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The Bio-Social Influences Over Women's Mate
Choice Copying

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PhD

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The Bio-Social Influences Over Women's Mate Choice Copying

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A thesis submitted in partial fulfilment of the requirements of the
University of Northumbria at Newcastle for the degree of Doctor
of Philosophy Research undertaken in the Faculty of Health and
Life Sciences

Research undertaken in the Faculty of Health and Life Sciences

November 2017

Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas and contributions from the work of other.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the Faculty Ethics Committee on 12 March 2013.

I declare that the Word Count of this Thesis is 51,701 words

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Date:

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Abstract

Background: Females assess the quality of potential mates based on the expression and presence of evolved cues and signals. Recent evidence shows that social information gained by observing the mate choices of same-sex peers can also influence mating decisions of females, i.e. mate choice copying (MCC). In humans, much of the MCC literature has focused on confirming the expression of this behaviour in women. Whilst findings are mixed, most research concludes that women do engage in MCC. Recent years have seen a shift away from confirming MCC in humans towards understanding how MCC alters the perception of traits possessed by males.

Aims: This thesis sought to expand upon this research arc in three novel ways. First, it examines the interaction between known biological modulators of mate choice and MCC. Second, it explores the interaction between participant individual differences and MCC. Third, it investigates how MCC influences the perception of traits that are likely to increase the probability that a given male is selected as a mate.

Method: Facial photographs of attractive and unattractive men were presented to participants in one of three conditions: i) men alone, without an accompanying image of a woman, and described as romantically single; ii) men presented alongside an attractive woman and described as her romantic partner; and iii) men presented alongside an unattractive woman and described as her romantic partner. Participants rated the photographs of men on questions specifically related to the three aims of this thesis.

Results: Age and hormonal fluctuations associated with ovulation did not significantly alter MCC behaviour. There were no significant differences in MCC between younger and older participants, or between women at high or low fertility. Men who benefitted from MCC were perceived as significantly more faithful potential partners and were perceived as easier to acquire mates than

men not benefiting from MCC. However, when participant individual differences (e.g. socio-sexual orientation, self-perceived mating success, self-esteem, big 5 personality factors and the dark triad factors) were factored into the analysis, MCC effects disappeared.

Conclusion: Overall, MCC failed to replicate in 6 out of 7 experimental chapters contained within this thesis. This lack of replication occurs for both the novel, never before tested questions, but also for questions commonly asked and replicated in wider MCC literature. Replication failure raises questions about the context in which MCC occur. I call for a meta-analysis of existent data to clarify effect size, heterogeneity, and possible publication bias.

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Chapter One: Introduction

1.0: Chapter overview

How and why women select their partners has been an area of contemporary scientific research for a few decades. It has been an area of public interest for millennia. One of the oldest examples of this wider non-scientific interest can be found in the preserved texts of the Egyptian Kahun Papyrus which dates back to 1800 BCE (Haimov-Kochman, Sciaky-Tamir, & Hurwitz, 2005; Knobil, 2006). It is likely that popular interest has always been with our species (Knobil, 2006). This thesis will focus upon a specific aspect of women's mate selection behaviour known as mate choice copying. Mate choice copying occurs when a woman gains information about a man's quality from observing the mate choices of other women. More details on this process can be found in chapter 2. In order to allow us to understand the reason why mate choice copying occurs, why it can be an important aspect of the mate selection process, and to allow us to generate grounded and sensible hypotheses we need to understand attraction more generally. This chapter will briefly provide an overview of the background literature explaining attractiveness, its function and, ultimately, how behaviour like mate choice copying can come to exist. To begin with, we must first understand the process by which animals acquire traits and behaviour.

1.1: Evolution via natural selection

Until Darwin (1859) published his theory of evolution by natural selection it was not known how animal species and their behaviours had developed and diversified across time. A number of key observations presented a mystery to naturalists of the time. First, it was evident from the small but rapidly growing fossil records that animal species had changed dramatically in form across geological time. Second, observations of animal populations showed that populations that were geographically close differed less in form than those separated by greater distances. A good example of this is the island-dwelling finch populations observed and recorded by Darwin. Whilst clearly of the same genus, species on a single island possessed

more similar adaptive features compared to their related species on neighbouring islands. Prior to the publication of the theory of natural selection, how these changes occurred and why such a pattern existed in nature was without naturalistic explanation. The theory of evolution via natural selection was the answer to this question.

To explain further: small variations exist between members of the same species. A visible example of this is height differences among human individuals. Natural pressures, such as predation or fluctuation in food availability, mean that some individuals are less well adapted to their environmental circumstances. This is particularly the case when the environment changes or when a population moves to a new environment as is the case with the finches observed and recorded by Darwin. These less well adapted individuals are less likely to survive or reproduce compared to those that are better adapted. Across time this means that those individuals successfully reproduce, pass on their traits to offspring. Thus the traits passed on become increasingly representative of the population as a whole. Across time this creates an exaggeration in the expression of adaptive traits and behaviour of animals. Changes in form observed in the fossil records, or differences between geographically close but separate species are thus explained by the slow accumulation of adaptive traits across isolated populations.

Evolution by natural selection underpins much about the current understanding of biology and has, over the last few decades, been increasingly applied to behavioural research. Darwin's original theory, whilst impressive in explanatory power, was not able to fully explain the diversity of ornamentation displayed by animal species. Natural selection states that organisms should adapt over time to increase their survivability in a given environment. A number of species display traits and behaviours which seem contrary to this notion. Examples of this include Trinidadian guppy (*Poecilia reticulata*) whose males purposefully swim close to predators (Dugatkin & Godin, 1993). The peacock's (*Pavo cristatus*) tail feather is a classic example of a seemingly contrary feature. The tail feathers are so long that they pose a hindrance to escaping from predation. Indeed, such features concerned Darwin so much that

in a letter to Asa Gray, April 3rd 1860 he wrote that "...the sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick". Why then do such traits exist if they seem to violate expectations of natural selection? Darwin (1883) provided an answer to this question: Sexual Selection.

1.2: Evolution by sexual selection

In addition to the pressures exerted on animals from natural selection there are also pressures exerted from the mate choices of, usually, females within a given species. In the examples stated above, males with large tail feathers or bold risk taking behaviour exist because males displaying such traits are desired and sexually selected by females over males that do not display these traits. In natural selection genes are passed on more frequently because individuals that are better adapted to their environment, suffer less predation and are more likely to be able to gather resources and are therefore more likely to survive to reproduce. In sexual selection, those individuals displaying a desirable trait are mated with preferentially and thereby pass on the genes for a given trait(s). This both increases the frequency of traits expressed in a population and, equally, increases the preference for such traits. Therefore, because females possess a preference for the extreme of a given trait, preferential male features become exaggerated over time resulting in changes in form and behaviour (Barraclough, Harvey, & Nee, 1995).

There are numerous examples in the animal kingdom of the effects of sexual selection. For example, the females of many species are known to select males who display high levels of carotenoid pigmentation (Kodric-Brown, 1985, 1989; Simons, Cohen, & Verhulst, 2012). Perhaps the most notable examples of sexual selection are found in both birds of paradise and bower birds (*Ptilonorhynchidae*). Male birds of paradise (*Paradisaeidae*) produce dramatic and colourful plumage to attract mates. In addition, many use song or dance to further attract partners. The females of the species are comparably drab with little to no colour and yet are highly selective (Payne, 1984). Compared to birds of paradise, bower birds tend to have less visible plumage. However, they go to great lengths in order to impress females. They clear

large areas of forests, sometimes up to two meters in size, in order to build complex displays for females. Females mate only with the males who produce the biggest and most elaborate nest (Frith, 2004). Species that display extreme sexual selection also have clear sexual dimorphism. Each sex develops differing reproductive strategies. Males tend not to be selective over mates and invest a large proportion of their resources into attracting mates or fighting to keep mates. Females tend to be highly selective. They invest their resources into inspecting and selecting mates rather than attracting them. Why should females be so selective and males so showy? For what reason does sexual selection exist? These questions were answered by parental investment theory (Trivers, 1972).

1.3: Parental investment

It has been noted for some time that, whilst sharing many similar mate selection criteria, males and females differ in how they approach mate selection (see section 1.4). Trivers (1972) theorised that these sex specific selective preferences were a consequence of differing costs to reproduction. This cost difference applies at both a biological and behavioural level. Female gamete cells are larger, more resource intensive to gestate, and are limited in number compared to male gamete cells (Parker, Baker, & Smith, 1972). That is not to say that sperm production is without resource expenditure; it evidently entails costs (Dewsbury, 1982), but this is less than that incurred by females as they must gestate and birth offspring. Gestational cost differs depending upon the species but serves to increase the basic calorific requirements of all females. For mammalian species such as humans this cost can be as low as 20,000 extra calories but has been theorised to be as high as 80,000 extra calories across pregnancy (Durnin, Grant, McKillop, & Fitzgerald, 1985). Whilst not all species provide parental care post birth (e.g. almost all reptiles do not provide parental care), a large number of species do. In offspring rearing species it is often the female who raises offspring. Males tend to have little input into the raising of offspring. Even in species which share the raising of offspring, females still have a greater minimal investment than males (Bjorklund & Shackelford, 1999).

This difference in the cost of reproduction is, according to Trivers' parental investment theory, the driving force for the differing sexual selection strategies of males and females. Where a sex incurs a greater cost to reproduction, that sex naturally seeks to minimize those costs. The burdened sex can reduce the cost of reproduction by selecting beneficial traits possessed by a partner. In every case where one sex incurs a greater cost to reproduction than the other, the burdened sex becomes highly selective over mates. Females, who are generally burdened with the greatest cost, are thus extremely selective over the males they choose. Males, because their investment in offspring is less, compete for selection. It is for this reason that sexual dimorphism expresses itself so vividly amongst males. This selectiveness allows females to offset some of the costs associated with reproduction by acquiring traits from males that boost the future survival and reproductive success of offspring and/or the survival of herself during pregnancy.

It is important to spend time discussing these selection criteria, but before delving into this it is important to state that there are many similarities between men's and women's mate selection. Notable examples of these similarities are mutual attraction and love, education, sociability and dependable character, which are valued by men and women alike (Buss, Shackelford, Kirkpatrick, & Larsen, 2001). Differences, however, do exist and are important to consider for the purpose of this thesis.

1.4: Female selection criteria

1.4.1: Male parental investment ability

Female selective criteria have been theorised to fall within two primary domains: i) selection for genetic quality and ii) selection for parental investment ability. In 1989 David Buss conducted the first global study on the mate selection preferences of men and women (Buss, 1989). He recruited 10,047 people across 33 countries, including tribal and island societies, and asked them to rate the importance of given traits when selecting a mate. With the exception of one culture which showed only marginal differences, women showed a greater preference for men who were ambitious, hardworking, and had higher financial status. Men

rated these traits as significantly less important than women did. Further, these selective criteria have been found to directly predict whether women will select a man during early dating situations (Li et al., 2013). That is to say that the display of these traits during the dating process increases the likelihood women will enter into a relationship with a man. This preference for resource accrual traits is supported by a number of different findings. For example, married men who become unemployed double their risk of being divorced. This isn't found when women become unemployed and this effect is immediate upon loss of employment (Jensen & Smith, 1990). Further, when women switch from one partner to another, the new partner tends to have higher resource accrual potential than the previous partner (Buss & Greiling, 1999). It could be argued that this is a result of women historically having less earning potential than men, which is known as the 'structural powerlessness hypothesis' (Buss & Barnes, 1986). Under this argument, women's preference for men with resources is not an evolved preference but merely an artefact of unequal earning opportunities. Data do not support this hypothesis, however. For example, comparing more recent mate preference data to those acquired in 1989 show women have increased the importance placed on men with resources despite greater income parity (Buss et al., 2001).

Women's desire for resource security is predicted in light of the costs to reproduction. Women who select men with sufficient ability to provide resources are more likely to survive pregnancy and are more likely to be able to provide resources to offspring in order to ensure they develop successfully. In modern societies it is possible to see how selecting mates with the ability to acquire resources can be beneficial. Socioeconomic status can have large impacts upon the wellbeing of potential children. For example, in a cross generational longitudinal study it was found that the good socioeconomic status of parents positively affected the socioeconomic and educational status of their children and their children's children (Sohr-Preston, Scaramela, Martin, Nepl, Ontai, & Conger, 2013). Further, low socioeconomic status, because of the stressors introduced during early pre-natal development, has been shown to alter childhood structural brain development (Jenkins, Woolley, Hooper, & De Bellis, 2013),

increase the risk of future obesity (Pavela, Lewis, Locher, & Allison, 2016) and be related to poorer general health (Beach et al., 2016a; Beach et al., 2016b). Each of these factors would affect the future reproductive success and the potential survivability of offspring. Therefore, given the desire to reduce the costs to reproduction we would predict that women would select for such features.

1.4.2: Good genes for health

In addition to selecting men who can provide resources, women also select men who are physically attractive. It is thought that physical attractiveness is an indicator of the ability of the genome to cope with environmental stressors both internal and external to the individual (Scheib, Gangestad, & Thornhill, 1999). There are two main hypothesised functions for the selection of good quality genes. The first is that they convey health benefits to offspring, and the second is that genes, on account of producing physically attractive traits, are likely to produce “sexy” or reproductively successful offspring.

In an environment containing life threatening viral and bacterial organisms, immunocompetence is key to the fitness of individuals. Individuals are more likely to survive to reproduce and therefore more likely to pass on genes to offspring if they have an immune system capable of fighting off infection. Animal research has shown that males with good immunocompetence and parasite resistance are able to present the best physical qualities to females (Moller, Christe, & Lux, 1999). In bird species, the development of fuller plumage with more symmetrical feathers and brighter display features has been linked to immunocompetence and parasite resistance (Balenger, Bonneaud, Sefick, Edwards, & Hill, 2015). Experimental evidence shows that females actively select males who display highly ornate features (Keyser & Hill, 2000; Kierl & Johnston, 2015). Given the link between plumage and immune quality and the preference for ornate males it is likely that females are selecting males because it is an honest signal of immune quality (Keyser & Hill, 2000). It is difficult to assess how these hypothesised gene benefits directly affect offspring survivability but, in animal species, it is possible. For example, in scorpion flies it was found that males

with ornamental features have better immunocompetence than males without ornaments and, though a small effect, sons of highly ornamented males possessed better immunocompetence than sons of males with less pronounced ornamentation (Kurtz & Sauer, 1999). Selecting males with good immunocompetence understandably increases the survival ability of potential offspring.

In humans, direct fitness benefits, as in the example above, are difficult to directly assess but can be inferred. This inference can be made two ways. First, by examining literature which shows how gene quality affects traits that are known to alter perceived attractiveness. Second, by understanding how the presence of gene quality indicators alters the life outcomes of individuals. For example, genes possessed by individuals have been demonstrated to contribute between 24 and 42% towards the probability of developing serious mental health issues (Rasic, Hajek, Alda, & Uher, 2013). Genes account for 40% of the variance in social ability and individual personality (Vukasović & Bratko, 2015) and account for a third of the variance in behavioural masculinity (Verweij, Mosing, Ullén, & Madison, 2016). Each of these attributes dramatically affects the personality, behaviour and, importantly, the attractiveness of individuals (Feingold, 1992).

Healthy gene indicators should, therefore, influence how a woman evaluates a man as a potential mate. Indeed, possession of good gene traits alters much about how individuals are perceived by others. For example, attractive individuals are perceived to be more successful, earn more, and are perceived to be more romantically successful than less attractive individuals (Benzeval, Green, & Macintyre, 2013). Physical attractiveness does not stop at altering the mere perceptions of success. Both attractive men and women, in relation to job success, benefit in measurable terms over less attractive counterparts. Meta-analysis shows that attractive people are more likely to be hired, more likely to start on a higher salary and are more likely to retire on a higher salary than unattractive people (Hosoda, Stone-Romero, & Coats, 2003). The above suggests that selecting for the outward signs of gene quality should have an

evolutionary benefit for both women and their offspring. But what are these outward signs of genetic quality which women may select for?

1.4.2.1: Symmetry

Certain physical features are thought to be a proxy for gene quality. In the classic peacock tail example, symmetrical and brightly coloured feathers are ornaments that indicate genetic fitness. Similarly, bilateral symmetry and colouration are hypothesised quality indicators in humans. No animal, human or otherwise, is perfectly bilaterally symmetrical. In fact, whilst participants show preference for symmetrical features, this preference exists only up until a point. Participants demonstrate a tolerance of imperfection as faces become increasingly close to perfectly symmetry, however perfect symmetry is seen as unnatural (Makin, Bertamini, Jones, Holmes, & Zanker, 2016). The slight variations in symmetry present in all individuals are known as fluctuating asymmetry. Fluctuating asymmetries result from random variation in the expression of genes due to environmental stressors experienced at the time of development. An unstable environment creates large fluctuating asymmetry in the individuals who are least able to cope with stressors. Conversely, a relatively stable environment creates fewer bilateral asymmetries (Beasley, Bonisoli-Alquati, & Mousseau, 2013).

