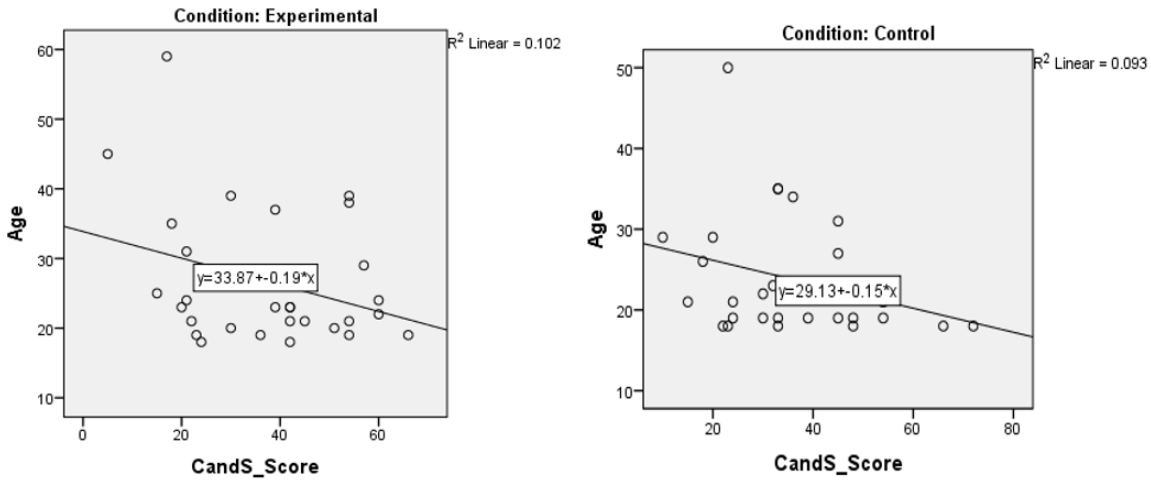
The second function suggests there is no relationship with single non-fathers, a weak positive relationship with committed non fathers and a weak negative relationship between committed fathers. This suggests that committed non-fathers score as well as single non-fathers despite making fewer attempts, indicating better accuracy, whereas committed fathers have a lower score and make fewer attempts.



Appendix 4.H: Scatterplots for the Violation of the Homogeneity of Regression Assumption



The violation of the homogeneity of regression assumption between age and number of attempts



The violation of the homogeneity of regression assumption for age and score

Appendix 5.A: Participant Information Sheet - Rod Balancing Task

University of Sunderland

Study Information: Rod balancing skills

What is the study about?

The current study aims to measure performance on a task and also your attitudes and perceptions of the task.

Who can participate?

I am looking for participants aged between 16-40.

What does participation involve?

You will be asked to provide consent, complete some demographic information then take part in the task. The task involves balancing a rod on your index finger for as long as you can. Finally, you will be asked to complete some brief feedback questions. This will complete the study.

What will happen to my data?

No one will have access to any of your data except for the researchers. You will not be identifiable from your data and likewise, you will not be identifiable from any published work.

Can I withdraw from the study?

As participation is entirely voluntary, you are free to withdraw at any time without giving reason and without penalty. You can do this by not giving consent to participate, or not submitting the questionnaires or not taking part in the task, alternatively if you have submitted your data and would like to withdraw at a later date, you can contact the researchers requesting the withdrawal of your information using the participant number you received on this sheet.

Contact details:

If you have any questions, or if you require additional information, please contact the researchers, rebecca.owens@research.sunderland.ac.uk, or helen.driscoll@sunderland.ac.uk.

This study has been approved by the University of Sunderland Ethics Committee. Should you have any concerns regarding the study, you may contact the Chairperson of the Ethics Committee of the University of Sunderland, Dr Robert Pullen at robert.pullen@sunderland.ac.uk

Thank you for your assistance.

Appendix 5.B: Consent form – Rod Balancing Task

This study is approved by the University of Sunderland Ethics Committee

Consent

In order to participate in this study, it is necessary that you give your informed consent. By signing below, you are indicating that you understand the nature of the study and your role as participant, and that you agree to take part in the research. Please consider the following points before proceeding:

As an informed participant of this study, I understand that:

1. My participation is voluntary and I may cease to take part in the study at any time, without penalty
2. I am aware of what my participation involves and that my data will remain anonymous
3. I am over the age of 16
4. If I have any questions, I will contact the researchers.

I consent to take part in this study

- ☐ Yes
- ☐ No

Signed:____

Print:____

Appendix 5.C: Demographic Questionnaire – Rod Balancing Task

- **Sex**: Male / Female
- **Please indicate your sexuality** ___________________________________
- **Nationality:** __________________________________
- **Age:** __________________________________
- **What is your highest level of education**?
    - No formal education
    - Primary/grade school
    - Secondary/high school
    - One or more years of university/college
    - A university/college degree/diploma
    - A postgraduate qualification or diploma

- **What is your current relationship status?**
    - Single
    - Casually dating (multiple people)
    - Casually dating (one person exclusively)
    - Long term relationship
    - Co-habiting
    - Married

- If you have indicated above that you are currently in a relationship with one person only, please state for how long (in months): ________________________________

- **Do you have any children?**
    - No, I have no children
    - Yes, I live with my biological children
    - Yes, I have biological children who live elsewhere
    - Yes, I live with non-biological children (e.g. step children, adopted children, foster children)

Appendix 5.D: Ethics Approval – Rod Balancing Task

University of Sunderland

RESEARCH ETHICS COMMITTEE

Application Number: 189

Project Title: Rod Balancing Skills
Chief Investigator: D. Farrelly

Co workers: R. Slater

Date: 25/6/13

THE COMMITTEE DECISION IS SHOWN BELOW

APPROVED WITH NO CONDITIONS: *This means you may start the project immediately.*	
PRE-CONDITIONS: *This means you must complete the conditions listed below before you start the project. However, you DO NOT have to send any information back to the Committee. The Committee will assume completion of these conditions.* Please note that the Information sheet should be in 'lay language' and better / fully explain to the participants what participation will involve.	√

COMMITTEE-CONDITIONAL: *This means you must complete the conditions listed below before you start the project. You MUST send the information requested back to the Committee before you start the project. Once the committee has received this information, it will contact you again about its decision.*	
REJECTION: *This means the committee does not wish this research to commence. You should not start this research. The Research Ethics Committee will explain why it has reached this view. Please contact the Committee Chair if you have any questions.*	
RECOMMENDATIONS: *These are simply points of advice from the committee. They are OPTIONAL. You do not have to undertake them or contact the committee about them.*	

Signed by the Committee Chairperson

Appendix 5.E: Audience Photographs – Online Task

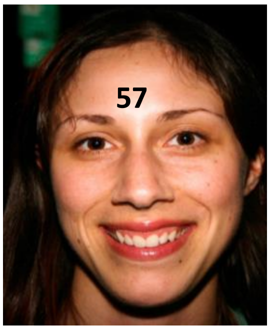
No Audience Condition

Attractive Female Audience Condition

1. 2. 3.

Less Attractive Female Audience Condition

1. 2. 3.



Less Attractive Male Audience Condition

1. 2. 3.

Attractive Male Audience Condition

1. 2. 3.

These faces were rated on a Likert scale ranging from 1 (extremely unattractive) to 10 (extremely attractive) by nine independent raters. Mean ratings were subject to a series of one-sample t-tests to determine whether or not the subjects in the photographs differed significantly from the median of the attractiveness rating (5.5) in the desired direction. The results can be seen in Table 5E.1.

Appendix 5E.1. One sample t-test results for attractiveness ratings of study six stimuli

Sex	Condition	Number	M (SD)	*t*	*p*	*d*
Female	**Attractive**	1	8.00 (0.87)	8.66	<.001	2.87
		2	7.78 (0.83)	8.20	<.001	2.74
		3	7.33 (1.23)	5.50	.001	1.49
	Unattractive	1	4.11 (0.78)	-5.33	.001	-1.78
		2	4.44 (0.73)	-4.36	.002	-1.45
		3	3.00 (0.71)	-10.61	<.001	-3.52
Male	**Attractive**	1	6.61 (0.78)	4.26	.003	1.42
		2	7.72 (0.67)	10.00	<.001	3.32
		3	7.06 (1.01)	4.60	.002	1.54
	Unattractive	1	1.89 (0.60)	-18.03	<.001	-6.02
		2	2.89 (1.05)	-7.43	<.001	-2.49
		3	2.44 (1.01)	-9.04	<.001	-3.03

Appendix 5.F: Demographic Questionnaire – Online Task

1. Are you: male ☐

   female ☐

2. Are you: Heterosexual ☐

   Homosexual ☐

   Bisexual ☐

3. What is your age? ____________________

4. What is your nationality? __________________________________

5. What is your highest level of education?

- ☐ No formal education
- ☐ Primary/grade school
- ☐ Secondary/high school
- ☐ One or more years of university/college
- ☐ A university/college degree/diploma
- ☐ A postgraduate qualification or diploma

6. What is your current relationship status?

- ☐ Single
- ☐ Casually dating (multiple people)
- ☐ Casually dating (one person exclusively)
- ☐ Long term relationship (not co-habiting or married)
- ☐ Co-habiting
- ☐ Married

- If you have indicated above that you are currently in a relationship with one person only, please state for how long (in months):

____

7. Do you have any children?

- ☐ No, I have no children
- ☐ Yes, I live with my biological children
- ☐ Yes, I have biological children who live elsewhere

- ☐ Yes, I live with non-biological children (e.g. step children, adopted children, foster children)
- ☐ Yes, I live with both biological and non-biological children

Appendix 5.G: Participant Information Sheet – Online Task

University of Sunderland

Study Information

Memory while playing online games

Thank you for agreeing to take part in this study. Before you proceed, it is important that you understand why the research is being conducted and what participation will involve. Please take the time to read this information sheet and ask the researcher, or email at a later date (details at the end) if anything is unclear.

NOTE: IT IS ADVISED TO USE A TABLET DEVICE TO PROCEED WITH THIS STUDY

What is the study about?

The current study aims to examine how you perform on a novel computer game whilst simultaneously engaging your memory, across a series of trials.

Who can participate?

Heterosexual people aged 18+.

What does participation involve?

In order to participate, you will be required to provide consent followed by some demographic information. You will then complete four questionnaires relating to your level of competitiveness and how you perceive your and your partner's (if you have one) mate value. This will be followed by five rounds of a simple computer game involving clicking on a chosen shape as often as possible in order to increase your overall score. Each round of the game lasts one minute and whilst playing the game, you will be asked to remember something from a picture that will be shown at the same time as the game. You will be asked feedback questions relating to your perception of your performance after each round. Completion of the five rounds will complete the study in approximately 20-30 minutes.

Do I have to take part?

Participation in this study is entirely voluntary. Should you decide to participate, you remain free to withdraw from the study at any time, without giving any reason, and without penalty.

Are there any risks?