High fluctuating asymmetry has been correlated with increased prevalence of genetically inherited disorders (Barden, 1980), reduced metabolic rate (Manning, Koukourakis, & Brodie, 1997), poor mental health in men (Martin, Manning, & Dowrick, 1999) and lower general intelligence (Banks, Batchelor, & McDaniel, 2010). Individuals with large fluctuating asymmetries and lower developmental stability are also less successful when it comes to acquiring mates (Gangestad & Thornhill, 2013). Further, men showing high fluctuating asymmetry are often rated as less attractive on various attractiveness measures. For example, they are rated as less vocally attractive (Hill et al., 2017), having a less attractive scent (Gangestad & Thornhill, 1998) and are rated less facially attractive than those with lower fluctuating asymmetry (Gangestad, Merriman, & Thompson, 2010). The relationship between

health, symmetry and women's preference for symmetrical men suggests that attractiveness is an indicator of genomic health. This research is not without contention, however. A recent review of fluctuating asymmetry highlights that whilst there is evidence that environmental stressors do increase asymmetry, human based studies are often methodologically unsound and so it is difficult to confidently draw conclusions (Graham & Özener, 2016). The above should be interpreted with caution.

1.4.2.2: Masculinity

Another hypothesised feature related to both women's mate selection and men's genetic quality is masculinity. Masculinity – a sexually dimorphic characteristic – can be characterised as a given set of traits, both physical and behavioural that differ from females, which form through the response of the male genome to testosterone (Andersson, 1994). Examples of masculine characteristics are; a larger shoulder to waist ratio (Hughes & Gallup, 2003), a higher bodily muscle mass than women (Dixson, Grimshaw, Ormsby, & Dixson, 2014), a larger more prominent jaw, smaller eyes and prominent brows (Boothroyd, Scott, Gray, Coombes, & Pound, 2013). More masculine males also demonstrate certain behavioural traits over less masculine males. Dominance (Batres, Re, & Perrett, 2015), higher 'Dark Triad' traits (Lyons, Marcinkowska, Helle, & McGrath, 2015), and leadership ability (Re, DeBruine, Jones, & Perrett, 2013; Re, Hunter, et al., 2013) are all considered masculine traits.

Masculinity as a driver of women's mate selection continues to be hotly debated in literature. Results are highly mixed but for the purpose of this introduction only a brief overview of the literature will be given. The most popular hypothesis for why masculinity is attractive is known as the 'Handicap Principle' (Zahavi, 1975). In this hypothesis the maintenance of secondary sexual characteristics is costly for males. Testosterone is an immunosuppressant and thus the presence of testosterone-driven secondary sexual characteristics is argued to be an honest signal of immunocompetence. As an organism has a limited energy budget to allocate to life goals such as survival or reproduction, only males with sufficient resources can afford to produce secondary sexual characteristics. Due to its

immune suppressing characteristics only males with robust gene quality can sustain highly masculine features without a large risk to survivability (Muehlenbein & Bribiescas, 2005). However, there exists a problem with the handicap hypothesis. For this hypothesis to be true the following three predictions must also be true. First, testosterone must be immune suppressive. Second, masculinity should correlate with testosterone levels and third masculinity should be linked to immune function.

The relationship between testosterone and immune suppression is not clear cut. Two factors complicate this relationship. First, organisms divert resources to differing priorities depending upon current life goals. Second, testosterone interacts differently with innate and acquired immune systems and its effects differ depending upon the type of infection an organism contracts. This means that interactions between testosterone and immune responses are sometimes complimentary and sometimes antagonistic depending upon life goals and which immune system is activated. Experimental evidence yields mixed results with some evidence suggesting that testosterone improves rather than suppresses immune response in men (Scott, Clark, Boothroyd, & Penton-Voak, 2013). Evidence is substantial, however, that in animals testosterone is related to secondary sexual characteristics (McGlothlin et al., 2008). Similarly, in humans, it appears that testosterone influences male secondary sexual characteristics associated with facial masculinity e.g. wider cheekbones, prominent brow ridges, longer and wider lower faces and thinner lips (Scott, Clark, Boothroyd, & Penton-Voak, 2013). The third prediction of the handicap hypothesis is that masculinity is related to immune function. Experimental evidence is mixed. For example, Rhodes, Chan, Zebrowitz, and Simmons (2003) found a weak association between early life health and masculinity. But they used a subjective measure of masculinity which may be confounded with other factors such as general attractiveness. Research using an objective measure of masculinity found conflicting evidence (Thornhill & Gangestad, 2006). With only one of its assumptions receiving solid evidentiary support debate continues in literature as to whether the handicap hypothesis is a valid concept. More recent research suggests that masculinity increases men's

competitiveness and therefore may make men more attractive on the basis that selecting competitive men increases fitness (Mehta & Beer, 2010). Again, however, as Scott et al (2013) point out, women's preference for masculinity is mixed.

There are a number of factors which are hypothesised to account for the variation in preference for masculinity. Life history and mating strategies alter the importance placed upon masculinity as a selected trait. For example, women experiencing large amounts of childhood illness show a preference for physically attractive, masculine males compared to women experiencing fewer childhood illnesses (de Barra, DeBruine, Jones, Mahmud, & Curtis, 2013). This tough early life is suspected to prime women to enact a "faster" reproductive strategy which is focused more on short term mating patterns and the acquisition of good genes. The logic is that as survival conditions become increasingly difficult and the chance of successfully acquiring resources decreases. Therefore, women preferentially seek to acquire physical traits that are most likely to increase offspring competitiveness, such as those possessed by masculine males, and thereby increase the survivability of offspring (Del Giudice, Gangestad, & Kaplan, 2015). Masculinity preference may also alter across the ovulatory cycle. As women become increasingly likely to become pregnant, a reported preference shift towards masculine males has been found (Havlicek, Cobey, Barrett, Klapilová, & Roberts, 2015 but for conflicting research please see Gildersleeve, Haselton, & Fales, 2014). These cyclical shifts are said to occur because women increase the likelihood of acquiring good genes and thereby increase the survivability and reproductive success of offspring at ovulation (ovulation will be discussed further in chapter 4, for details please refer to this chapter).

Further, it is possible that women prefer masculine men because they are more able to directly compete for and win resources than other less masculine men (Dixson, Sulikowski, Gouda-Vossos, Rantala, & Brooks, 2016). However, conflicting data exists and meta-analysis suggests that male dominance is not necessarily considered attractive (Gildersleeve, Haselton, & Fales, 2014a). Whether masculinity is used reliably in women's mate selection is currently unclear and debate continues within the literature. For example, a recent hypothesis suggests

that masculinity may be a result of intrasexual competition rather than female mate selection. In this hypothesis, men are masculine because it both aids in fighting ability and reduces the risk of challenge by other males (For details of this hypothesis see Puts (2010)). The discussion so far has focused upon the health and resource benefits of selecting men with good genes. These explanations have merit but there is an additional explanation to briefly consider whilst discussing the motivations for mate selection – the selection of genes for the production of “sexy” offspring.

1.4.2.3: Genes for sexy offspring

The ‘good genes’ hypothesis suggests that good genes are acquired so that future offspring are reproductively successful. This is based on the observation that the presence of genes that produce male traits are commonly accompanied by genes which code for female preferences for said traits. Therefore, the presence of this genetic preference in females means that males possessing specific traits are more likely to be selected as a mate, whether those traits convey health benefits or not, simply because the preference for those traits is inherited by females (Kokko, Booksmythe, & Jennions, 2015). This is known as the ‘Runaway Hypothesis’ and was proposed as an explanation for the fast development of sexual dimorphism (Fisher, 1930). Fisher states that the female preference for a trait is created under natural selection. Successive sexual selection begins a runaway process by which both the preference for a trait and the trait itself become exaggerated over time until it is constrained by natural selection (West-Eberhard, 2014). Therefore, males possessing a trait are reproductively successful merely because of the presence of a trait.

Experimental evidence for good gene preference can be found in the study of extra pair copulatory (EPC) behaviour. In bird species, females engage in extra-pair copulation in order to acquire genes from desirable males. The offspring from such extra pair males are often reproductively successful and possess the same desirable traits which attracted her (Foerster, Delhey, Johnsen, Lifjeld, & Kempenaers, 2003). In women, EPC is much more difficult to study and benefits must be inferred rather than directly observed. Data show that women are

likely to have extra pair affairs with physically attractive males, particularly when their own partner is less attractive (Pillsworth & Haselton, 2006). It is hypothesised that, like with the birds, this occurs so that attractive traits can be acquired for offspring. Interestingly, recent genetic analysis indicates that a gene variant correlated with a large increased tendency for sexual infidelity shows evidence of recent selective pressure (Garcia et al., 2010). This suggests that EPC behaviour may indeed be of adaptive benefit to females. It has also been argued that women use extra pair copulation to test men as potential new partners in order to switch from a current lower quality man to a new higher quality man (Buss, Goetz, Duntley, Asao, & Conroy-Beam, 2017). Given the costly nature of extra-pair copulation, it is striking that such behaviour exists and suggests that the acquisition of high quality genes is a powerful driver for female mate selection regardless of the costs imposed by such behaviour.

1.5: Deceptive males

Women's selectiveness over health, good genes, parental ability and resource provisioning ability are important in both reducing the costs of reproduction and increasing the survival chance of offspring. There are two important points of consideration to address so that the rationale behind mate choice copying is understood. The first is that men and women differ in the reproductive pressures they experience and thus operate different reproductive strategies. The second is that these differences can cause conflict between the sexes as each sex tries to enforce its reproductive strategy. A brief overview is provided below.

Whilst men's mate selection criteria are not something that will be focused upon in this thesis, it is important to note that men's mate selection is slightly different from women's mate selection. Briefly, because men incur fewer costs associated with reproduction than women do, they are thus less selective over potential mates. There is less need to acquire resources for gestation and child rearing, for example. Men place far more importance on gene quality and youth indicators compared to women (Ellis, 2008). A smaller waist-to-hip ratio (Bovet & Raymond, 2015), even skin tone, and general health indicators are all consistently rated as attractive by men and are linked to reproductive fecundity (see Ellis, 2008). Another

key difference is that men compete against other men for selection to a greater extent than women do. Additionally, men show a greater preference for short-term mating compared to women. For example, when asked to rate their preference for short term mating, men frequently report a higher preference than women do for uncommitted affairs (Buss & Schmitt, 1993), are more likely to pursue extra-pair mating and short-term strategies than women (Buss, 2015) and are more likely to attempt mate poaching than women (Schmitt & Buss, 2001).

The competitive desire men possess to be selected as a mate means that men specifically advertise traits that are known to be desired by women. A good example of this can be found in online dating profiles. Men specifically exaggerate traits which women find attractive. For example, men often inflate their height by either taking self-portrait images from below so that they appear taller than they actually are or by directly lying about their height in their biography (Hancock, Toma, & Ellison, 2007; Sedgewick, Flath, & Elias, 2017). Men also exaggerate their resource possessions and income compared to women (Hall, Park, Song, & Cody, 2010). Finally, more recent research suggests that deception over physical appearance is almost universal in certain online dating scenes (Zytka, Grandhi, & Jones, 2016). Women – especially attractive women – are highly selective over potential partners and often select mates from a large pool of potentials. Men must therefore be highly competitive. Often men do not possess the traits to effectively compete, and so exaggerate what they do possess in order to improve their chance of selection. The ability to provide resources, their status, their ability to commit, or the costs they may impose on a women in order to gain access to reproduction are often frequent points of men’s exaggeration (Buss, 2006; Haselton, Buss, Oubaid, & Angleitner, 2005).

This deceptiveness makes mate choice potentially risky for females. Research shows that deception with regards to resource availability, status and commitment both prior to and after sex is far more psychologically distressing to women than it is to men (Haselton et al., 2005). Further, changes in a partner’s mate value, whether due to deception or changes in circumstances, are related heavily to a woman’s relationship satisfaction (reviewed by (Buss,

Goetz, Duntley, Asao, & Conroy-Beam, (2017)). This is expected because the consequences of selecting a low value mate are numerous and far reaching. For example, research shows that the children of parents who were in unhappy relationships suffered negative consequences to their own relationship success later in life (Booth & Edwards, 1990). More recent research replicates this finding but also finds that children of unhappy relationships tend to suffer more substance abuse, poorer academic achievement and earlier relationship breakdown (Musick & Meier, 2010). Another risk to poor mate selection is potential abandonment during pregnancy or shortly after the birth of offspring. Though not as severe a risk in modern society compared to past environments, abandonment is risky for the potential success of future offspring. For example, depending upon the financial status of the woman, single parent households can suffer low socioeconomic status. This can then negatively affect foetal/infant and brain development (Tomalski et al., 2013). Further, in polygynous societies low socioeconomic status has a sex specific effect on offspring survivability with male children being more likely to die than females (van Bodegom et al., 2013).

Many of the qualities which make men good parents, such as resources, commitment willingness, and an appropriate personality, are not outwardly visible. Unlike gene quality, which is outwardly visible, it takes time and resources to assess these hidden qualities. Females of many species have evolved mechanisms to reduce the riskiness of mate choice. The selectiveness over mates is one such adaptation. However, this can be costly in time and resources. In the following chapter we will review in depth one such mechanism for reducing the risk associated with mate selection: mate choice copying.

Chapter Two: Literature Review

2.0: Chapter overview

In the previous chapter I discussed the background literature detailing female reproductive strategy and its hypothesised origin. I also discussed the potential cost to women of selecting a man who is either of poor quality or who has purposefully exaggerated their ability or intent to invest post-copulation. Mate choice copying is suggested to act as a short cut to both assessing hidden male traits and reducing the risk of selecting poor quality or deceitful males. This chapter will be divided into three main sections. The first will detail the literature covering the animal kingdom. The second will cover human mate choice copying. The third will briefly overview the topics to be covered throughout this thesis.

2.1: Definition

Mate choice copying, sometimes known as “non-independent mate choice”, occurs when an individual’s choice of mate is influenced by observing the mate choice patterns of others. Formally, mate choice copying was originally defined as follows:

“... copying occurs when the conditional probability of choice of a given male by a female is either greater or less than the absolute probability of choice depending on whether the male mated previously or was avoided, respectively.” (Pruett-Jones, 1992, p. 1001)

Whilst designed to neatly cover mate choice copying behaviour this original definition also inadvertently covered a variety of behavioural patterns which, though related, are separate from strict mate choice. For example, female deer (*Dama dama*) are attracted to large groups of other females. Consequently, males who defend a large group of females are preferred by external females and have increased mating success compared to males with fewer females. Originally, this behaviour was interpreted as mate choice copying (Gibson & Höglund, 1992; Wiley, 1991) but the key attractor of female deer is the social presence of other females and

not the mating success of the male in the group. When checked, female deer mate with males out of sheer proximity. That a given male is present in a large group of females is a by-product of male-male intra-sexual competition (Clutton-Brock & McComb, 1993). This example cannot be called mate choice copying as mate choice is largely irrelevant to the decision of external female deer seeking to join a group. To prevent this misinterpretation of observation, mate choice copying was redefined as follows:

“Mate choice copying occurs when: The conditional probability of choice of a given male by a female is greater than the absolute probability of choice depending upon whether the male mated previously. Further, the information about a male’s mating history (or some part of it) must be obtained by the female via observation” (Dugatkin, 1996a, p. 85)

The addition of the second sentence in the definition prevents examples like the one above being mischaracterised as mate choice copying. It means that mate selection must be the driving cause of any behaviour described as mate choice copying. With this definition laid out we can begin our review of the literature.

2.2: Non-human animals

2.2.1: Birds

Mate choice copying was first hypothesised following observational study of two species of lekking bird: the sage grouse (*Centrocercus urophasianus*) (Wiley, 1973) and white-bearded manikin (*Manacus manacus*) (Lill, 1974). Lekking birds have a distinctive mating pattern. Males of the species congregate in large numbers to take part in competitive displays in order to attract females. They compete over territory and dance to attract attention. Successful mating is largely skewed towards the highest quality male with the best displays and territory leaving lower quality males with little to no mating success.

At the time Wiley and Lill published, mate selection was thought to be driven by factors entirely independent of the actions of others i.e. by the genetic quality indicators

possessed by males and by the evolved sexual selection criteria of females. Using expectations based upon sexual selection theories, they produced mathematically modelled predictions of how male mating success should be skewed across a given lek. Observing the actual behaviour of female birds revealed that the predicted pattern of mate selection deviated slightly from models. If male quality together with individually varying female selection criteria were the only factors driving female mate choice in leks then models suggested that males should be selected slightly more randomly than was actually observed. Both Wiley and Lill suggested that rather than selection being made on purely independent factors, female mate choice was made both independently, on evolved male quality assessment, and also non-independently i.e. influenced by the choices of other females. This hypothesis was used to explain the larger than predicted skew in male mating success. The argument states that because females are influenced in their mate choice by the behaviour of others, then any male who receives attention from females will be preferentially selected, regardless of individual differences in selection criteria. Thus, the less than random distribution of selection found in data is to be expected because the choice of other females reinforces the positive selection of successful males.