There are no known risks to taking part in the study. However, if you feel uncomfortable at any time, or wish to end your participation, simply close your browser to end your participation.

What advantages are there?

Not only will your participation assist in increasing scientific knowledge in this area of research, upon successful completion of the study you will be given the chance to be entered into a prize draw to win a £50 Amazon voucher.

Anonymity & Confidentiality

You are not required to give your name. Therefore, all of the information you provide is anonymous. Your data will be held confidentially. The only people who will usually have access to your personal (but anonymous) data are the small group of researchers working on this project. However, it should be noted that it may be the case that appropriate members of the University of Sunderland may be given access to your data for monitoring or audit of this study to ensure we are complying with standards and regulations. The data you provide will be stored on a password protected computer or in a locked room at the University. It will be destroyed after five years of completion of the PhD. The results of this study (if appropriate) will be written up and submitted for publication in an academic journal.

Can I withdraw from the study?

As participation is entirely voluntary, you are free to withdraw at any time without giving reason and without penalty. You can do this by not giving consent to participate, by exiting the study at any time, or if you have submitted your data and would like to withdraw at a later date, you can contact the researchers requesting the withdrawal of your information up to two weeks after participation using your participant number.

Contact details:

If you have any questions, or if you require additional information, please contact the researchers, rebecca.owens@research.sunderland.ac.uk, or helen.driscoll@sunderland.ac.uk.

This study has been approved by the University of Sunderland Ethics Committee. Should you have any concerns regarding the study, you may contact the Chairperson of the Ethics Committee of the University of Sunderland, Dr Etta Evans at etta.evans@sunderland.ac.uk

Thank you for your assistance.

Appendix 5.H: Consent Form – Online Task

This study is approved by the University of Sunderland Ethics Committee

Consent

In order to participate in this study, it is necessary that you give your informed consent. By signing below, you are indicating that you understand the nature of the study and your role as participant, and that you agree to take part in the research. Please consider the following points before proceeding:

As an informed participant of this study, I understand that:

1. My participation is voluntary and I may cease to take part in the study at any time, without penalty
2. I am aware of what my participation involves and that my data will remain anonymous
3. I am over the age of 18
4. If I have any questions, I will contact the researchers.

I consent to take part in this study

- ☐ Yes
- ☐ No

Appendix 5.I: Debrief – Online Task

Participation in this study is now complete. Thank you for taking part. The current study was concerned with how an audience affects subsequent task performance in males. Research suggests that males will be more competitive in the presence of more attractive individuals than less attractive individuals. However, research also suggests that males who are in committed relationships and/or fathers will be less competitive overall.

If you have any questions or require any other information, please contact me on rebecca.owens@research.sunderland.ac.uk or my supervisor on helen.driscoll@sunderland.ac.uk.

Thanks again!

If you would like to be entered into the prize draw, please provide your email address:

____

Appendix 5.J: Ethics Statement – Online Task

University of Sunderland

RESEARCH ETHICS COMMITTEE DECISION STATEMENT

Application Number: 232 FINAL

Project Title: Memory while playing online games

Chief Investigator: Helen Driscoll

Co workers: Rebecca Owens (Postgraduate Research Student), Ros Crawley (Co-supervisor), Daniel Farrelly (Co-supervisor, University of Worcester)

Date: 01-12-2014

YOUR RESEARCH PROJECT DECISION IS LISTED BELOW

APPROVED WITH NO CONDITIONS: This means you may start the project immediately.	
PRE-CONDITIONS: This means you must complete the conditions listed below before you start the project. However, you DO NOT have to send any information back to the Committee. The Committee will assume completion of these conditions. • Amend start date of the project to ensure that data collection does not start before ethics approval is obtained.	✔

They are OPTIONAL. You do not have to undertake them or contact the committee about them.	
COMMITTEE-CONDITIONAL: This means you must complete the conditions listed below before you start the project. You MUST send the information requested back to the Committee before you start the project. Once the committee has received this information, it will contact you again about its decision.	
REJECTION: This means the committee does not wish this research to commence. You should not start this research. The Research Ethics Committee will explain why it has reached this view. Please contact the Committee Chair if you have any questions.	
RECOMMENDATIONS: These are simply points of advice from the committee.	

Signed by the Committee Chair:

E. Evans

Dr Etta Evans

<u>NOTE</u>: The University of Sunderland 'Research Ethics Completion Statement' proforma must be completed and submitted to the Committee within three months following the project end date.

Appendix 6.A: Satisfied Prime

Imagine you have finished work early today. You arrive home savouring the early start to the weekend, but at the same time, you're feeling slightly apprehensive. Tonight is the night you have decided you are going to propose to your girlfriend of three years. You ring the restaurant to book a table for two at 8pm...Mexican...her favourite. You decide to make sure everything is ready for tonight then have a shower so the bathroom is free for your girlfriend when she arrives home. You go upstairs to find the ring, you're sure she will love it...you carefully chose it, and you asked advice from her best friend. You go and put the ring into your jacket pocket thinking forgetting it would be the last thing you would want!! Well...almost...the last thing you want would be for her to say no....

Imagine you are the man in the story...how are you feeling at the minute and why?