These initial results and hypotheses encountered a mixed reception. There were two main criticisms lodged against this hypothesis. First, early mate choice copying research relied upon observation of natural behaviour rather than experimental manipulation. Consequently, it was difficult to know whether the non-random distribution of female mate choice was because of mate choice copying, or simply the result of male-male competition and/or female selection criteria. The second was that lek size varied considerably between studies. This meant that the opportunity for females to observe the mate choice of others also varied between leks which made it difficult to truly assess the contribution of mate choice copying to female mate selection. This made early hypotheses unreliable (Höglund, Alatalo, & Lundberg, 1990).

In 1995 researchers observing the black grouse (*Tetrao tetrix*) combined experimental and observational techniques in one of the first experimental studies of mate choice copying

(Höglund, Alatalo, Gibson, & Lundberg, 1995). Höglund et al used dummy females in three conditions to manipulate the perception of female birds. First, taxidermic females placed on the ground in male territories gave males the chance to display to, and copulate with dummy females. Second, taxidermic females were placed on sticks to mimic observing females which allowed males to display, but not copulate with dummy females. Third, plastic ducks were placed in male territories to act as a control condition. Males did not display to dummy birds of other species, but displayed to both dummies of the same species. Males also copulated with the dummy females placed on the ground in their territory. Observing females spent more time assessing males where same species dummies were present compared to the control condition. Females also mated more frequently with males who were observed copulating with dummy females compared to either the non-copulatory condition or control condition.

This provided experimental evidence that mate choice, at least in lekking birds, was not entirely independent of the decisions of other females. Combined with two key findings—that the presence of females assessing males increases the amount of time other females spend assessing males (Rintamäki, Alatalo, Höglund, & Lundberg, 1995) and that Höglund et al. (1995) replicated the non-random male success skew in leks of varying size—this research answered the two main challenges to mate choice copying hypotheses of the time, and triggered further research.

An example of such research comes from the Japanese quail (*Coturnix coturnix japonica*). Rather than using dummy females Galef and White (1998) used real mate choices to generate the mate choice copying effect. Female quail were given a choice to spend time with one of two males. Experimenters classified the males as preferred and non-preferred depending upon the initial choice of the female. The female was then separated from the males and allowed to observe the non-preferred male. The non-preferred male was presented either with or without another female. The original observing female was then given another choice between the preferred or non-preferred male. Only when the non-preferred male was seen to mate with the female conspecific, did the observing female alter her initial choice of mate.

Additional species have demonstrated mate choice copying behaviours. For example, the greater snipe (*Gallinago media*) has been observed increasing their likelihood to mate with males when other females are observed on his territory (Fiske & Kålås, 1995).

Not all research supports the presence of mate choice copying in these bird species however. In a captive population of sage grouse no evidence of mate choice copying was found (Spurrier, Boyce, & Manly, 1994). These researchers placed 6 males in pens surrounding a central pen. The central pen contained an observing female. They placed conspecific females in the pens with males thereby creating an artificial lek. No effect of copying on female mate choice was recorded. However, given that all grouse in this experiment normally reside and interact with each other in the same captive area, it is likely that hens would not demonstrate choice copying behaviour on account of having prior knowledge of the males' quality. Little further information than that which they already possessed could be gained from mate choice copying.

A further criticism of mate choice copying came from the statistical modelling of real mate choices taken from female greater snipe in two distinct leks (Fiske, Kålås, & Sæther, 1996). Modelling suggested that the contribution of mate choice copying to a female's mating decision was a statistically non-significant influence when compared to independent mate selection criteria. The authors concluded that observations of mate choice copying may be explained by other behaviour, e.g. females grouping together in order to reduce harassment from other animals. This could lead to the observational appearance of mate choice copying, but is in fact merely an artefact of female social behaviour. They further suggest that mate choice copying is species dependent and restricted to lekking species, in which male mating success is highly skewed.

More recent research into a species of zebra finches (*Taeniopygia guttata*), a non-lekking species, shows that the quality of the information presented to observing females directly impacts the chance that mate choice copying occurs (Kniel, Schmitz, & Witte, 2015).

In this experiment Kniel et al. manipulated the amount of information observing females had to infer mate choice. They allowed observing females to see the full interaction between a male and female conspecific or they allowed them to hear only the vocal exchanges. Observing females only mate choice copied when they had a rich naturalistic display with which to infer actual mate choice. Further, in zebra finch species, mate choice copying has been shown to influence the preference for novel phenotypic features (Kniel, Dürler, et al., 2015). Kneil et al. tested this by presenting females with a choice between a normal male and a male which had an artificial red feather attached to its head. Under normal selective criteria, when females were given a simple choice between the adorned or unadorned male, females did not deviate from their normal preference. However, when other females are witnessed to select males with the red feather, they shifted their preference towards adorned males over unadorned males. These data demonstrate three points: first, it shows that mate choice copying occurs in species that do not lek. Second, it shows that mate choice copying occurs only when the stimuli are sufficiently rich; this could explain why artificial lek creation fails to produce mate choice copying. Third, as Kneil et al. point out, it shows that mate choice copying could help to drive a preference for novel traits where independent selection does not generate preference shifts. This brings into question the assumption of Fiske et al. (1996). Fiske compared observed mate selection behaviour in lekking greater snipe against simulated populations containing a varying proportion of females who use mate choice copying as a means of selecting mates. They suggest that as a proportion of the population, copying must account for less than 20% of female selection behaviour and is therefore of little importance.

Taken together there appears to be substantial evidence for mate choice copying in avian species. Not all research is clear, however, and mixed results require a cautious interpretation of data. If other, non-avian, species display mate choice copying behaviour then it would constitute independent evidence of the co-evolution of mate choice copying as a wider reproductive strategy rather than it merely being an artefact of lekking bird species.

2.2.2: Fish species

Amongst animal species displaying mate choice copying behaviour, fish are the most researched and account for a large amount of the mate choice copying data. Early research focused primarily upon Trinidadian guppies (*Poecilia reticulata*). Evidence for mate choice copying is substantial within this species. For example, female guppies change their preference for a mate when mate choice copying is allowed (Dugatkin & Godin, 1992). In this experiment females are given a choice between two males. In this initial choice she uses her independent selection criteria to select the highest quality mate. Once a male has been selected the female is removed from the tank and placed into a segregated “observation” tank. The experimenters then place a model female near the less desired of the two males. After a period of observation, she is placed back into the tank and allowed to re-select a mate. If females used only independent selection criteria then the observation of another female’s choice should have no effect on the re-selection of males, she should re-select the same male. However, a majority of females in the experiment reversed their initial mate choice after observing other females selecting the initially rejected male. In a similar experiment, using the same methodology, young female guppies were found to copy the choices of older female guppies. The reverse was not true; older females did not copy younger females (Dugatkin & Godin, 1993). Dugatkin et al., (1993) suggest this is because older females are more experienced at selecting quality mates thus have less need to verify the quality of males via the choices of other females. Conversely, young females, because they have less experience at selecting males, copied the choices of more experienced females because they benefit from the extra information provided by the choices of experienced females.

In a similar response to the early results of avian research, an early criticism of such fish based mate choice copying data was that separating the claimed mate choice copying behaviour from the influences of social shoaling behaviour was difficult. Godin, Herdman, and Dugatkin (2005) showed, however, that it is possible to separate this behaviour from the influences of shoaling. They replicated the methodology used by Dugatkin (1993) but made

some small modifications. In order to control for shoaling they offered a choice between a male and multiple females matched for length. If shoaling was causing the apparent copying behaviour, then females should be expected to spend more time with the larger group of individuals than they would with the male. They found no evidence to show that females preferred shoals to males. This allowed them to show that mate choice copying behaviour was not just a proxy for shoaling behaviour. Within this same experiment they also tested whether mate choice copying behaviour altered the long term preference for male traits or whether it was time-locked to a specific observed male-female interaction. Females were allowed to select a male they preferred (typically a brightly coloured male over a drab male). They were then separated from the males and allowed to view both the attractive and less attractive males interacting with other females. Where the observed female was seen to select the drab male, then females switched their choice away from attractive males to drab coloured males. This replicated the original finding. Further, females showed a long term preference shift for male traits after observing a female's mate choice, i.e. where originally they would have selected a brightly coloured male, after observing third party female preference for drab males they then continued to select new drab coloured males over brightly coloured males.

Interestingly, other species of guppy have failed to demonstrate mate choice copying. For example, in a further replication of Dugatkin's work, this time using shop bought wild type guppies, no evidence of mate choice copying was found (Lafleur, Lozano, & Sclafani, 1997). In guppies that do not originate from the Trinidadian river systems, female preference for males high in carotenoid pigmentation was found to be both genetically determined and not overruled by mate choice copying except in specific circumstances (Brooks, 1996). However, Brooks showed that whether wild type fish mate choice copy or not depends upon the magnitude of the present mate choice copying effect and the quality difference between males. Where males differed in carotenoid pigmentation by more than 40% females chose the male with the high pigmentation. This is true even when drabber males are seen paired with a female for a short period of time (5 minutes). However, when drab males are paired with a

single female for a longer period (10 minutes) or are paired with multiple females, then observing females are more likely to overrule this genetic predisposition to highly coloured males. Where males are more similarly coloured, mate choice copying is more likely to occur.

Trinidadian guppies are not the only species to demonstrate mate choice copying. Sailfin mollies (*Poecilia latipinna*) demonstrate similar behaviours. Females of the species show consistent mate choice copying behaviour, and show this behaviour immediately upon observing conspecific mate choices and also across longer periods of time following separation from the male (Witte & Massmann, 2003). Their ability to remember which males were selected by females is evidence of how salient mate choice copying information is for mate selection. Further, in this species males have been observed to copy the choices of other males. This includes reversing their original mate choice as seen with guppy species (Schlupp & Ryan, 1997).

Although mate choice copying has been observed on multiple occasions across these two species of fish, almost all research has been conducted in a laboratory setting. This was an issue because the two studies conducted on wild type fish until this point both showed negative results (Brooks, 1996; Lafleur et al., 1997). To address this issue Witte and Ryan (2002) conducted an experiment with a fully wild species of molly in their own river environment. They placed an upside down fish tank on the river bed to act as a platform so that jars containing fish were clearly visible to observing fish. Male fish were presented without a female or in close proximity to another female. They were also presented with two males in close proximity, this acted as a control for shoaling behaviour. This same setup was used for female fish. They found that both male and female wild type fish preferred partners that were viewed in close proximity to opposite sex partners over fish presented alone. They also found that this behaviour only occurred with the mate choice copying pairings and not the shoaling pairings. Evidence for mate choice copying behaviour is robust for fish species and recent experimental confirmation of the presence of mate choice copying in wild type species has solidified its position in the literature. Examples of documented wild type instances of

mate choice copying are: the whitebelly damselfish (*Amblyglyphidodon leucogaster*) (Goulet, 2006), ocellated wrasse (*Symphodus ocellatus*) (Alonzo, 2008), and the Trinidadian guppy (*Poecilia reticulata*) (Godin & Hair, 2009).

2.2.3: Other non-human animals

The fly species *Drosophila melanogaster* may also demonstrate mate choice copying (Mery et al., 2009). In experiments where females are given a choice between two males, a high quality, good condition male and a low quality, poor condition male, they would normally select the high quality male. However, females will reverse their normal mate selection criteria when they observe other females mating with poor quality males. Note, however, that in another species of fly (*Drosophila serrata*) no evidence of mate choice copying was found (Auld, Punzalan, Godin, & Rundle, 2009). Mate choice copying has also been observed in a species of wolf spider (*Sensu s ocreata* and *Sensu s rovenseri*) (Fowler-Finn, Sullivan-Beckers, Runck, & Hebets, 2015). In this experiment virgin female spiders copied the preference of older more experienced female wolf spiders. There are relatively few studies investigating the presence of mate choice copying in invertebrates. With such mixed results in so few studies it is not possible to confirm the presence of mate choice copying in invertebrate species. If, however, further research confirms the presence of mate choice copying then the implications are dramatic. That such behaviour is found in vertebrate and invertebrate species alike, suggests convergent evolution and thus that mate choice copying is evolutionarily beneficial. To the best of my knowledge, no literature exists to show whether non-human primate species also demonstrate mate choice copying. Before discussing human research, it is important to understand why mate choice copying is thought to occur.

2.3: Theoretical benefits of mate choice copying

There is a strong theoretical underpinning for inherited, independent selection some of which is covered in the introduction section. There has been an attempt to theoretically explain the presence of non-independent mate choice copying. Two primary theoretical explanations have been suggested to explain this. The first states that mate choice copying is

a cost avoidance strategy. The second states that mate choice copying evolved as it increases the accuracy of mate quality assessment.

2.3.1: Mate choice copying as cost avoidance

The ‘Cost-Avoidance Model’ suggests that females who copy the choice of others obtain a direct fitness benefit over females who rely solely upon independent assessment criteria. By copying the mate choice of others, copiers reduce the time and resource cost of mate quality evaluation, the risk of predation during intense mate quality assessments is reduced, and the risk of losing a mate to intra-sex competition is lessened, as decision making is faster (Andersson & Simmons, 2006; Dugatkin & Höglund, 1995; Pomiankowski, 1987; Reynolds & Gross, 1990). In his review of mate choice copying literature Vakirtzis (2011) reports the following equation used to quantify how copying could be beneficial in a given theoretical population. In the theoretical population there are two types of female: “choosers”, that is to say females who assess male quality independently of the influence of any other females, and “copiers” who use the choice of other females to infer quality. The fitness of the chooser can be expressed in the following equation:

$$E(x) = W + f - k$$

where E is the average fitness, (x) is the chooser, W is the mean heritable fitness of males, f is the extra fitness gained by assessing male quality, and k is the evaluation cost (Pruett-Jones, 1992). A copier (y) does not pay the evaluation cost paid by choosers and therefore their heritable fitness can be expressed as follows:

$$E(y) = W + f > E(x)$$

In this scenario, mate choice copying removes the evaluation cost suffered by choosers when selecting a mate. Therefore, mate choice copying should be expected to infiltrate a population and become a behaviour expressed by at least some of a given population. In this theoretical model a pure copier would only see fitness benefits if the population was mixed between copiers and choosers. If all females copy, then no fitness benefits are to be gained as all females

do not assess the quality of males and therefore are copying the choices of females who are not aware of the quality of the male they have selected.

Circumstantial evidence exists to support this theoretical position. For example, in most species demonstrating mate choice copying it is the females which display this behaviour. Females are theorised to be the more selective sex, because they are burdened with greater parental investment costs (Trivers, 1972). In this context, where mate choice copying is a cost-reduction strategy, it makes sense that females would be the sex likely to display mate choice copying. This in itself is not evidence for the theoretical model, because copying could just be a part of normal female behaviour and not related specifically to cost-reduction strategies. Some species show a reversal in parental investment, for example in the deep-snouted pipefish (*Syngnathus typhle*). In this species males and not females give parental care. It is males and not females who show mate choice copying behaviour (Widemo, 2006). In species where neither sex is the main care giver and both deliver parental care then both males and females show mate choice copying behaviour (Frommen, Rahn, Schroth, Waltschyk, & Bakker, 2009). This suggests that the behaviour is related to parental investment assessments and therefore, along with high choosiness, could be a way of reducing mating costs.

Direct experimental evidence for the cost-reduction model is hard to find. Two experiments have been conducted to test key assumptions of the cost-reduction model. First, it was hypothesised that mate choice copying may reduce the risk of predation during the assessment of male quality. When tested on a species of guppy, no evidence of this was found (Briggs, Godin, & Dugatkin, 1996). Second, it was hypothesised that mate choice copying was a way of reducing the time cost associated with mate selection so that resources could be spent on other activities like food gathering. It should be expected then that females who live with food shortages should copy the mate choice of others more frequently than those who have excess food so that they can spend extra time gathering resources. In an experiment comparing undernourished females with satiated females the exact opposite of this was found (Dugatkin

& Godin, 1998). These experiments cast doubt upon this model but these data are not without criticism.

Firstly, these results were found in a single population of a single species of lab grown guppies. Mate choice copying has been observed in a variety of both wild-type and lab-grown populations. It is difficult to know whether these specific effects – predatory response and hunger responses – are population specific or generalizable to the species without replication. Second, the experimental manipulation used by both experiments has a flaw. The species used were domesticated varieties and therefore do not normally encounter predators or starvation. Therefore, the application of the experimental manipulation, given its short term nature, may not have been sufficient to generate mate choice copying (Vakirtzis, 2011). Vakirtzis explains that the presence of hunger or predation in wild populations is stable across development. Thus the emergence of mate choice copying as a cost reduction strategy would be expected to form across time. Negative results may occur because the experimental manipulation didn't exist for long enough during the lifespan of captive guppies for mate choice copying to form. Vakirtzis states, however, that the biggest issue with this theoretical model is that it fails to produce definitive positive results or easily testable hypotheses.