You go back up-stairs turn the shower on. As you relax in the shower, you close your eyes for a minute...you think about your girlfriend...you're sure she will say yes...she must do...right...? You think about all the times you have had together, the good and the bad...your mind drifts back to when you first met her, how you had accidentally bumped into her in the supermarket causing her to drop a bottle of wine...her face had been a picture, she was so embarrassed as the wine sloshed down the aisle!! You couldn't resist coming to her rescue...she was so beautiful...and after all it had partly been your fault...but fate has its way...no way could you miss this opportunity to ask such a beautiful woman out to dinner!! And she had accepted...and here you are now...three years down the line proposing marriage!! You never thought you would feel like this about a girl, you never thought you would meet someone you actually wanted to settle down with...shun the partying with your friends in favour of cosy nights in snuggled up together...you thought that was only for soppy blokes in films!! Even the other week when a gorgeous new girl started at work, all your friends went mad for her!! They were all falling over themselves trying to impress her and you thought yes she is good looking, you can see why they like her, when you go for drinks with your work friends sometimes she seems a lot of fun...but you have absolutely no interest in her at all...your girlfriend has changed you...for the better...and you couldn't be happier. You know how lucky you are to have such a fantastic girlfriend, she looks after you without being over bearing, she gets on well with your friends, you love doing things with your girlfriend ....days out, nights in...you even started learning a language together!! Initially you had thought this would never be your thing, you always loved playing footy with the lads, you still enjoy a kick about with them now and then, but you enjoy doing this with your girlfriend...it's something you can do together.

Imagine the man in the story is you...how do you feel and why?

As you get out of the shower, your mind is still flickering over the past three years together...all the ups and downs...you remember how you were her rock when she didn't get the promotion at work she had applied for, how you made her smile again...and how much you love seeing her smile. Likewise...you remember when you had had one too many one night with the lads...she hadn't been angry, it was a one off, and she looked after you all day. Just then, you hear your girlfriend arrive home from work. She comes straight upstairs, sets the bath away running, and comes into the bedroom. She looks worn out from work, her hair is windswept... she tells you a car has drove through a puddle and splashed her on the way home too...she looks fed up...you look at her and you're still thinking how beautiful she is and how lucky you are to have her. You give her a cuddle and comfort her...you tell her at least she is home now, a nice warm bath will sort her out...you will even come and wash her back for her to make her feel better...she smiles that gorgeous smile that melts your heart and she nuzzles into your chest...never, ever did you think a smile was capable of doing that to you! But it feels amazing...better than anything else you have ever experienced in your life! She moves away, undresses and gets into the bath. You gently pour some bath water down her back...and as you look at her...you know your future together is going to be perfect, you can't wait to spend the rest of your life with her...you have had relationships before...but nothing compares to this...she's your soul mate...tonight you KNOW she is going to say yes...and you can't wait.

Imagine you are the man in the story...what happens next?

Appendix 6.B: Unsatisfied Prime

Imagine your work has finished early today...its Friday and you always finish a little early and call in at a bar for a few drinks. Your girlfriend doesn't know this, you just leave the bar at the usual time you finish work; she wouldn't be happy about you spending a few hours with your friends. If she knew you finished early, she would arrange to finish early too, and she would be offended you hadn't told her about this earlier. You miss your independence, and you want to spend some time alone or with your friends sometimes...plus a beautiful girl started working with you a recently and you want to get to know her better...she seems so much fun! You only live round the corner from the bar so you decide to quickly call home to spruce yourself up and meet your friends over there...getting changed would look like you have put too much effort in, and also your girlfriend will notice...so you decide re-doing your hair, having a quick wash and splashing on some aftershave should be enough.

Imagine you are the man in the story...how are you feeling at the minute and why?

As you walk home, you feel a little bit bad for thinking this way about another woman when you have a girlfriend. Although nothing has happened with this woman, talking to her and having fun with her makes you realise how much things have deteriorated with your girlfriend... conversation is stilted...she seems to talk at you...just yapping on about something on TV programme you're not interested in or gossiping about people at work...you just nod and say yes occasionally so she thinks you're listening...and she does it more so when you are trying to watch something on TV yourself...it's so annoying! But it also makes you want to go out and have fun again...currently your life is not fun...this girl reminds you of the fun you used to have and how much you miss it. You have been feeling fed up in your relationship for a while...when you first met your girlfriend three years ago you thought she was beautiful. Things were purely physical... no strings attached...but you don't know how you got to the stage you are now...people started giving you joint invitations to places as if you were a couple...then she started treating you as if you were her boyfriend...the fire had begun to dwindle...she wasn't as much fun anymore...in fact you can't remember the last time you enjoyed spending anytime with her or even the last time you went to bed at the same time! You always said you wouldn't stay in a relationship that wasn't worth it but for some reason you didn't resist...you went with the flow, never feeling truly happy, you moved in together...you have been thinking more and more that it is time to end the relationship...you miss your independence, you want to be able to go out with your friends, you want to do what you want when you want, you don't want to have to answer to anyone...you feel like you are missing out, you have settled down with the wrong person, and now you feel you are ready to take back control of your own life...you decide tonight you are going to break up with your girlfriend.

Imagine you are the man in the story...how do you feel and why?

You arrive home and quickly run upstairs, have a quick wash, do your hair and spray on some aftershave. You are ready to leave again. You grab your keys then the door opens. Your girlfriend walks in. She says she had suspicions you were finishing work early and wondered what had been going on...why would you keep that from her... she seems mainly angry but a little upset...she just keeps throwing questions at you but not giving you a chance to speak...you think how typical, she wants answers but she won't shut up to let you give her them! You feel the frustration building up as she relentlessly rants on at you...you are missing out on the fun you are supposed to be having with your friends... with the gorgeous new girl...Yes, this has confirmed it...you have made the right decision to break up with her, you are completely certain...you don't want this anymore...this isn't the gorgeous fun girl you met three years ago...you feel you have made a mistake...this isn't the direction your life was supposed to go...but for now, you tell your girlfriend you will talk to her about it later when she has calmed down a bit and you walk past her and out of the door...Dutch courage is just what you need...you head down to the bar to meet your friends, you feel excited, you already feel as if a weight has been lifted off you just from making the decision to move on...you start thinking about your life after today...after you have gotten over this hurdle...you will have your independence back again...no one to answer too...you can go to the bar with your friends whenever you like...you can watch what you want on TV...you can stay up as late as you like...no nagging...no moaning...just fun!