2.3.2: Mate choice copying as an accuracy check

The other main theoretical model states that mate choice copying increases the accuracy of male quality assessment. Despite the effort put into mate quality assessment, females can often make errors in judgement (Ryan, Akre, & Kirkpatrick, 2007). These mistaken choices can have negative effects on fitness. Any means of reducing uncertainty during selection should be utilised by females to inform mate selection. In the context of this model mate choice copying is a form of 'Inadvertent Social Information' (ISI) that females gather from the environment (Danchin, Giraldeau, Valone, & Wagner, 2004). Animals provide information, unintentionally, every time they act upon an object or situation in the environment. Observing animals can use this information to inform their own decision. For example, if a scavenging animal finds food but chooses not to eat that food then other animals can assume

that the food is not worthy of consumption and so avoid it. The animal doing the initial food search has no intention of signalling to other animals that the food it found is unworthy. Equally, an observing animal does not wait to receive this information first before assessing the quality of a food item. An observing animal merely acts upon the information provided by the rejection of food stuff as an additional source of information when deciding whether to eat or not. In a similar way, mate choice copying might not be a specific alternative to independently assessing mates but an additional and inadvertent source of social information, that can be used by a female to infer the quality of a male.

This theoretical model makes predictions about mate choice copying which has evidentiary support. If mate choice copying is not a specific behaviour in and of itself, but is instead an adaptation to use available ISI, then you would not expect to find individual ‘copiers’ in a given population. Instead, you would expect to find that mate choice copying is used by any female in a context specific way. Mate choice copying should be applied when it is difficult to judge male quality, for example when two males are closely matched in quality. Conversely, when males differ dramatically in quality then mate choice copying is unlikely to occur. Internal female states should also influence mate choice copying. Young inexperienced females who have little experience selecting good quality mates should be expected to demonstrate mate choice copying. Experimental evidence shows this to be the case for both these points. It is well established that in guppy populations females mate choice copy only when males vary in quality by a small amount. Where male guppies vary in carotenoid pigmentation by between 12% and 24% then females will copy the choice of another female, even if the male is inferior. Where there is no confusion about male quality, i.e. when males differ by more than 40% in pigmentation, then females default to their independent quality assessment (Dugatkin, 1996b; Witte & Noltemeier, 2002). Mate choice copying behaviour also differs depending upon the age of the female doing the copying. Young guppies copy but older females do not (Dugatkin & Godin, 1993). The extra experience possessed by older females means that they have a clear idea of a high quality mate and so deviation from this

ideal makes it easier to discriminate between males of varying quality. The younger females, however, lack a clear idea of a good quality mate and thus find it harder to differentiate between males of closely related quality. Both data sets show that females use mate choice copying where quality assessment is difficult and information is lacking. This is predicted by a model that suggests mate choice copying is a quality assurance tool rather than a cost reduction tool.

From this view point, there would never be a ‘copier’ as described by the cost-reduction model. Instead, all females are ‘choosers’ and operate independent selection criteria. Mate choice copying would only be employed when discrimination between males is difficult using purely independent selection criteria. For socially complex species such as ourselves, mate selection involves the assessment of visible gene quality traits together with traits that are not plainly visible such as personality, wealth, and parental ability. This lack of trait visibility combined with a prolonged care giving period makes mate selection and quality differentiation difficult. Because of this one would predict that mate choice copying would be present in humans (Dugatkin, 2000).

2.4: Human research

Uller and Johansson (2003) conducted the earliest experimental research into human mate choice copying. They termed it the “wedding ring effect”. The principle was that wedding rings represent a visible symbol of selection. It is difficult to know immediately whether a man has been selected as a partner or not by another woman. The wedding ring, though subtle, is a way for a woman to know whether a man has been selected without having to actively observe mate selection. Uller and Johansson had women interact with men in short interview style meetings. Half the time men were wearing a wedding ring and half the time the same men wore no ring. They had each female participant rate the men on various questions pertaining to how likely she would be to engage in various types of relationships with him. They found no differences between the men wearing wedding rings and men not wearing wedding rings.

There are three plausible reasons, detailed below, why this initial experiment failed to find positive results.

Definitions of mate choice copying state that, in animals, it is the observation of active female mate choice that induces the mate choice copying effect and not the by-products of said mate choice (Vakirtzis, 2011). To illustrate this point, an example: in stickleback fish, female fish prefer to mate with males who have nests that already contain the eggs of other females. This was thought to be mate choice copying but subsequent analysis suggests that a more likely explanation is that the presence of other eggs in the nest increases the survival odds of a female's own eggs (Goldschmidt, Bakker, & Feuth-de Bruijn, 1993; Jamieson, 1995). In the wedding ring example, women are not observing actual mate choice but the by-product of mate choice i.e. the wedding ring. Thus, given that in the animal literature it is the act rather than the by-product of mate selection that drives mate choice copying, it is possible that the wedding ring would not induce mate choice copying effects at all. Further, later research confirmed that the salience of the stimuli matters. Jones, DeBruine, Little, Burriss, and Feinberg (2007) demonstrated that men who are seen to elicit positive expressions from women are rated as significantly more attractive than men who illicit relatively negative expressions. Women who are perceived to have a positive character also producing a greater mate choice copying effect than women who are perceived as less positive (Chu, 2012). Given that a) the wedding ring gives little information about the woman who has selected the target man as a mate, b) is the by-product of mate selection rather than mate selection itself, and c) conveys little direct positive emotion, it should not be expected to alter mating decisions. Further, marriage is a highly committed relationship status. It is possible that observing women perceived married men as less attainable partners and as such did not display any mate choice copying behaviour.

The wedding ring effect used a proxy measure of mate choice but later research, the main bulk of human based research, used more direct manipulation to test mate choice copying. Eva and Wood (2006) presented women with images of 10 men together with one of two

vignette character descriptions. These descriptions differed only in their relationship status. Men were described as single or married. Women rated the men described as married as more attractive, more interesting, and friendlier than men described as single. Further research refined this methodology by creating artificial couples out of facial photographs. Waynforth (2007) used facial photographs to create more realistic mate choice copying stimuli. In the animal literature it is the act of watching male-female interactions that trigger mate choice copying. Ethical restrictions mean that it is difficult to observe or manipulate this behaviour in such a direct way for humans. Stimuli must therefore, to some degree, remain proxy cues to mate choice. Though not perfect, the experimental stimuli used in Waynforth (2007) became the standard throughout the mate choice copying literature. Waynforth presented female participants with images of men alone, or men's facial images paired together with a woman's image. Participants rated the attractiveness of both the men and women in the stimuli. Data were regressed with attractiveness as the predicted value and age, sexual strategy and attractiveness of the female conspecific as predictors. Men pictured with attractive women were rated as more attractive than men pictured alone or with less attractive women. Age and sexual strategy were not significant predictors of mate choice copying behaviour in women. Interestingly, unlike with animal research, this raises that possibility the women mate choice copy only from women who are high quality.

Mate choice copying has also been found to interact with masculinity/femininity preference and long or short term relationship preference (Little, Burriss, Jones, DeBruine, & Caldwell, 2008). Women were presented with images of men accompanied by images of women. The pictures of women had been masculinized and feminized to produce two distinct image sets. Participants provided a rating of attractiveness for the men in the context of long and short term relationships. Little et al. found that mate choice copying occurred only when a man was considered for a long term relationship and that mate choice copying was more pronounced when the man's partner was feminine as opposed to masculine. This result shows two things. First, though it is not a clear cut relationship, femininity is thought to be related to

attractiveness (Welling et al., 2008), and so this indirectly supports the idea that women mate choice copy preferentially from those who are attractive. Second, women place differing degrees of importance on parental investment traits depending upon whether they are selecting for short or long term partners (see e.g. Regan, Levin, Sprecher, Christopher, & Gate, 2000). Parental care is more important to long term than short term relationships, but this is hard to assess from external appearance. In contrast, cues to genetic quality, prioritised in short term relationships, are easier to detect from visual cues alone. That women show mate choice copying for long term relationships, but not short term relationships, suggest that mate choice copying occurs where qualities are less immediately visible. This fits with theoretical models suggesting that mate choice copying is used as quality assurance tool, because women only mate choice copy where hard to assess information is needed to make a mate choice.

As with the animal literature, the vast majority of mate choice copying research is laboratory based. Consequently, it faces a common criticism, i.e. that results may just be a laboratory artefact. Place, Todd, Penke, and Asendorpf (2010) conducted the first “real world” observation of mate choice copying in men and women. They showed participants short video clips taken from real world speed dating events. Participants were not told whether there was romantic interest present or not in the clips they viewed, but had to infer the interest as would be expected in a real world situation and as is done in animal experimentation. Participants rated the clips on how likely they would be to engage in a long or short term relationship with the target men. Both men and women mate choice copied, but they did so in different ways. Men were influenced by positive selection: i.e. they were more likely to copy when they saw other men behaving positively towards a woman. Women were influenced more by negative selection: that is, women were more likely to reject men that they thought other women had rejected. The authors also note that mate choice copying is likely to occur if the same sex peer is perceived as more attractive than the participant. In this study, there was no difference in ratings for long or short term relationships unlike with previous research (Little et al., 2008). That mate choice copying is replicable using real world data, suggests that this is not an artefact

of laboratory experimental manipulation. This research highlights the importance of the attractiveness of the conspecific in human mate choice copying.

Much recent research suggests that the attractiveness of the female conspecific, the individual being copied, has an important role to play in mate choice copying. However, the inflation of desirability ratings given to men may exist simply because presenting men with images of women who are more attractive than themselves either generates a halo effect or produces experimental demand effects. It is not unreasonable to assume that this effect explains data on mate choice copying. Vakirtzis and Roberts (2010) clarified this. They used a modified version of the standard mate choice copying procedure. Rather than just pairing images of men and women together they grounded the image of the conspecific amongst other stimuli so that the purpose of the experiment wasn't clear. They showed an image of a man or woman together, with personal information provided about them and their past relationships by a supposed ex-partner. The information provided about the target did not vary, but the attractiveness of the pictured ex-partner did vary. The aim of this was to conceal the manipulation from the participant. This was done so that any obvious demand or halo effects resulting from simply displaying images of men accompanied by women are less likely to affect data, because the manipulation is concealed amongst a rich diversity of information rather than being the main focus of raters as it is in standard experimentation. Therefore, any changes to rated willingness to date are less likely to be demand or halo effects. They found that men were not influenced by the attractiveness of ex-partners, but that women were. Women were influenced differently depending upon the attractiveness of the ex. Where the ex was attractive, this significantly increased willingness to date, but where the ex was unattractive this significantly decreased the willingness to date. Vakirtzis et al. termed this effect quality biased mate choice copying because it is specifically the high quality women being copied rather than copying the choice of any woman generally.

Animal research, discussed earlier, suggests that females copying the mate choice of others can create a preference for novel male ornamental traits, which would otherwise have

not been selected for if not for mate choice copying (Godin et al., 2005; Kniel, Dürler, et al., 2015; Mery et al., 2009). So too it appears mate choice copying can influence women's preference for men's ornamental traits (Bowers, Place, Todd, Penke, & Asendorpf, 2012). In this experiment, participants were presented with images of men together with a woman who was either showing interest or not showing interest in the man. Participants were shown a further set of images in three conditions: a control male who shared no similar features with the original target man, an experimental male who was modified to share facial features, or an experimental male who was modified to share style traits such as clothing. They found that men who had interest shown towards them generated an increased preference for shared style traits e.g. similar clothing but not similar facial features. Bowers et al. hypothesised that this is because phenotypic features are visible and easily assessed using independent selection criteria and so would not trigger a copying response. Style and cultural traits are variable, indicative of similarities in tastes or status and thus convey information about hidden desirable qualities. Accordingly, they are more subject to choice copying than visible physical traits are. Further research has tested this hypothesis. Women do indeed use mate choice copying to infer qualities about men that are not easily observed. Women rate men with women as more intelligent, trustworthy, humorous, wealthy, romantic, goal driven, adventurous, generous, and attentive to the needs of others, when compared against men who were presented without women (Rodeheffer, Leyva, & Hill, 2016). A point of further relevance is that sexually inexperienced women use men's past relationship length to infer mate quality, when judging them as potential partners (Amano & Wakao, 2016). Given that the above stated are important factors when considering a man for a relationship, it appears probable that women are indeed using mate choice copying as a method to increase the accuracy of quality judgements.

2.5: Areas of interest

Human mate choice copying literature has come a long way. I suspect that only high quality females induce the choice copying effect, that the positive valence directed towards men increases his attractiveness, that women use mate choice copying to infer hidden quality

about men and that, at least to some extent, mate choice copying produces a generalizable preference for some copied traits. Much of the extant literature has focused upon confirming that mate choice copying occurs in humans. To this aim, it appears there is substantial evidence that women do mate choice copy. There are some important outstanding questions which remain to be answered. Below I will discuss the questions this thesis seeks to answer. For detailed reviews and hypotheses please see the relevant experimental chapters.

2.5.1: Cyclical hormonal shifts

Hormonal fluctuations across the ovulation cycle have been shown to substantially influence female mate choice (Gildersleeve, Haselton, & Fales, 2014a). Whether cyclical shifts alter mate choice copying behaviour is currently unknown. There are scant data to show that hormonal shifts may alter this behaviour. Oxytocin (Kavaliers et al., 2006) and oestrogen have both been linked to variation in mate choice copying behaviour in non-human species (Choleris, Clipperton-Allen, Phan, & Kavaliers, 2009; Choleris, Clipperton-Allen, Phan, Valsecchi, & Kavaliers, 2012; Kavaliers et al., 2006). It has been hypothesised that hormones may influence human mate choice copying (Choleris et al., 2009; Rosenthal, 2016). To date, no study has investigated human mate choice copying in relation to shifting hormones across the ovulatory cycle.

2.5.2: Age

Numerous, primarily animal, studies have investigated the effects of age upon mate choice copying behaviour. In animals the effect is clear cut. Young animals copy the choices of older animals. In humans the few results have been mixed. One of the reasons this could be the case is that sample age ranges normally extend from undergraduate students. It is possible that these age ranges fall outside the period in which women would be considered naive to mate selection. i.e. the women are too old for a reliable age effect to be produced. It is hypothesised that if women aged less than 16, an age at which women are far less experienced at judging the quality of a men, were compared to either undergraduate or older aged participants then a clear mate choice copying effect would be observed.

2.5.3: Faithfulness

Previous research shows that women infer unobserved personality characteristics about men who have been paired with women. These prescribed characteristics are useful for identifying males who possess good parental and resource provisioning abilities. Of particular interest is the finding that men are deemed more trustworthy when in relationships. This is important because men who commit infidelity can negatively affect how much time and resources they divert into a relationship. It is possible that, like with other personality characteristics, men in a relationship are perceived to be at a lower risk of committing infidelity and thus less likely to divert resources to others. It should be expected that men in relationships will be perceived as potentially more faithful partners than the same men if they are perceived as single.

2.5.4: Attainability

Given that men are perceived to be more attractive, desired for long and short term relationships and are thought to possess positive characteristics when paired with women, men in relationships should be the preferred target partner. Preferring to select a man in a relationship introduces directed intersexual competition into the equation, however. This should make men in relationships more difficult attain as a partner. However, women are highly selective over potential partners and high quality men are highly sort after. This makes high quality males appear rare and it may be that direct intra-sexual competition has little impact over whether a woman attempts to acquire a taken male as a mate or not. Whether a woman thinks she can acquire a given man as a partners has a direct impact on the likelihood a woman would actually attempt to acquire a man as mate. It is of interest to know whether mate choice copying alters perceived partner attainability in the same way that it affects the perception of many other characteristics.

2.5.5: Personality

Mate choice copying behaviour is intuitively linked with mate poaching behaviour. That is to say that the preference for chosen mates (mate choice copying) should be related to

the attempt to take chosen mates (mate poaching behaviour). Research into mate poaching has shown that variations in personality determine how likely individuals are to partake in mate poaching (Jonason, Li, & Buss, 2010; Schmitt, 2005). If the preference for chosen mates is similar to the preference for taking chosen mates, then it may be the case that individual differences alter mate choice copying behaviour as it does with mate poaching.

In the next chapter the general method of this thesis will be laid out. It will detail how and why experimental stimuli were used. The experimental chapters following this will address the above discussed points of interest.

Chapter Three: General Methodology

3.0: Chapter overview

A number of different methodologies have been used to research human mate choice copying. These differing methodologies serve one of two main purposes. Either they allow for the production of somewhat ecologically valid stimuli which are reminiscent of a natural and believable mate selection scenario (e.g. as with speed dating) or they allow for a highly controlled manipulation of perceived relationship status at the expense of credibility (e.g. as with the presentation of vignettes or manipulated images). In this chapter I will outline these commonly used methodologies, and examine their strengths and weaknesses before detailing and justifying the creation of the stimuli used throughout this thesis.

3.1: Previously used methodology

3.1.1: Methods to increase ecological validity

The first methodological strategy commonly used aims to assess mate choice copying in as ecologically valid a way as possible. This method has participants either observe real mate choice interactions or interact directly with targets in order to make judgements. Examples of this type of experiment can be found in Place et al. (2010). These researchers used recorded video clips of real speed dating events. The recordings showed men and women interacting in a natural way. Half of the recordings were selected to show women expressing romantic interest in their date and half showed the recorded women expressing disinterest in their date. As a manipulation check, participants rated the perceived interest expressed by the same sex target before rating the likelihood that they would engage in a short or long term relationship with the opposite sex target. This meant that participants saw real successful or unsuccessful dates and thus judged real mate selection. Another example of an ecologically valid method comes from the study of “the wedding ring effect” (Uller & Johansson, 2003). In this study women interacted with male stooges either wearing a wedding ring or not wearing a ring then rated those men on attractiveness.

The principle behind both of these methodologies is that participants are able to observe or engage in interactions reflective of how they would appear in the real world. Thus results should be more realistically generalizable to populations rather than being laboratory specific. However, such studies also contain large confounding factors that are difficult to control for. As a brief illustration of this point, each of the following can affect rated attractiveness: body language (Clare, Wiggins, & Itkin, 1975), voice pitch and tone (Jones, Feinberg, DeBruine, Little, & Vukovic, 2010), body odour and the confidence of men (Roberts et al., 2009). Alone they can affect judgement but such factors also likely interact with one another across dynamic situations in order to alter attractiveness. This presents a potential issue for a number of reasons. First, in observing video clips of successful or unsuccessful speed dates, how would one differentiate between changes in attractiveness ratings given because of a woman's acceptance or rejection of a man (i.e. because of mate choice copying) and changes in a man's confidence and body language, for example, as a date either goes well or goes badly? Second, in allowing participants to interact with male stooges who are either wearing or not wearing a wedding ring, how does one stop knowledge of the experimental procedure subtly altering voice tonality or body language of the male stooge during interactions? Whilst the believability of the manipulation and its natural presentation are strong plus point for such methods, lack of control over a large variety of potentially interacting confounds means that a clear interpretation of data can often be difficult to reach. Consequently, this thesis does not use this method. For further details see section 3.1.3.

3.1.2: Methods to increase manipulation accuracy

Another commonly used methodology relies less on trying to enhance ecological validity and more upon controlling for the effects of confounding factors so that mate choice copying can be cleanly studied. Such methodologies often present facial images of men either with or without images of women (as a means of manipulating whether they appear to be in a relationship or not), or they simply use a small vignette text description that overtly describes the relationship status of men. These methods allow for the clean manipulation and control of

perceived relationship status. Examples of these methodologies can be found in Waynforth (2007), where men's facial photographs were paired with images of women who varied in attractiveness. Other research has paired men's facial images with text descriptions of their relationship status (Eva & Wood, 2006). These researchers presented participants with an image of a man's face together with a short personality description. Within the personality description was a statement about his marital status. The only variation between stimuli was the relationship status of the pictured men. The usage of still images and text descriptions, whilst being less ecologically valid, allows for the clean manipulation of perceived relationship status and a highly controlled stimuli set but this method is not without issues.

A possible issue with using photographs as stimuli is that the manipulation of relationship status, placing a photograph of a man next to the photograph of a woman, can be suspect. It is possible that these stimuli can either produce demand effects or raise suspicion of potential manipulation in participants. Therefore, in this thesis I used image editing software to merge separate images of men and women into a single photo with the purpose of making it look like the image of a real couple. This was done to create the impression that couples attended the lab together and were photographed together in order to reduce the potential that participants suspected the images of being false or manipulated.

The use of photographs in attraction research has long been in practice, and consequently we have learned much about factors which affect ratings of photographs. It has been argued previously that facial expression (Schmidt, Levenstein, & Ambadar, 2012), clothing style and colour (Cunningham, Barbee, & Pike, 1990), and variation in background colour (Rosenberg, Kahn, & Tran, 1991) can alter the perceived attractiveness of others. Please see Peperkoorn, Roberts, and Pollet (2016) and Roberts, Owen, and Havlicek (2010) for a critique of the effect of colour upon attractiveness.

3.1.3: Stimuli adopted by this thesis

In order to reduce the impact of these potential confounds, it was decided to produce a high quality and controlled set of images with which to conduct experiments. To reduce

facial expression variation, participants would remain neutral in their expression. Though it is unclear whether colour actually impacts upon ratings, it was decided to err on the side of caution and have participants wear a plain black over gown in order to cover any clothing and thereby reduce colour variation between images.

A further point on standardising stimuli: it can rightly be argued that having variation in stimuli allows for more generalizable results. Thus a potential criticism for producing such controlled stimuli is that any results found become difficult to generalise to a wider population. However, because changes in rated attractiveness as a result of mate choice copying are small (see literature cited in the previous chapter) then potential confounds can dramatically alter the likelihood of detecting effects. In order to isolate mate choice copying effects from potential confounds found it was decided that greater control was a price worth paying for reduced generalizability. For the above reasons, photographic stimuli were used to manipulate mate choice copying. Steps were taken to try to improve the credibility of such stimuli, however. Below I will detail the process for the acquisition of photographic stimuli and the production of experimental stimuli used through this thesis.

3.2: Photo acquisition

3.2.1: Participants

Sixty undergraduate participants (30 males and 30 females – demographics for participants were collected but due to data loss are not available) were recruited. Participants were of standard undergraduate age and thus probably between the age of 18-25. All participants were white British, were recruited opportunistically from the student population of a university in the North East of England. All participants were heterosexual and were fully informed of the purpose of their participation.

3.2.2: Materials

A Nikon D300 DSLR camera was used in conjunction with a 17-55 mm lens to acquire photographs of participants. An adjustable tripod was used to ensure that the camera could be placed with the lens perpendicular to the floor and at face height. This ensured photographs of

the participant were free from artefacts caused by camera angle. A wireless button press system was used to prevent camera shake whilst handling the camera. This ensured a clear image. A light grey background was used along with soft lighting so that a uniform and evenly lit photograph was produced. Finally, participants removed any bulky clothing and wore a black hairdresser's gown to both prevent distortion of their shoulders and hide clothing.

3.2.3: Procedure

The following procedure received ethical approval from the Department of Psychology Ethics Committee. Participants were fully informed of the purpose of the research and fully consented to participation. Participants were informed that their photograph would be used in future research projects and would be rated on numerous personal characteristics by other people. Participants were instructed to remove any bulky clothing such as coats or hooded jackets in order to prevent such clothing from distorting body shape. Participants were instructed to stand 45 cm in front of a flat grey background. The grey background was produced by layering a white sheet over black material in order to produce a light grey background. The sheet was tightly secured to a board to ensure it was free from wrinkles. The camera/tripod setup was placed 1 metre from the participant. The height of the tripod was adjusted so that the camera was level with the participant's eyes and perpendicular to the ground. Lighting was placed behind the camera and adjusted for each participant so that their face was evenly illuminated and free from shadows. Windows in the room were covered so that natural light was blocked. This ensured even illumination.

Participants were instructed to look straight into the camera whilst a test photo was taken to check for any focusing and lighting issues before the photograph was taken. A number of photographs were taken; these included instructions for the participant to smile, hold a natural unforced expression, and to hold a neutral emotionless expression. These images were collected with participants looking straight to the camera and in profile with the participant looking to their right hand side. Participants were also requested to remove makeup and to wear a light grey hair band to pull hair away from the face. The latter two requests were

voluntary and occurred after the main set of images were taken. When participants were photographed in profile a soft light was placed to the side of their face. This was done to prevent shadows forming and to provide even illumination. Following capture of the photographs, images were cropped so that only the head, upper shoulders and a small amount of the background was visible. This was done for each of the photographs to ensure that images were uniform in size. An additional photograph including just the grey background with no participant present was also acquired for use later in stimuli production (see 3.5.3 Production for details on the usage of this photograph). Note that for the purposes of this thesis the only photographs used were the neutral facial expressions in which participants looked straight into the camera and were not wearing a headband.

3.3: Photographic rating

3.3.1: Participants

Fifteen women were recruited opportunistically from the student population of a university in the north east of England. Participants were aged between 19 and 31 with a mean of 22.6 (SD = 3.40) years. All participants were heterosexual, white British and healthy. Participants were recruited on a voluntary basis.

3.3.2: Materials

Participants were presented with information sheets detailing the purpose of the experiment and consent forms. A short demographic questionnaire was used to record age, sex and sexual orientation. Media lab was used to present 60 images (30 men and 30 women) along with a 1 to 9 (1 = not at all, 9 = absolutely so) Likert rating scale to participants. This was used to test attractiveness.

3.3.3: Procedure

The following procedure received ethical approval from the Department of Psychology Ethics Committee. Participants were fully informed of the purpose of the experiment and consented to participation. Questionnaire presentation was counterbalanced so that half the participants received the demographic questionnaires first and half the participants

received the photograph rating task first. The order in which participants received this counterbalancing was randomised. The 60 photographs (30 men and 30 women) were presented via media lab. The images were centred on the screen and placed on a plain black background. Above the image was text instruction which read “please rate this individual on how attractive you think they are”. Participants provided attractiveness ratings on a 1 (not at all) to 9 (absolutely so) Likert scale placed below the image. Likert options were labelled both in numbers and text description for ease of understanding. The order of photographic presentation was also randomised between participants so that no participant saw the same photo presentation order. This was done so that order effects would not alter the ratings of images.

3.4: Results of photographic ratings

Once ratings were obtained for the photographs they were rank ordered and split by sex into a total of six groups. Each sex was split into a high, medium and low rated attractiveness group. The middle 10, or medium rated photographs for each sex were discarded. This left behind an attractive group of 10 male and 10 female photographs and an unattractive group of 10 male and 10 female photographs. These were then used in all of the studies described in this thesis.

Male photographs: The mean attractiveness rating of the 10 unattractive men was 2.16 (SE = 0.32). For attractive men the mean attractiveness rating was 4.14 (SE = 0.19). ANOVA confirmed that the attractive group was rated significantly more attractive than the unattractive group [$F(1,18) = 282.22, p < .001$].

Female Photographs: The mean attractiveness rating of the 10 unattractive women was 2.71 (SE 0.40). For attractive women the mean rating was 4.66 (SE = 0.37). ANOVA confirmed that the attractive group was rated significantly more attractive than the unattractive group [$F(1,18) = 127.47, p < .001$].

Further analysis showed that females were rated significantly more attractive than males overall [$F(1,36) = 26.62, p < .001$]. In the attractive groups, females were rated more attractive than males [$F(1,18) = 11.49, p = 0.003$], and in the unattractive group, females were also rated more attractive than males [$F(1,18) = 16.29, p = .001$].

3.5: Production of experimental stimuli

3.5.1: Materials

Photoshop CS6 extended edition was used to create photographs of couples from the above pre-rated photographs. A Wacom graphics tablet was used for ease of image manipulation in Photoshop but this is not necessary for replication purposes.

3.5.2: Procedure

Photographs of men were to be presented to participants in one of three conditions: single; with a congruently rated woman; or with an incongruently rated woman. To clarify: by single it is meant that men were presented alone and accompanied by a statement stating that they were romantically single. By congruent pairing, it is meant that attractive rated men were paired with attractive rated women and unattractive rated men were paired with unattractive rated women. By incongruent pairing, it is meant that attractive rated men were paired with unattractive rated women and unattractive rated men were paired with attractive rated women. Men in the paired conditions were accompanied with a text described stating they were in a romantic relationship with the accompanying woman. Creation of the paired images is detailed below.

3.5.3: Production of couples

In order to produce convincing images of couples, Photoshop CS6 was used to combine images of men and women to create a single image. The following procedure details the production of couple photographs. Each instructional point provided below is accompanied by a screen shot of the process for ease of replication. For the purposes of privacy, a stand in image has been used in place of real participant faces.

First, the empty background photograph that was taken during photograph acquisition was imported into Photoshop and rotated to landscape format. This was done by selecting image menu → image rotation → rotate image.

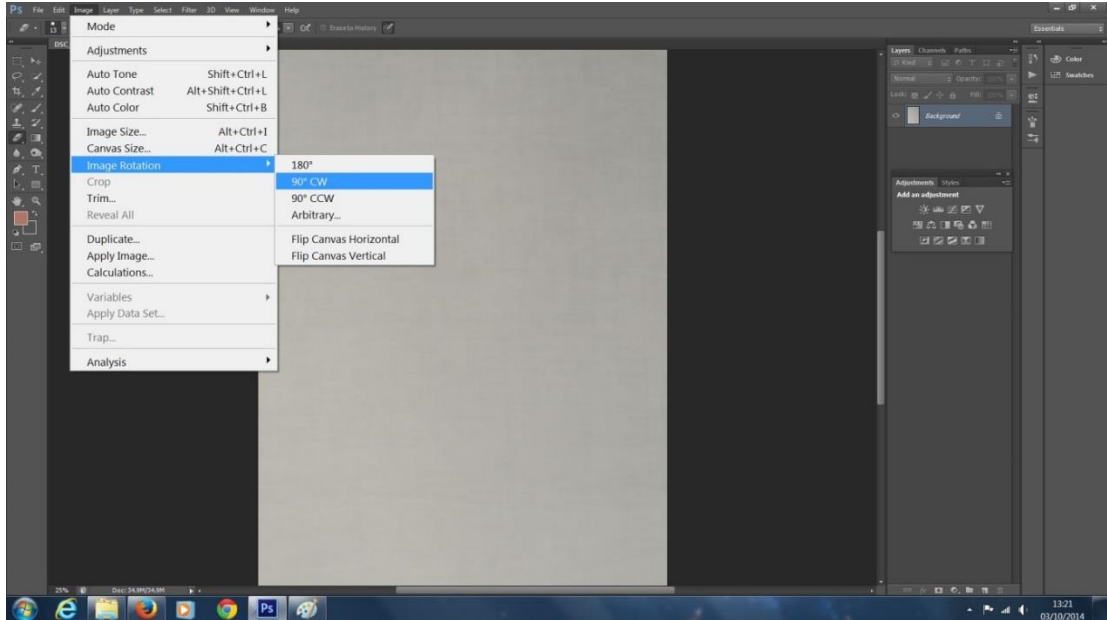


Figure 3.1: Step 1 in the couple generation process.

This blank grey screen formed the new background to the image. Next, an image of a man was entered as a new layer over the background. This was done by simply dragging an image into the Photoshop window and dropping it. Photoshop automatically creates a new layer for the image. Pasting photographs into Photoshop creates hard edges and artefacts which make for an unconvincing image (this can be seen in figure 2). To ensure that the image looked convincing the image had to be modified. The quick selection tool was used to highlight only the man's face. This was done selecting the tool from the left hand menu bar and painting the man with it until a dotted border covers the full face as seen below.

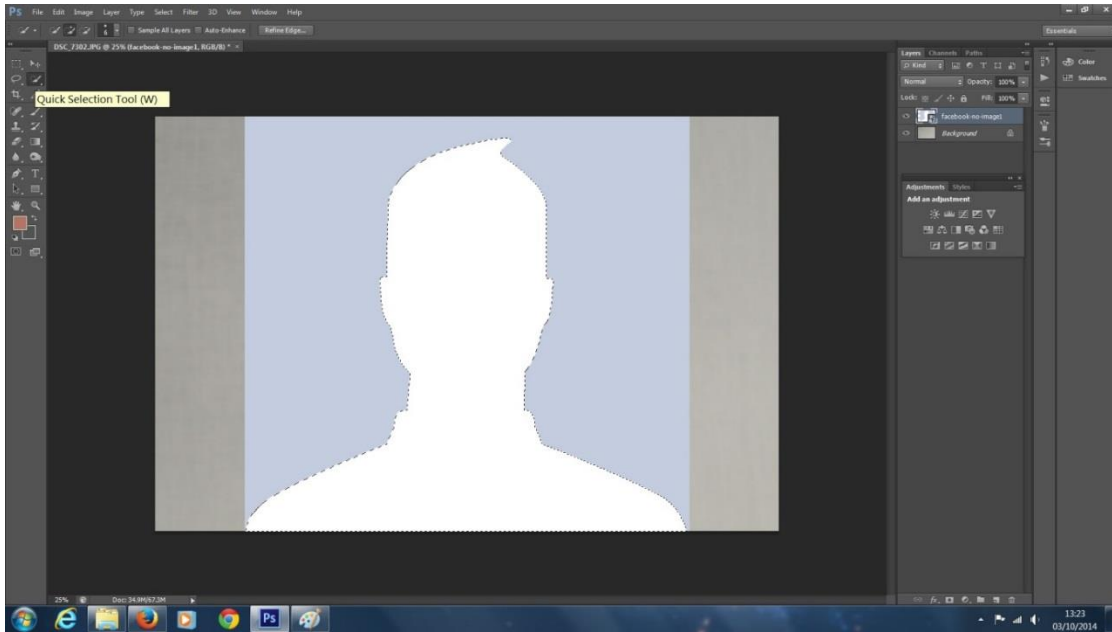


Figure 3.2: Step 2 in the couple generation process.

Next the refine edge tool was used to select the fine details on the face missed by the quick selection tool. If this is not done, then the end product looks pixelated and unconvincing. This was carried out from the “select” menu with the “refine edge” option.