Imagine you are the man in the story...what happens next?

Appendix 6.C: Participant Information Sheet

University of Sunderland

Study Information

My name is Rebecca Slater and I am a postgraduate PhD student at the University of Sunderland. I am carrying out this pilot study in preparation for the first study in my PhD. I would like to invite you to take part in this study, but before doing so it is important that you understand why the research is being conducted and what participation will involve. Please take the time to read this information sheet and email either myself or my Director of Studies (details at the end) if anything is unclear.

What is the study about?

The current study is to establish the validity of some newly designed experimental materials which aim to test relationship behaviours.

Who can participate?

I am looking for male participants aged 18 or over.

What does participation involve?

In order to participate, you will be required to consent to participate, read a short story and answer questions on it then complete two short questionnaires. This should take around 15 minutes.

What will happen to my data?

No one will have access to any of your responses except for myself and my Director of Studies. Your date of birth will be your reference number and you will not be identifiable from your responses. Likewise, participants will not be identifiable from any published work.

Can I withdraw from the study?

At the end of this sheet is a unique participant number. As participation is entirely voluntary, you are free to withdraw at any time without giving reason and without penalty. If you do not hand in your completed questionnaires your data will not be included in the study. Alternatively, you can contact myself or my Director of Studies to withdraw your information using your reference number.

Contact details:

If you have any questions, or if you require additional information, please contact either myself (bb5rgo@student.sunderland.ac.uk) or my Director of Studies Dr. Daniel Farrelly (daniel.farrelly@sunderland.ac.uk).

This study has been approved by the University of Sunderland Ethics Committee. Should you have any concerns regarding the study, you may contact the Chairperson of the Ethics Committee of the University of Sunderland, Dr. Robert Pullen, on robert.pullen@sunderland.ac.uk.

Thank you for your assistance,
Rebecca Slater.

This study is approved by the University of Sunderland Ethics Committee

Your Participant Number is:....................

Appendix 6.D: Consent Form

University of Sunderland

PARTICIPANT CONSENT FORM

Participant Number: ……………………………………………………

Consent

In order to participate in this study, it is necessary that you give your informed consent. By signing below, you are indicating that you understand the nature of the study and your role as participant, and that you agree to take part in the research. Please consider the following points before proceeding:

As an informed participant of this study, I understand that:

1. My participation is voluntary and I may cease to take part in the study at any time, without penalty
2. I am aware of what my participation involves
3. I understand that my participation will be anonymous
4. If I have any questions, I will contact Rebecca Slater or Daniel Farrelly

I consent to take part in this study

Date................................Signed (*Participant*)…………………………………………………....................

Please hand the consent form back to the researcher if you consent and keep the study information sheet for your reference as it contains contact details and your participant number.

Appendix 6.E: Demographic Questionnaire

1. What is your date of birth? (*Please enter in six digits, e.g. 01/01/77)* __/__/__

2. How would you describe your sexuality?

   Heterosexual

   Homosexual

   Bisexual

3. Are you currently in a relationship?

   Yes

   No

4. What is your nationality? ____________________________________

5. What is your highest level of education?

   No formal education

   Primary/grade school

   Secondary/high school

   One or more years of university/college

   A university/college degree or qualification

   A postgraduate qualification or diploma

Appendix 6.F: Ethics Statement for Study Seven

University of Sunderland

RESEARCH ETHICS COMMITTEE

PROJECT REVIEW DECISION

Application Number: 209

Project Title: The effect of mood priming on relationship perception

Chief Applicant: Daniel Farrelly

Co workers: Rebecca Slater

Date: 23/8/10

CONDITIONS:

These conditions must be completed before you commence the work. You do NOT need to submit anything back to the committee administrator since the committee will assume you have met these conditions before you commence the work.

NO CONDITIONS - APPROVED

R G L Pullen

Research Ethics Chairperson

Appendix 6.G: Hypothetical Relationship Development

Section 1

Imagine...you are young free and single. While you want to meet someone and settle down at some point, you aren't particularly fussed about that point being right now. You have a strong group of friends, you all support each other, and you have great fun together. This fun sometimes involves men…it feels fine to you to do this; no one is getting hurt, and besides you are only young once!

You and your friends often socialise together at weekends after you have worked hard throughout the week; some of you work and some of you are at university, but all of you are ready for a break by the time the weekend comes! One particular week, you are going to a house warming party of another friend, a friend who you do not socialise with as often as you do with your girls, but she is sweet and fun all the same.

Saturday night comes, and you and your friends are all dressed up, having fun and the drinks are flowing. You jump into a taxi and arrive at your friend's party at 9pm; the party is in full swing, there are many people there who you know and many people there who you don't know. You and your girls are the life and soul of the party, you attract a lot of attention and exude confidence even though you may not always feel so confident! You are having fun, and you are enjoying yourself with your favourite people…how can you not feel good?!