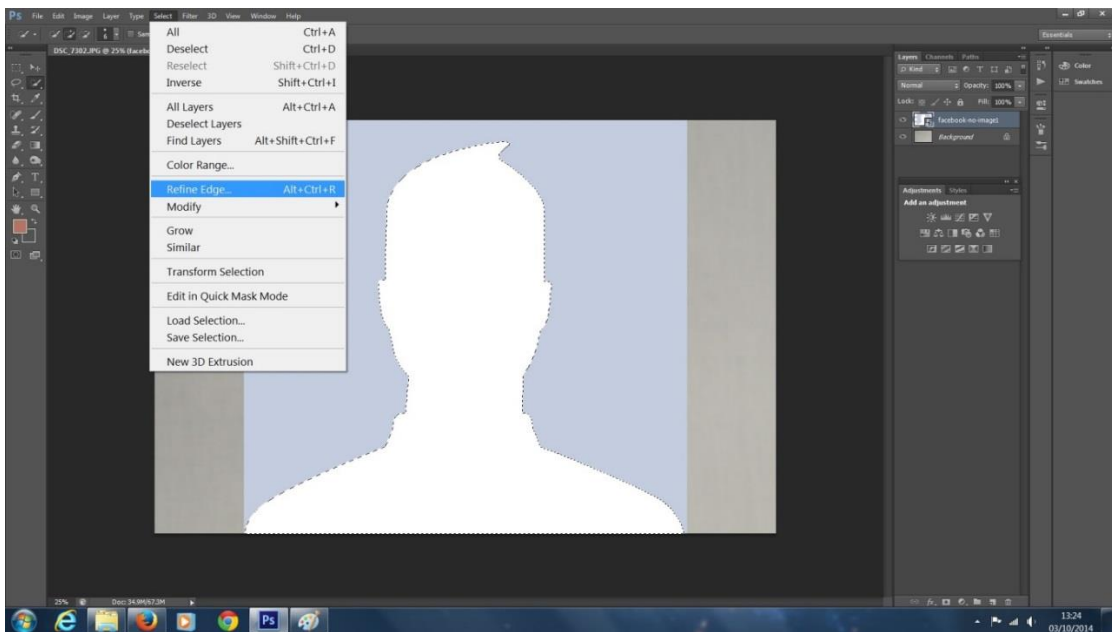


Figure 3.3: Step 3 in the couple generation process.

The edges of the participants' faces must be painted with the refine edge tool to ensure that the full face, including individual hairs and finer details, are fully selected. The “ok” option finalised the selection.

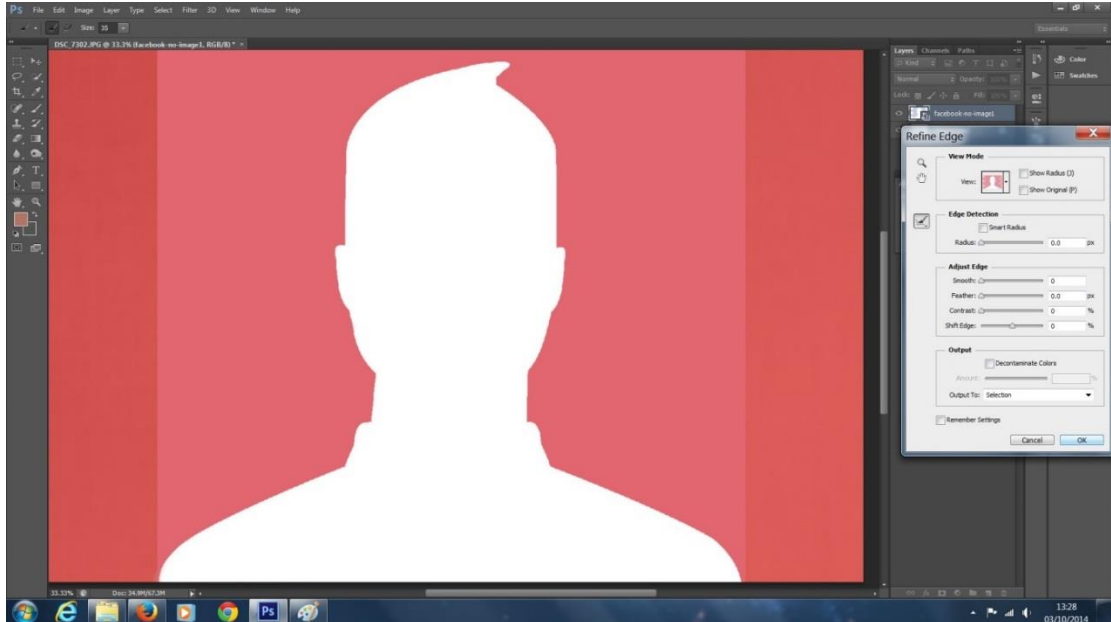


Figure 3.4: Step 4 in the couple generation process.

Next the “edit” menu was selected, followed by “copy” and the male face was pasted into a new layer by selecting the “layer” menu, then “new” and “layer via copy”.

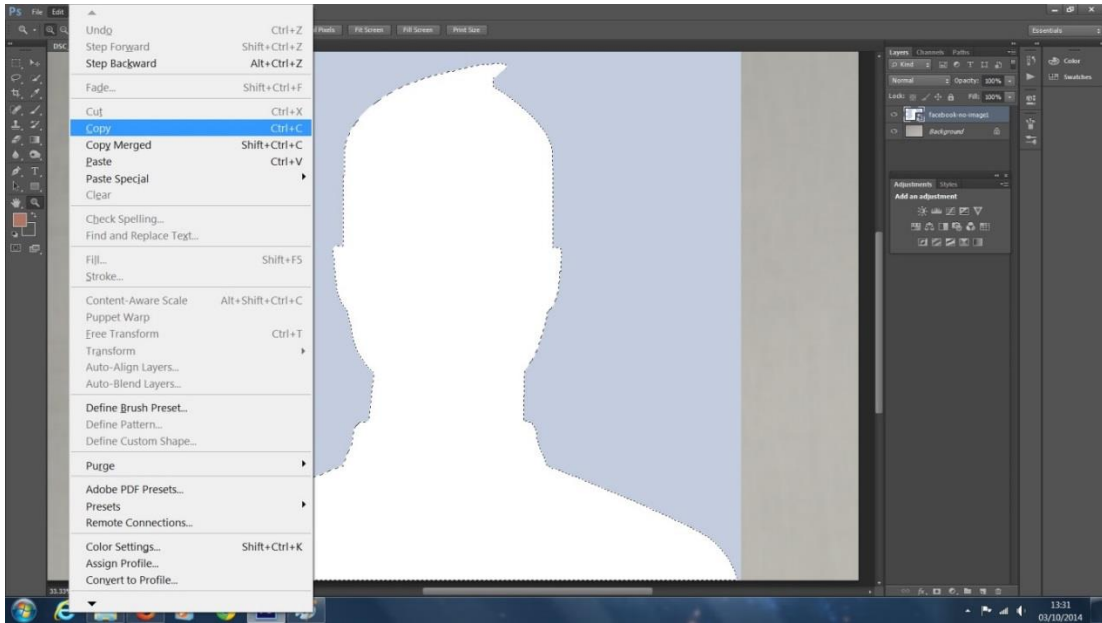


Figure 3.5: Step 5 in the couple generation process.

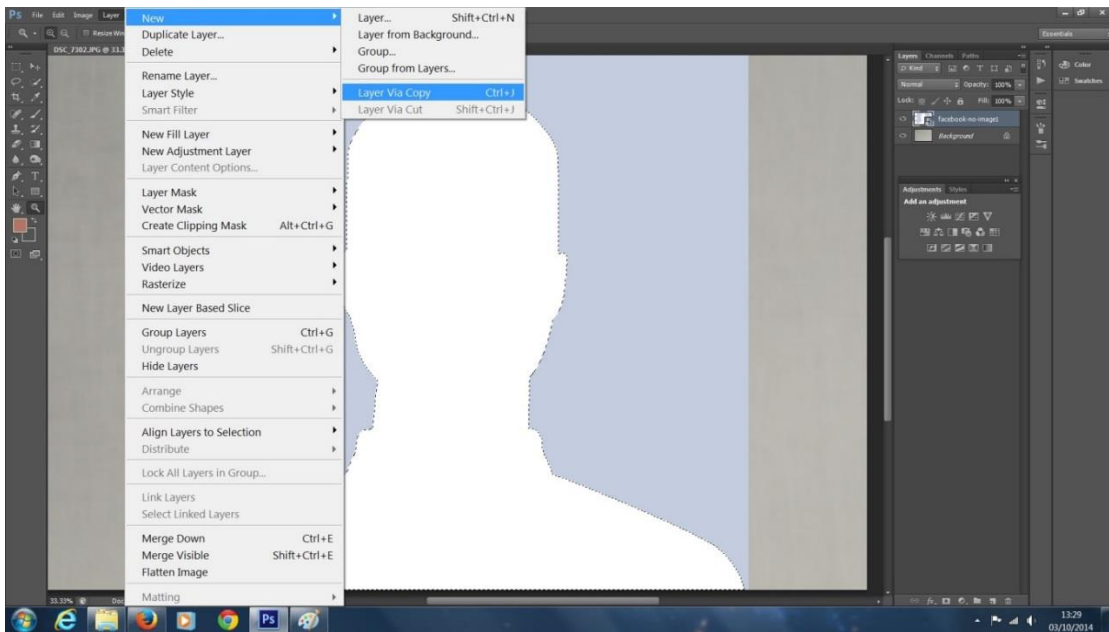


Figure 3.6: Step 6 in the couple generation process.

The original imported image was then deleted by highlighting the layer which contained the original image and deleting it. This can be found in the layer window. Deleting the original image leaves only the male face without any artefacts or borders.

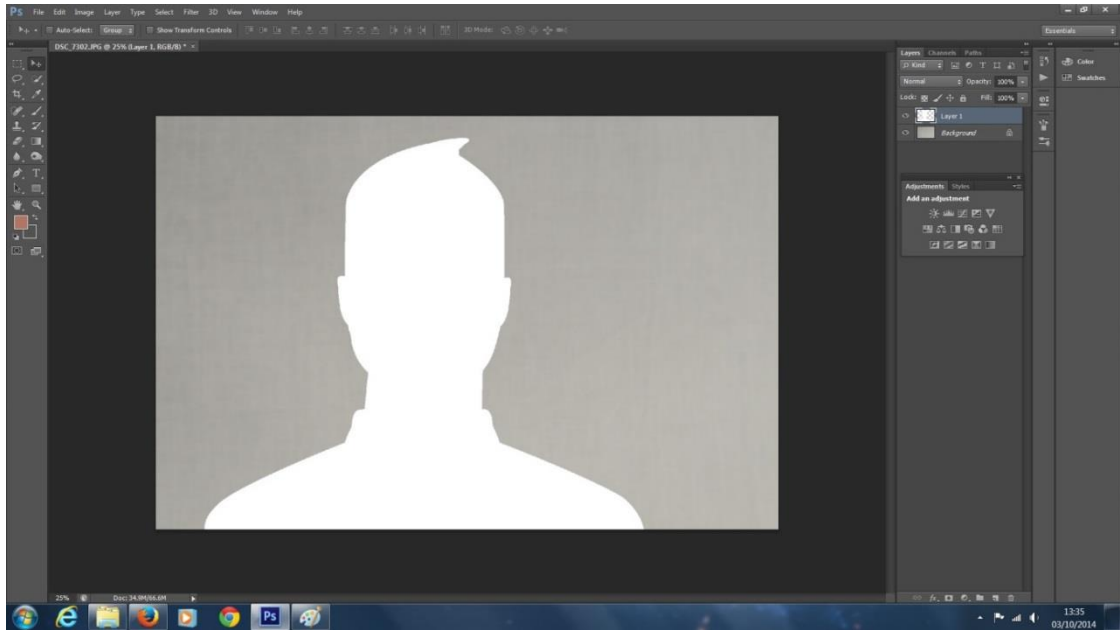


Figure 3.7: Step 7 in the couple generation process.

This process was repeated for the woman's face. The background was then scaled relative to the height of the man for consistency. The man's face was positioned on the left and the woman's on the right. The two faces were uniformly spaced, with the woman at the same relative height compared to the man for each of the images. The woman was placed slightly below the man on the screen because on average men are taller than women and research shows that shortness, as indicated by the lack of height difference, negatively impacts on men's rated attractiveness (Pawłowski, Dunbar, & Lipowicz, 2000).

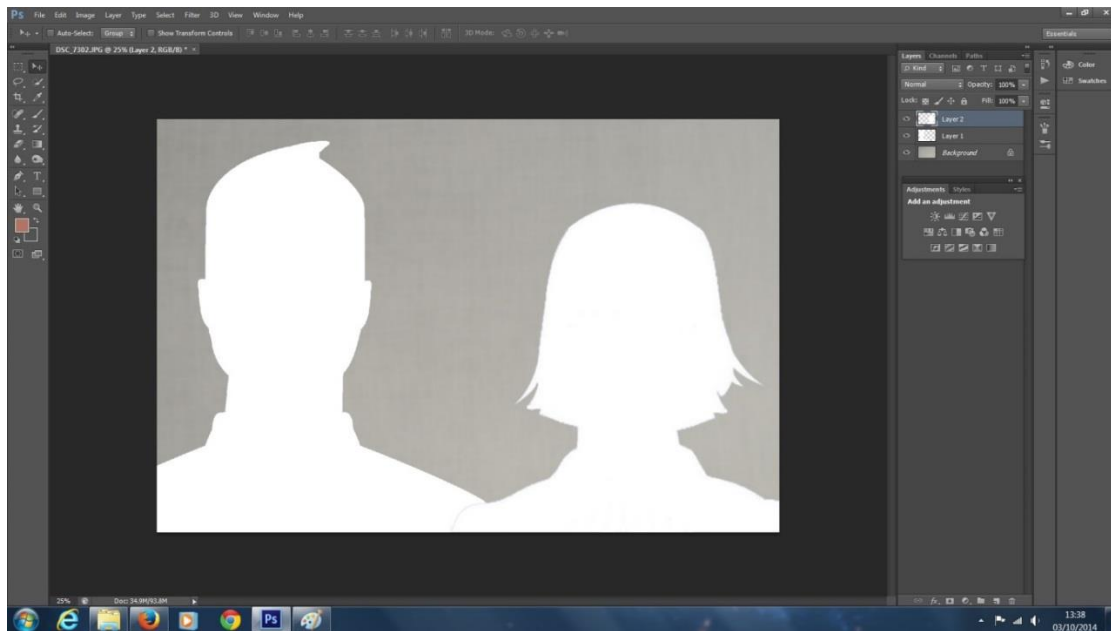


Figure 3.8: Step 8 in the couple generation process.

This method was used because it produced photographs which look like they are of a genuine couple.

3.5.4: Presentation of stimuli

Prior to beginning this research programme, preliminary data acquired during undergraduate study found that mate choice copying affected ratings given to men differently depending upon how attractive men were (Ord & Orme, Unpublished). Participants were presented with images of men as single, with an unattractive rated woman, or an attractive rated woman. Participants rated men on various attributes (e.g. attractiveness, health, wealth and preference for long or short-term relationship). Ratings differed for each attribute but, in general, paired unattractive men were not rated significantly different from single unattractive men. For attractive rated men, the expected mate choice copying effect was present. Attractive men were rated more highly when paired with women compared to when presented singly. This also differed as a function of the woman's attractiveness, with the most attractive women producing the greatest change in ratings. Consequently, in light of the above analyses showing differing effects of mate choice copying depending upon male attractiveness, only the most

and least attractive male images were used in stimuli construction. The medium group of male images was discarded leaving only 10 high and 10 low rated men.

Each of these 20 men was paired with every woman so that, for example, attractive man number 1 had 20 photographic variants, one with each attractive woman and one with each unattractive woman. Images were paired this way to prevent confounds which may arise from one particular woman skewing the rating for a particular man. To explain further, if woman 1 was always paired with man 1 it would be difficult to disentangle the effect woman 1 has on the man from the effect of being paired with women more generally. To further reduce confounds, participants would only ever see each individual once per experiment pack. The same man did not appear with more than one woman in the same pack. Likewise, the same woman did not appear with more than one man within a stimuli pack. This was done to maintain the illusion that the images presented were in fact real couples.

Each rater was presented with 20 images of men (10 attractive males and 10 unattractive males) in one of three pairing conditions: alone and described as single, with congruently rated women and described as in a relationship, or with incongruently rated women and described as in a relationship. Unless otherwise stated this is the basic layout for each experiment. The order of stimuli presentation was randomised so that no participant saw the same presentation order except by chance. Either “randomise.org” or software specific randomisation was used to produce a true random order for stimuli. Presentation of the experiment packs and any accompanying demographic and/or experimental questionnaires were always counterbalanced to prevent order effects. The specific attribute participants were expected to rate is detailed in the experimental chapters. From this point forward, the above presentation of stimuli is referred to as a “mate choice copying pack”.