As the time goes by, you and your friends split up and mingle with other guests a little, and you notice a guy who has been paying particular attention to you. You aren't averse to the idea of a hook up…you aren't averse to the idea of something more either, you are laid back about what may or may not happen but you don't want pressure or complications. He approaches you and starts a conversation. You like him, you spend the rest of the night with him, not knowing whether this would ever develop into something more or not…but that is fine…you are happy if it is just for this one night.

Section 2

It turns out…this guy is great and now your first anniversary is approaching! He called you a few days after you met him, you went on a few dates, and things became more serious. You still see your friends, they are still your girls and you couldn't be without them, but now you have him too. Some of your friends are now coupled up as well…everyone's lives seem to be progressing, and that is fine, you all understand that priorities change but you will always be there for each other. You are pleased it didn't turn out to be just a one night thing, you feel privileged to be with him…he is everything you could want from a man! But you have not been swept away, you still understand that you are young and you wouldn't want to rush into anything without being sure…but this feels good right now.

Section 3

You are thinking back to when you first met your man…it feels like a lifetime ago! It has been a whole five years! A lot of things have happened in that time…there have been ups and downs. You have forgotten what life was like without him and you don't ever want to think about it! You both have your own lives, friends and interests, but you both know where your priorities lie; you are on the same page when it comes to what you want in life. Looking back, you can't believe how carefree and reckless you both could be! You have grown together these last five years…you have both changed for the better and have grown together. Your priorities have completely changed, he is your family now. You feel lucky to have each other.

<u>Section 4</u>

Sitting amongst all the chaos of your little one's first birthday, you are reminiscing about your relationship with your man. It feels crazy when you think about how you met…when you were both young and carefree, happy with your lives the way they were and not looking for anything else, but you found it anyway. You didn’t expect to still be together now…you thought it would have been just one night and look at you both now...you are parents to the most fantastic little person you could have ever imagined. Neither of you could be without the other, you are so entwined you don’t think you could be separated even if you wanted to! You look over at him with pride and admiration as he scoops up your little one as they blow out the birthday candle. Your little one has cemented your relationship, and you feel so lucky you met him…you now have a wonderful family of your own. Despite life’s ups and downs, you two make an unbelievable team, both for each other and your perfect baby.

Appendix 6.H: Ethics Statement for Study Nine and Study Ten

RESEARCH ETHICS COMMITTEE DECISION STATEMENT

Application Number: 214

Project Title: Female mate preferences

Chief Investigator: Dr Helen Driscoll

Co workers: Mrs. Rebecca Owens - PhD student, Dr. Ros Crawley - Co-supervisor, Dr. Daniel Farrelly - External expert (University of Worcester)

Date: 29-05-2014

YOUR RESEARCH PROJECT DECISION IS LISTED BELOW

APPROVED WITH NO CONDITIONS: This means you may start the project immediately.	
PRE-CONDITIONS: This means you must complete the conditions listed below before you start the project. However, you DO NOT have to send any information back to the Committee. The Committee will assume completion of these conditions. Participant Information:	✓

• Please include ○ the time it takes to complete the online study ○ that participants will be asked questions about their menstrual cycle	
COMMITTEE-CONDITIONAL: This means you must complete the conditions listed below before you start the project. You MUST send the information requested back to the Committee before you start the project. Once the committee has received this information, it will contact you again about its decision.	
REJECTION: This means the committee does not wish this research to commence. You should not start this research. The Research Ethics Committee will explain why it has reached this view. Please contact the Committee Chair if you have any questions.	

Signed by the Committee Chair:

Appendix 7.A: Information Sheet

University of Sunderland

Study Information

Male Creativity and Task Performance

Thank you for agreeing to take part in this study. Before you proceed, it is important that you understand why the research is being conducted and what participation will involve. Please take the time to read this information sheet and ask the researcher, or email at a later date (details at the end) if anything is unclear.

What is the study about?

The current study aims to examine creativity and performance on a simple computer based task.

Who can participate?

Heterosexual males aged over 18.

What does participation involve?

In order to participate, you will be required to provide consent followed by some demographic information. You will then be presented with a hypothetical scenario divided into three subsections where you will be asked to write about the subject in the scenario. You will then complete one brief questionnaire relating to the likelihood of engaging in additional mating opportunities, then the computer game which lasts for three minutes. This will complete the study in approximately 20 minutes.

Do I have to take part?

Participation in this study is entirely voluntary. Should you decide to participate, you remain free to withdraw from the study at any time, without giving any reason, and without penalty.

Are there any risks?

There are no known risks to taking part in the study. However, if you feel uncomfortable at any time, or wish to end your participation, simply close your browser to end your participation.

What advantages are there?

There are no known advantages to taking part in this research however your participation will assist in increasing scientific knowledge in this area of research.

Anonymity & Confidentiality

You are not required to give your name. Therefore, all of the information you provide is anonymous. Your data will be held confidentially. The only people who will usually have access to your personal (but anonymous) data are the small group of researchers working on this project and the ethics committee. However, it should be noted that it may be the case that appropriate members of the University of Sunderland may be given access to your data for monitoring or audit of this study to ensure we are complying with standards and regulations. The data you provide will be stored on a password protected computer or in a locked room at the University. It will be destroyed after five years of completion of the PhD. The results of this study (if appropriate) will be written up and submitted for publication in an academic journal.

Can I withdraw from the study?

As participation is entirely voluntary, you are free to withdraw at any time without giving reason and without penalty. You can do this by not giving consent to participate, by exiting the study at any time, or if you have submitted your data and would like to withdraw at a later date, you can contact the researchers requesting the withdrawal of your information up to two weeks after participation using your participant number.

Contact details:

If you have any questions, or if you require additional information, please contact the researchers, rebecca.owens@research.sunderland.ac.uk, or helen.driscoll@sunderland.ac.uk.

This study has been approved by the University of Sunderland Ethics Committee. Should you have any concerns regarding the study, you may contact the Chairperson of the Ethics Committee of the University of Sunderland, Dr Etta Evans at etta.evans@sunderland.ac.uk

Thank you for your assistance.

Appendix 4.B: Consent Form

This study is approved by the University of Sunderland Ethics Committee

Consent

In order to participate in this study, it is necessary that you give your informed consent. By signing below, you are indicating that you understand the nature of the study and your role as participant, and that you agree to take part in the research. Please consider the following points before proceeding:

As an informed participant of this study, I understand that:

1. My participation is voluntary and I may cease to take part in the study at any time, without penalty
2. I am aware of what my participation involves and that my data will remain anonymous
3. I am over the age of 18
4. If I have any questions, I will contact the researchers.

I consent to take part in this study

- ☐ Yes
- ☐ No

Appendix 7.C: Ethics Statement

University of Sunderland

RESEARCH ETHICS COMMITTEE DECISION STATEMENT

Application Number: 234 **Project Title: Male creativity and task performance** **Chief Investigator: Helen Driscoll** **Co workers: Rebecca Owens (Postgraduate Research Student), Ros Crawley (Co-supervisor), Daniel Farrelly (Co-supervisor, University of Worcester)**

Date: 03-11-2014

YOUR RESEARCH PROJECT DECISION IS LISTED BELOW

APPROVED WITH NO CONDITIONS: This means you may start the project immediately.	✔
PRE-CONDITIONS: This means you must complete the conditions listed below before you start the project. However, you DO NOT have to send any information back to the Committee. The Committee will assume completion of these conditions.	

COMMITTEE-CONDITIONAL: This means you must complete the conditions listed below before you start the project. You MUST send the information requested back to the Committee before you start the project. Once the committee has received this information, it will contact you again about its decision.	
REJECTION: This means the committee does not wish this research to commence. You should not start this research. The Research Ethics Committee will explain why it has reached this view. Please contact the Committee Chair if you have any questions.	
RECOMMENDATIONS: These are simply points of advice from the committee. They are OPTIONAL. You do not have to undertake them or contact the committee about them.	

Signed by the Committee Chair:

Dr Etta Evans

NOTE: The University of Sunderland 'Research Ethics Completion Statement' proforma must be completed and submitted to the Committee within three months following the project end date.

Appendix 7.D: Demographic Questionnaire

1. Please indicate your sex: M F

2. What is your age?

____

3. What is your nationality?

____

4. What is your highest level of education?

- ☐ No formal education
- ☐ Primary/grade school
- ☐ Secondary/high school
- ☐ One or more years of university/college
- ☐ A university/college degree/diploma
- ☐ A postgraduate qualification or diploma

5. What is your current relationship status?

- ☐ Single
- ☐ Casually dating (multiple people)
- ☐ Casually dating (one person exclusively)
- ☐ Long term relationship
- ☐ Co-habiting
- ☐ Married

- If you have indicated above that you are currently in a relationship with one person only, please state for how long (in months):

____

6. Do you have any children?
- ☐ No, I have no children
- ☐ Yes, I have children

Appendix 7.E: Debrief

Participation in this study is now complete. Thank you for taking part. Research suggests that male competitiveness is an adaptive behaviour that serves to attract mating opportunities. The current study was aims to see if competitiveness fluctuates according to whether males are primed with a 'satisfied' or an 'unsatisfied' relationship scenario.

If you have any questions or require any other information, please contact me on rebecca.owens@research.sunderland.ac.uk or my supervisor on helen.driscoll@sunderland.ac.uk.

Thanks again!

Appendix 8.A: Participant Information Sheet

University of Sunderland

Study Information

Study title: Female Mate Preferences

Thank you for agreeing to take part in this study. Before you proceed, it is important that you understand why the research is being conducted and what participation will involve. Please take the time to read this information sheet and email either myself or my Director of Studies (details at the end) if anything is unclear.

What is the study about?

The current study aims to understand how females prioritise different qualities in mates according to the intentions of the relationship.

Who can participate?

We are looking for heterosexual female participants aged over 16.

What does participation involve?

In order to participate, you will be asked to read a short story and imagine yourself in the scenario presented. This story will take you through the course of a relationship, from when you first meet a partner. Even if you do not have a partner, you will be asked to imagine yourself in this situation then answer the associated questions at various stages of the 'relationship'. Finally, you will be asked some questions about your menstrual cycle and if you are on any hormonal contraception. The study should take 20-30 minutes.

Do I have to take part?

Participation in this study is entirely voluntary. Should you decide to participate, you remain free to withdraw from the study at any time, without giving a reason, and without penalty.

Are there any risks?

There are no known risks to taking part in the study. However, if you feel uncomfortable at any time, or wish to end your participation, simply close your browser to end your participation.

What advantages are there?

There is no direct personal benefit to taking part. However, your participation will assist in increasing scientific knowledge in the area of mate choice.

Anonymity & Confidentiality

You are not required to give your name. Therefore, all of the information you provide is anonymous. Your data will be held confidentially. The only people who will usually have access to your personal (but anonymous) data are the small group of researchers working on this project. However, it should be noted that it may be the case that appropriate members of the University of Sunderland may be given access to your data for monitoring or audit of this study to ensure we are complying with standards and regulations. The data you provide will be stored on a password protected computer or in a locked room at the University. The results of this study (if appropriate) will be written up and submitted for publication in an academic journal. All of the data will be destroyed after three years following completion of my PhD.