Section 1:

Biological Influences Over Mate Choice Copying Behaviour

Chapter Four: Ovulation and Mate Choice Copying

4.0: Chapter overview

In recent decades the impact of the female ovulatory cycle – and the associated hormonal shifts – upon mate choice behaviour has become a focus of mate selection research (Gildersleeve et al., 2014a). This chapter will investigate whether mate choice copying is influenced by ovulatory changes. Before doing this, and in order to build an understandable rationale, I must overview the ovulatory cycle, how key hormones can influence mating behaviour, and how this may influence mate choice copying.

4.1: The ovulatory cycle

For most female mammals, successful reproduction can occur only in the short period when an egg (ovum) is available for fertilisation. Unlike males, who have a ready supply of gamete cells, female gamete cells are available for fertilisation only during a short phase of their reproductive cycle. In humans this “ovulatory cycle” is split into 3 primary phases. In stage 1 – the menstrual stage, uterine lining from the previous cycle is shed and levels of the gonadotrophins progesterone and oestrogen are at low base levels. Oestrogen and progesterone are ovarian hormones which are released by the follicles of the ovaries in response to follicular stimulating hormone (FSH) and luteinising hormone (LH). In stage two, the luteal phase, the pituitary gland releases FSH and LH into the blood stream. These hormones bind with receptors in the ovaries which trigger the growth and development of ovum containing follicles. As the follicle and ovum matures oestrogen is released into the bloodstream. Towards the end of the follicular phase, a surge in oestrogen triggers a spike in LH production which, consequently, triggers ovulation. At ovulation, the now fully matured follicle ruptures and an ovum is released for fertilisation. This begins stage 3 of the ovulatory cycle – the luteal phase. The ruptured follicle releases increasing amounts of progesterone. This causes a thickening of the uterine lining. Additionally, the release of the hormone inhibin prevents the release of

further FSH in preparation for pregnancy. Oestrogen levels fall sharply post ovulation whilst progesterone and inhibin peak during the latter stages of this phase. If conception does not occur, levels of progesterone, oestrogen and inhibin return to base levels and the uterine lining is shed as the menstrual stage begins. The drop in inhibin causes the pituitary gland to begin the release of FSH and LH. The ovulation cycle then begins again. For a detailed overview of the ovulation cycle please see (Neave, 2007). For the purposes of this chapter a brief overview of the process is sufficient. Of more importance to this chapter is the effect hormonal fluctuations have upon mating behaviour.

4.2: Hormones and mate selection

Before examining the effects of hormones upon human mate selection, it is important to understand the basic mechanisms of how hormones influence behaviour. Most, if not all, of the effects of oestrogen upon mating behaviour are mediated by either oestrogenic receptor activation in the brain or via the activation of agonistic neurons in deep seated limbic systems (Keefe, 2002; Keefe & Naftolin, 1993). Two primary types of oestrogen receptors exist: ER α and ER β (Dupont et al., 2000). In humans it is difficult to directly test how activation of a given receptor type affects the mate choice behaviour of women. This is because directly manipulating hormone systems in the brain system isn't possible. However, certain lab-developed rodent species offer means by which direct manipulation of oestrogenic systems can be carried out. Before discussing the effects of ER α and ER β manipulation it is important to understand the normal reproductive behaviour of female rodents. In healthy rodents, females adopt a receptive behavioural posture when a desired male initiates mating. This is known as lordosis and allows males to engage a female sexually. This behaviour only occurs during estrus, when oestrogen levels peak and the female is reproductively viable. Males attempting to engage in mating during any other phase of the ovarian cycle are aggressively repelled. For a more detailed review please see Caligioni (2001).

In order to test the functionality of oestrogen receptors, researchers developed a variant of mouse known as "Knockout mice". These are mice which have been genetically

engineered to be missing one of the two receptors and which allow us to discern the impact of oestrogens upon reproductive behaviour (Dupont et al., 2000; Hewitt & Korach, 2003). Knockout mice demonstrate a marked difference, both physiologically and behaviourally, compared to unmodified mice. For example, mice with ER α knocked out demonstrate a reversal of sex roles (Ogawa, Taylor, Lubahn, Korach, & Pfaff, 1996). Females who would normally be receptive to male advances no longer adopt the lordosis pose in response to male advances and instead perform male sex typical reproductive behaviours (Ogawa et al., 1998). Mice who have had ER β knocked out are unable to generate sufficient FSH to trigger ovulation (Keefe, 2002). Because it is not possible to genetically manipulate humans to knock out either ER α or ER β it is difficult to confirm whether humans would respond in a similar way. However, mice biology is sufficiently understood and sufficiently similar to human biology that mouse models have been used in a variety of fields to inform human based research. For examples please see Ho et al. (1995); Kinkade et al. (2008); Le Magnen, Dutta, and Abate-Shen (2016). Human research is understandably less robust than it is in rodent species. It lacks the usage of ablative hormonal manipulation techniques used in mice and must rely upon testing by association, rather than by direct genetic manipulation. Below we will detail how this ‘testing by association’ is done, and how it fits with a number of competing hypotheses over the role of hormones in human reproductive behaviour.

4.3: Human hormonal modulation of mate choice

4.3.1: Human ovulatory shift hypothesis

The ovulatory shift hypothesis comes from the observation that in many animal species, particularly primates, female mating behaviour alters with the ovulatory cycle. Females tend to both engage in mating behaviour and advertise fertility when oestrogen levels are high and cease mating behaviour and advertisement when oestrogen levels and fertility are low. For examples of this e.g. for evidence in orangutans, chimpanzees, capuchins, and vervet monkeys see Clutton-Brock and McAuliffe (2009); Keddy-Hector (1992); Knott, Thompson, and Stumpf (2007); Pieta (2008); Stumpf and Boesch (2005). Unlike most of our primate

cousins, women engage in reproductive behaviour across the ovulatory cycle and do not have clearly visible fertility displays. Early researchers thus concluded that humans had evolved concealed ovulation, and speculated about the functional reasons why this might have evolved. Some researchers have theorised that “concealed ovulation” and “extended sexual activity” may have evolved to secure scarce resources (whether that is genetic or parental investment) from the male partner to support child-rearing. This is achieved by two means: first, non-advertised ovulation can promote paternity uncertainty, which could increase the overall contribution of resources from multiple men (Hrdy, 1979) and could allow women to secure resources from a partner(s) across the entire ovulatory cycle, rather than just for the short reproductively fertile period (Strassmann, 1981). Second, confusing paternity and concealing their fertile window is argued to allow women to operate a dual mating strategy, whereby they seek to acquire high quality genes from extra-pair copulations at peak fertility (Thornhill & Gangestad, 2008), whilst simultaneously securing resources (e.g. parental investment, food or protection) from a current stable partner across low fertility phases of the cycle (Strassmann, 1981). Under this hypothesis, concealed evolution and extended sexuality are therefore evolved adaptations geared towards acquiring high quality genes and securing resources.

A number of sources of evidence have been proposed to demonstrate this ovulatory shift. First, some evidence suggests that the overall sexual interest and desire of women peak during the mid-follicular phase, compared to during less fertile phases of the ovulatory cycle (Hill, 1988; Bogusław Pawłowski, 1999; Regan, 1996). Second, women are reported to show an increased preference for extra-pair men at peak fertility, when the woman can become pregnant, than at low fertility (Gangestad, Thornhill, & Garver-Apgar, 2005). This is in comparison to desire for within pair copulation, which remains stable regardless of the fertility state of the woman (Baker & Bellis, 1995). Grebe, Gangestad, Garver-Apgar, and Thornhill (2013) hypothesise that these differences in EPC behaviour are evidence that women seek to acquire high quality genes when they are likely to become pregnant, whilst simultaneously maintaining a relationship with a mate who can provide resources in order to raise any potential

offspring. This is further supported by evidence which shows that EPC behaviour is context specific. Namely, women show an increased desire for EPC and an increased sexual interest towards attractive others when her own partner is of low quality (Pillsworth & Haselton, 2006).

A number of other pieces of evidence are reported to show that women experience cyclical shifts in preferences for high quality males. For example, at peak fertility women have been reported to demonstrate a stronger preference for symmetrical men (Gangestad & Thornhill, 1998), masculine faces (Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Penton-Voak et al., 1999), more masculinized vocal ranges (Puts, 2006), and competitive and dominant men (Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004). Of particular relevance to this chapter is that women at peak fertility show a preference for talent based traits (Haselton & Miller, 2002), and an increased willingness to engage in intra-sexual competition, in order to obtain mates (Piccoli, Foroni, & Carnaghi, 2013). These two latter factors are important for two reasons: one, mate choice copying aids in the assessment of less visible traits and is, therefore, more likely to influence traits such as perceived talent. Two, acting upon mate choice copying necessitates intrasexual competition. Both of these are reportedly increased at peak fertility. These findings appear to be born out in meta-analyses. A recent meta-analysis of 50 studies testing the effects of ovulation upon women's mate preference found that women showed a small but reliable and significant preference towards physically attractive men at peak fertility (Gildersleeve et al., 2014a). However, the literature is not undisputed as an additional meta-analysis using the same data set reported contradictory findings (Wood, Kressel, Joshi, & Louie, 2014). Wood and Carden (2014) even go so far as to suspect that what few positive results their analysis show originate from p-value hacking, publication bias, or other methodological artefacts (but see Gildersleeve, Haselton, and Fales (2014b) for a response to this).

4.3.2: Perceptual spandrel hypothesis

The above paragraphs list evidence which is often provided in support of the ovulatory shift and concealed ovulation hypotheses. Most researchers agree that the above is evidence

for adaptive, evolved behavioural mechanisms which alter female mating behaviour. That is to say, these shifts in reported behaviour have specifically evolved because of their adaptive benefits. However, this adaptationist interpretation, and the evidence used to support it, is not without contention. Jones et al. (2017) report that a number of issues exist with research in this area. First, sample sizes are often small and which can result in underpowered studies, and an overestimate of the size of observed effects. Second, hormonal states are often estimated based on inaccurate self-reports rather than actually tested with assay kits. Third, data are contradictory and the replication of results is difficult. Often experiments are between subject designs. This is an issue because the hormonal profile of women varies greatly between subjects. Therefore, it is difficult to know whether data are representative of a real hormone effect or are simply a by-product of individual differences. Fourth, typically participants are only tested twice, which may only provide a limited understanding of a much more complex interaction between responses and hormones.

To address these concerns Jones et al. (2017) conducted the largest within subject, hormonally assayed, experiment to date. A total of 584 participants took part and no shift in preference was found. Indeed, the one effect of hormones found – a comparison between hormonal contraceptive pill usage and non-usage – was significant in the opposite direction to what was expected. Further, in a review of the ovulatory effects upon attractiveness and intercourse frequency in women, comparison of extant articles showed that women's sexual interest exists across the ovulatory cycle, and is not so uniformly restricted to ovulation as would be predicted by hormonal shift hypotheses (Bogusław Pawłowski, 1999). Importantly, the meta-analyses quoted above (Gildersleeve et al., 2014a, 2014b; Wood et al., 2014) report that effect sizes within ovulatory shift data are both small and heterogeneous. Combined with above cited disconfirming data, this suggests that adaptationist interpretations and the evidence used to support them may not be entirely sound.

An alternative to adaptationist hypotheses has been suggested, however. Havlíček et al. (2015) suggest that small, statistically weak and heterogeneous effects are not what should

be expected of behavioural adaptations. Instead, such unclear findings can be expected if ovulatory behavioural shifts are not themselves adaptations but are by-products – otherwise known as “spandrels”— of other adaptive systems (i.e. biological reproductive systems which trigger ovulation). Havlíček et al. (2015) argue that between-participant variation in the bodily and behavioural response to oestrogen has a greater effect on the reproductive behaviour of women than the small and heterogeneous effects associated with within-participant hormonal shifts. This is important because if ovulatory shifts were adaptive rather than a by-product of other systems, then one should expect a larger and less heterogeneous effect of within-participant oestrogen responses than is reported. Recent research has attempted to confirm this, but instead found that within-participant hormone levels correlated to attractiveness more than between participant hormone levels correlated to participant attractiveness (Jones, Hahn, Fisher, Wang, Kandrik, Han, Lee, et al., 2017).

This research has two primary weaknesses. First, though a large number of women were recruited to provide hormone measures, only 28 (14 males and 14 females) participants rated the attractiveness of the women. In collecting attractiveness ratings from such a small sample size, researchers commit the first major error associated with hormone based research reported in Jones et al. (2017). Namely, their research is conducted with such a small sample size that it is difficult to know whether results are sufficiently powered to detect the small effects common to hormonal research. Second, in the between-participant testing phase, experimenters averaged the hormone levels across each of 5 testing sessions for each woman who provided a sample. In so doing, they produce a single mean hormone measure for each individual woman. The consequence of this is that in collapsing the variance within participants to a mean of their overall hormone range, they may have ultimately reduced the variance between participants compared to the variance within participants. This may damage the effect that they are trying to measure. Further, they collapse just 5 data points across the ovulation cycle. It is, therefore, unclear if these selected data points are representative of the

overall hormone profile of women. It is possible that this method may have interfered with results.

Extant data and theoretical interpretations of ovulatory shifts are mixed and controversial. Where effects are present, they appear to be subtle (Gildersleeve et al., 2014a). Whether hormonal shifts affect mate choice copying behaviour has not been studied, however. Despite the controversial nature of ovulatory shift data, there are reasons to hypothesise why mate choice copying may be influenced by hormonal shifts. This is discussed below.

4.4: Mate choice copying and hormones

Three separate but additive observations exist which suggest that hormonal modulation of mate choice copying behaviour may occur. First, oestrogen administration immediately increases the sexual interest that female mice display towards male mice (Cornil, Ball, & Balthazart, 2015). Second, estrogenic receptor activation plays a role in moderating social interaction and judgement in mice (Tang et al., 2005). Third, in rodents – but also hypothesised to occur in humans – estrogenic systems modulate oxytocin hormonal systems, which in turn influence the social aspects of mating behaviour (Gabor, Phan, Clipperton-Allen, Kavaliers, & Choleris, 2012). To expand on this further: in rodents, oxytocin has been shown to influence pair bonding, social recognition, memory and social learning (Choleris et al., 2009; Donaldson & Young, 2008; Mitre et al., 2016). Mate choice copying is fundamentally a social phenomenon. Observing and using information gleaned from the mate selection of others in order to inform one's own mate selection requires social learning. Therefore, from the above three points, the following can be concluded: 1. Oestrogen affects mate selection, 2. Oxytocin regulates social learning and judgment, 3. Oestrogen interacts with oxytocin systems, 4. Both hormone systems influence social learning systems and mate selection behaviour. Thus, the link between oxytocin and oestrogen is potentially an important influence over mate choice copying.

Evidentiary support for the above link between oestrogen, oxytocin and mating behaviour can be found in oxytocin knockout mice. Female mice who do not benefit from the

actions of oxytocin, despite being in estrus and therefore having high levels of oestrogen, lose their sexual interest in males (Nakajima, Görlich, & Heintz, 2014). Human research is lacking but studies of human brains highlight that oxytocin receptors are found in similar neural locations to rodent brains (Ferguson, Aldag, Insel, & Young, 2001; Gamer, Zurowski, & Büchel, 2010; Huber, Veinante, & Stoop, 2005), and that receptors perform a similar function in humans as they do in rodents (see Kavaliers, Matta, & Choleris, 2017 for a review). Thus, it is possible that activation of human oxytocin and oestrogen systems has a similar behavioural impact. Few experiments have directly tested hormonal influences over mate choice copying. However, the few research articles which do exist show that mice in estrus perform mate choice copying whilst those not in estrus do not mate choice copy (e.g. Choleris et al., 2012). Equally, rodents who are supplied with an oxytocin antagonist fail to show mate choice copying behaviour compared to those mice which do not receive an inhibitor (Kavaliers et al., 2006; Kavaliers et al., 2017). It is possible, given the similarities between receptor location and function of oxytocin and oestrogen systems in rodents and humans, that humans may too be similarly influenced.

Evidence for the influence of oestrogen and oxytocin over human mate choice copying is entirely lacking. Recent papers hypothesise that hormonal activity, whether that be oestrogenic or oxytocinergic, may influence mate choice copying behaviour in women (Choleris et al., 2009; Kavaliers et al., 2017; Rosenthal, 2016).

This experiment will assess the influence of hormones over human mate choice copying behaviour. Because oestrogenic and oxytocin systems are linked, ovulation was used as the comparison point for hormonal manipulation. This is because oestrogen peaks around ovulation and, due to the interactive nature of oestrogen and oxytocin, both hormonal effects should be present. Whilst this does not allow us to differentiate between which specific hormone influences behaviour – if behaviour is in fact influenced by hormones – a change in mate choice copying behaviour between ovulation and a low fertility period would highlight whether mate choice copying is influenced by hormonal fluctuations.

4.5: Hypotheses

H1: If mate choice copying influences behaviour, then men paired with women would be rated as more attractive than men without women.

H2: If hormones influence mate choice copying, then women at peak fertility would demonstrate greater differences between their ratings of single and paired men compared with women at low fertility.

4.6: Methodology

4.6.1: Design

A 2 (pairing condition: males alone and described as single vs males with women and described as in a relationship) by 2 (fertility state: high vs low) by 2 (male attractiveness: high vs low) within subject experimental design was used. The dependent variable was rated attractiveness ratings given to male photographs.