Can I withdraw from the study?

As participation is entirely voluntary, you are free to withdraw at any time without giving reason and without penalty. You can do this by not giving consent to participate when prompted, at which point you will exit the study. If you wish to end your participation at any time during the study, just close your browser. If you complete the study and later decide you would like to withdraw your data, you can contact the researchers requesting the withdrawal of your information using the unique reference ID (date of birth) you provided at the beginning of participation. However, you must do this within two weeks of participation.

Contact details:

If you have any questions, or if you require additional information, please contact either myself (rebecca.owens@research.sunderland.ac.uk) or my Director of Studies Dr. Helen Driscoll (helen.driscoll@sunderland.ac.uk).

This study has been approved by the University of Sunderland Ethics Committee. Should you have any concerns regarding the study, you may contact the Chairperson of the Ethics Committee of the University of Sunderland, Dr Etta Evans, etta.evans@sunderland.ac.uk.

Thank you for your assistance,

Rebecca Owens.

Appendix 8.B: Consent Form

This study is approved by the University of Sunderland Ethics Committee

Consent

In order to participate in this study, it is necessary that you give your informed consent. By signing below, you are indicating that you understand the nature of the study and your role as participant, and that you agree to take part in the research. Please consider the following points before proceeding:

As an informed participant of this study, I understand that:

1. My participation is voluntary and I may cease to take part in the study at any time, without penalty
2. I am aware of what my participation involves and that my data will remain anonymous
3. I am over the age of 16
4. If I have any questions, I will contact the researchers.

I consent to take part in this study

- ☐ Yes
- ☐ No

Appendix 8.C: Demographic Questionnaire

Demographic Information

Please indicate your sex: M F

What is your date of birth? (DDMMYYYY)__________________

What is your nationality? _____________________

How would you describe your sexuality?

- ☐ Predominantly homosexual
- ☐ Bisexual
- ☐ Predominantly heterosexual

What is your relationship status?

- ☐ Single
- ☐ Casually dating (multiple people)
- ☐ Casually dating (one person exclusively)
- ☐ Long term relationship
- ☐ Co-habiting
- ☐ Married

Do you have any children?

- ☐ Yes
- ☐ No

Appendix 8.D: Menstrual Cycle Information

Are you currently using any form of hormonal contraception, e.g. the pill, mini pill, contraceptive implant, intrauterine device (IUD)?

Yes ☐

No ☐

Have you used any form of hormonal contraception within the past three months (even if you are not taking it now)?

Yes ☐

No ☐

Are you currently pregnant?

Yes ☐

No ☐

Are you currently breastfeeding?

Yes ☐

No ☐

The following questions concern your menstrual cycle. It is extremely important that the information provided in response to these questions is as accurate as possible. If you are not sure about the answers, please take the time to check.

Please circle the approximate average number of days in your menstrual cycle (the number of days between the first day of one period and the first day of your next period):

22 23 24 25 26 27 28 29 30 31 32 33 34

35 36 37 38

Is your menstrual cycle currently regular?

Yes ☐

No ☐

Please state (as accurately as possible) the date of the **first day** of your last menstrual bleed (the first day of your last period). A calendar is provided should you need this to determine the correct date.

Date of first day of last menstrual bleed:

Day/date _______________________

Month _______________________

Year _______________________

Please indicate how confident you are that the date provided above is accurate?:

Absolutely sure (this is definitely the exact date)

☐

Confident within one day (it is possible that your period began one day before or after the stated date

☐

Not confident (the actual date may be more than one day before or after the stated date).

☐

Appendix 8.E: Debrief

Debrief

Many thanks for taking part, the study is now complete. This study was concerned with whether female mate preferences change over the course of a relationship. If you have any questions please email myself (rebecca.owens@research.sunderland.ac.uk) or my Director of Studies (helen.driscoll@sunderland.ac.uk).

THE AIMS OF THIS STUDY

This research aims to examine how the characteristics females desire in a male partner will change over the course of a relationship.

SUBJECT OVERVIEW

Previous research considering male behaviour suggests that males behave in a competitive, dominant manner in order to secure mating opportunities. This has an adaptive function as in an ancestral environment, women were required to be choosy regarding their choice of mate and potential father to their offspring. If this truly is adaptive, then females should have co-evolved to find dominant, confident males more attractive at the beginning of a relationship when the longevity of the relationship is less secure; then for their preferences to gradually shift as the relationship becomes more secure in order for the male to demonstrate he is no longer concerned with attracting other females and for him to direct his resources towards her and her offspring.

YOUR DATA

Participation in the study is anonymous and confidential. You will be given a unique participation number (date of birth DDMMYY) and your data will only be identified by your participation number not by your name. All personal information will be stored separately to your responses to ensure anonymity. The results of the statistical analysis will be written up and presented in my final thesis however, you will be not be recognisable and all of the data will be destroyed after three years following completion of my PhD.

HOW TO WITHDRAW

Participation in this study is entirely voluntary and you are free to withdraw at any time up until two weeks after participation without giving reason. If you decide to withdraw please inform me or my project supervisor using the email addresses provided. Please remember to include your date of birth (DDMMYY) which will enable us to remove your data set from the study. If you have any questions, require additional information or would like to withdraw please contact either myself; rebecca.owens@research.sinderland.ac.uk, or my Director of Studies helen.driscoll@sunderland.ac.uk.

Please do not discuss the purpose and aim of the study with any fellow participants, as it may confound the overall results of the study.

Thank you for your time.