4.6.2: Participants

Nineteen women were recruited from a university student population. Participants were healthy, normally cycling women who were not, or had not in the last 3 months, used a hormonal contraceptive. Participants were aged between 18 and 42 (mean = 26.89, SD = 7.26). Participant attrition was extremely high with a drop rate of 44% after completion of the first sessions and 86% before completing the first session. The 19 women who took part were participants left after drop-out. 9 of the participants were romantically single, 10 were in a relationship with a length of between 2 months and 15 years. Average relationship length was 6.57 years (SD = 4.76 years).

4.6.3: Materials

Ovulation Testing: There are a number of differing measures available for assessing ovulation. Some of the most commonly used are the forward and backwards counting method (i.e. asking the participant to count forwards or backwards from the start of their cycle a given number of days to estimate the likely ovulation date). Whilst these are useful estimates they are criticised because, as estimates, they are based upon the participant accurately

remembering the length of her ovarian cycle. This can make conclusions uncertain. Actual ovulation dates vary both between and within women, so applying a backwards or forwards counting methodology imposes a regularity to the cycle which is not often found. Consequently, when data are collected, there is little certainty over whether data is actually captured at ovulation or not (Gonzales & Ferrer, 2016). The chosen method for measuring ovulation was usage of the LH testing kit called the Clearblue ovulation test. This tests the participant's urine for the LH surge which precedes ovulation. It is both non-invasive and has a reported 97% accuracy rate (Su, Yi, Wei, Chang, & Cheng, 2017).

Stimuli: A modified version of the mate choice copying experimental pack was used. Because participants were taking part in a fully repeated measures study, it wasn't possible to have the same male photograph reported as both single and in a relationship with two women of varying attractiveness without compromising the manipulation (i.e. without having the participant question the perceived relationship status of presented image pairs). Rather, participants were presented with a modified stimuli pack consisting of 20 men, 10 of which were presented as if in a relationship with an attractive rated woman and 10 of which were presented as if single and without a woman. Therefore, each participant saw 4 sets of stimuli: 5 attractive and 5 unattractive men with women, and 5 attractive men and 5 unattractive men without women. Stimuli were presented on the media lab software program (Jarvis, 2004).

4.6.4: Procedure

This procedure was ethically approved by the Department of Psychology Ethics Committee of Northumbria University. Prior to participation, all participants were informed on procedure and consented to take part. Care was taken not to reveal the manipulation. Participants attended the lab on 3 separate sessions.

In the first session participants completed a short questionnaire (appendix 1) which allowed an estimate of ovulation timing. In this questionnaire, participants were asked for basic demographics (age, relationship status, and relationship length) as well as when the beginning of their last cycle was and how long their cycle normally lasts. Accompanying this

were questions about how sure they were of their cycle length and regularity. With this information, cycle length was counted and a forward counting method was used to estimate when ovulation was expected to occur in the next cycle. The participant was provided with a number of home usage LH testing kits. The number provided to participants differed depending upon how sure she was of her cycle. Sufficient kits were provided so that the participant could use one test once per day for four days on either side of the expected ovulation date. Where participants were unsure of the cycle start date or length, then additional tests were provided to account for error in the estimates of ovulation. Participants were provided with instructions, both verbal and written, on the usage of such tests. Instructions advised to use tests once per day and to report back as soon as a positive result was detected. Participants attended the lab no later than two days post LH surge detection. This timeframe was allowed because research shows that LH detection occurs prior to ovulation by between 0 and 2 days and that oestrogen levels remain high for this period (Su, Yi, Wei, Chang, & Cheng, 2017) For the low fertility phase participants would attend the lab post ovulation between 0 and 3 days prior to the expected end date of the participants' cycle. This time period was chosen because both oestrogen and progesterone are low. Whilst this research question does not concern progesterone, its effects upon mate choice copying are unknown. Normally, ovulatory studies contrast ovulation with post ovulatory days 17-21. But as progesterone is high during these days, and because its effects on mate choice copying are unknown, a later time was selected so that any potential influence of progesterone was reduced.

The experimental procedure was the same for both testing sessions. Upon attending the lab participants were informed "*you will be presented with a series of male faces. Some of these men will be presented with their girlfriends and some are single. For the purposes of this experiment please rate the man on attractiveness*". The order of the 20 male images was randomised by media lab. No participant saw the same order of faces. Further, the order in which participant took part in the fertility conditions was counterbalanced so that half the participants did the high fertility phase first and half did the low fertility phase first.

Participants rated male images on a 1-9 Likert scale with 1 being highly unattractive and 9 being highly attractive. Participant rated the same stimuli twice: once at high and once at low fertility. The coupling of the male/female pairs was kept the same between testing sessions for two reasons. The first was to prevent suspicion over the stimuli. i.e. a male seen with one girlfriend would look suspect if, upon a second viewing, he was pictured with another girlfriend. Second, they were kept the same so that any changes observed could be attributed to ovulatory changes rather than changes in stimuli. Following completion of the research participants were fully debriefed and were rewarded for taking part with either a £15 amazon voucher or course credit.

4.7: Results

Repeated measures ANOVA shows that there was no mate choice copying evident in the data. There was no significant difference in rated attractiveness between men paired with women (mean = 4.350, SE = 0.316) and men presented as single (mean = 3.900, SE = .309) [$F(1, 15) = .523, p = .481, \eta^2 = .034$]. Nor was there any significant effect of ovulation upon rated attractiveness. No significant difference existed between ratings of attractiveness provided by women at high (mean = 4.208, SE = .332) or low (mean = 4.042, SE = .297) fertility [$F(1,15) = .3.13, p = .097, \eta^2 = .173$]. Unsurprisingly, a significant difference in attractiveness ratings was found. Attractive men (mean = 5.16, SE = .344) were rated as more attractive than unattractive men (mean = 3.09, SE = .289) [$F(1,15) = 6.872, p = .019, \eta^2 = .314$]. No significant interaction effect exists within the data and no effect of age or relationship status was present (all p 's > .05).

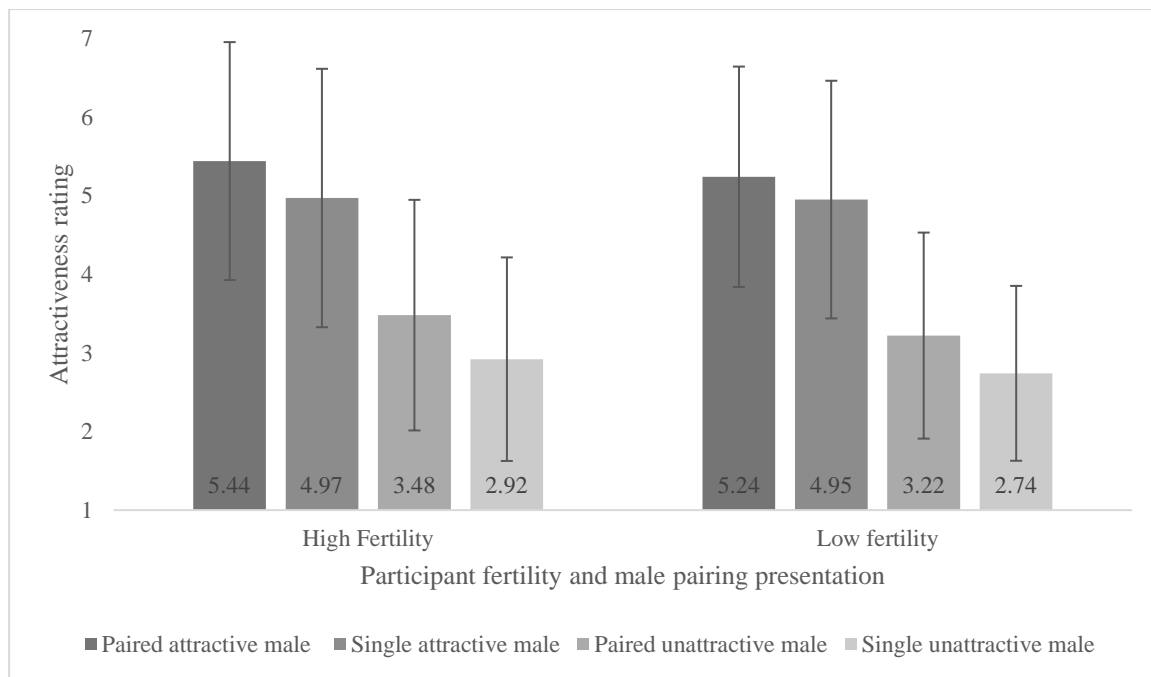


Figure 4.1: Mean (and SE) attractiveness ratings given to attractive and unattractive men when paired with a woman or presented as single. Ratings were taken when participants were at high and low fertility.

4.8: Discussion

Previous rodent based research showed that mate choice copying was influenced by both oestrogen and oxytocin. At peak fertility mate choice copying occurred, whilst it did not occur at low fertility (Choleris et al., 2009; Kavaliers et al., 2006). No research to date had tested the effects of hormones upon human mate choice copying. Researchers had hypothesised that hormonal fluctuations may impact upon mate choice copying (Kavaliers et al., 2017). This research sought to clarify this. Data did not support H1 or H2. I was not able to replicate a mate choice copying effect. Nor was there any evidence of ovulatory shifts in either attractiveness rating provided to males or mate choice copying.

4.8.1: Failed replication of mate choice copying

A number of possible explanations exist for the failed mate choice copying replication. First, participants were older than is usual for mate choice copying research. For example, in the following data sets: Eva and Wood (2006); Place et al. (2010); Uller and Johansson (2003); Waynforth (2007), participant age was closer to 20 +/- 2. This compares to a mean participant age of 26.89 in this experiment. This is important because in animal research, the age of the

copying female has an important role in moderating mate choice copying behaviour. In guppies [*Pocellia reticulata*], for example, only inexperienced females display mate choice copying. Those females who have aged sufficiently to have experienced the mating market are less likely to display mate choice copying behaviour (Dugatkin & Godin, 1993). Further, in human research, age has been hypothesised and shown to be a factor in influencing mate choice copying behaviour (Bowers et al., 2012; Little, Caldwell, Jones, & DeBruine, 2015). For a fuller review of age related effects please see chapter 5. It is possible that participants, being generally older than those in extant data, had sufficient experience of the mating market to not be influenced by mate choice copying. Though participant age did not significantly affect ratings in analysis, it is not possible to rule this out age effects due to the next plausible reason for a lack of replication. The primary issue with this experiment is a lack of statistical power. A low participant completion and uptake rate means that it is likely that this experiment lacks the statistical power sufficient to capture the subtle influence of mate choice copying. With partial eta squared as low as .034 and observed power recorded at .104, it is probable that this preliminary study is likely to be heavily underpowered. This is an issue because meta-analysis shows that ovulatory based changes in ratings have small effect sizes, and therefore, require larger sample sizes to avoid error. Equally, mate choice copying results are likely small in effect size.

4.8.2: Failed replication of ovulatory shift

Without a mate choice copying effect present, and with the above stated caveat about statistical power, it is difficult to ascertain whether ovulation has any effect on mate choice copying at all. If a larger replication is able to duplicate this lack of effect, then it is possible that mate choice copying is not influenced by the hormonal fluctuations of the ovulatory cycle. There would be a number of reasons for this. First, oestrogen and oxytocin systems feed directly into the limbic system and impact heavily upon reproductive and social behaviour (Patchev, Schlosser, Hassan, & Almeida, 1993). In humans, social and reproductive interaction is complex. Whilst oestrogen and oxytocin systems may play a role in mate choice

copying in animal species, Patchev et al. (1993) suggest that limbic systems are heavily moderated by the higher cognitive functions of the frontal cortex. Therefore, due to the interference of the frontal cortex, the expected hormonal modulation of mate choice copying may not manifest in humans in the same clear way it does in rodents. Even if hormonal fluctuations associated with ovulation do influence mate choice copying behaviour, it is likely that this experiment is unable to detect such results. Detection of the moderated ovulatory effect hypothesised above would likely, as with other ovulatory shift effects (see Gildersleeve et al., 2014a for example), manifest with a small effect size and therefore require powerful experiments to detect.

As a final point, there were no detected ovulatory effects at all. This is expected for mate choice copying effects but somewhat unexpected for attractiveness ratings. If the ovulatory shift hypotheses were correct, an effect on attractiveness, regardless of mate choice copying, should be found. Whilst it is correct to state that this experiment lacks the power to make claims confidently, an important point should be noted. Jones et al. (2017) point out that most research investigating ovulatory shifts are both underpowered and use estimates of ovulation dates rather than actual ovulation dates. Jones et al., argue that this has the consequence of potentially increasing type 1 error. Nevertheless, given the rigorous tracking of ovulation and the low power, it may be expected to find a shift effect (even if it would likely be type 1 error). This was not the case, however. Though very tentative, this would fall in line with predictions from the “perceptual spandrel” hypothesis (Havlicek et al., 2015). Namely, that within participant hormone studies are likely to produce small effects and/or mixed results as opposed to the clear expected directionality that would be associated with responses delivered due to evolved adaptations. Regardless, further data is needed to substantiate any of the claims made within this section.

Chapter Five: Age, Mate Choice Copying and Boundary Effects

5.1: Chapter overview

In the previous chapter neither mate choice copying or ovulatory shift effects were present in data. It was hypothesised that this lack of replication may have been methodological in origin. Specifically, that the participants recruited were older than participants collected in the wider literature and that, a lack of statistical power may have interfered with the detection of effects. In *Poecilia reticulata*, a species of guppy, the age of the female engaging the mate choice copying is of key importance. Only younger fish display mate choice copying (Dugatkin & Godin, 1993). In addition to confirming the effects of age upon their fish subjects, Godin et al. (2005) also confirmed that mate choice copying occurs in a mating specific context only. They confirmed that females are influenced by others when deciding between two mates but are not influenced by others when deciding between social shoaling partners (Godin et al., 2005). In other words, they confirmed that the boundary of choice copying stopped at mate choice. In this chapter I will investigate these two points in humans. First, I will test whether age impacts upon mate choice copying. This will be achieved by comparing a population with less direct experience of the mating market (i.e. a school aged population of women) with a standard population of university aged students who are more likely to have experienced the mating market. The second aim of this chapter is to check whether the boundary of choice copying in humans also stops at mate choice. This will be done by comparing ratings of attractiveness given to stimuli designed to illicit MCC, social copying and object copying. Please see section 5.3 for details.

5.2: Age effects

Literature shows that age is an important factor in modulating the mate choice copying behaviour of certain animal species (Amlacher & Dugatkin, 2005; Dugatkin & Godin, 1993). Though not clear from the human research, it can be inferred from such animal research that age is likely to modulate human mate choice copying. The argument for this is as follows: the

mate selection behaviour of the fish species used in the above cited research is relatively simple i.e. they select primarily for physical traits rather than complex social traits. If female guppies who are naïve to the mating market need to employ mate choice copying to reduce uncertainty over a plainly visible feature such as physical appearance, then naïve members of species where mate choice is more complex should also be likely to utilize mate choice copying. Human mate selection is more complex than that of guppies and often involves the assessment of less visible personality and character traits (see chapter 1 for an overview of human mate selection). This increased complexity should therefore make the mate quality assessment and differentiation process more difficult for women, particularly those who lack experience in selecting mates, than for species which assess on purely physical attributes. Therefore, women with less experience of mate selection should be more likely to employ many sources of information to reduce uncertainty. Mate choice copying is one such source of information. Extant human literature on mate choice copying and age modulation is mixed, however. One such reason for this lack of clarity is that often research lacks sufficient detail in order to make reliable hypotheses over the likely influence age has upon mate choice copying. This is detailed below.

In human research, often age demographics are either lacking sufficient variance or are simply not stated in sufficient detail to be able to infer whether age related effects are likely to exist. For example, in some of the more frequently cited research papers, participant age details are reported as follows: Waynforth (2007) reported 112 students aged between 19 and 23, no mean or standard deviation was provided. Eva and Wood (2006) report 38 participants with a mean age of 20.8, no range of standard deviation was provided. Place et al. (2010) report 40 female participant with a mean age of 20.0, no range or standard deviation was provided. Uller and Johansson (2003) report 97 participants between 18-30, no mean was provided. Yorzinski and Platt (2010) report 60 participants aged between 18 and 30 with a mean of 22.1 (SD 0.4). Whilst this is not a problem with the cited research, it does allow two conclusions to be drawn. First, most research is likely to be conducted upon university aged

participants with a probable age of around 20 and so extant data likely lacks the variance to infer age related results. Second, because insufficient demographics information about age range and variation is available, it is difficult to hypothesise over whether or not age modulation of mate choice copying should be expected. This latter point requires explanation.

As a hypothetical scenario, imagine that two mate choice copying studies exist. The first offers a positive replication of mate choice copying, the second fails to replicate mate choice copying. Both these studies have a participant age range of 18-25 but do not state what the mean age for participants are. In these examples, the actual mean age of participants in the first study is 18.5 whilst the mean age in the second study is 23.5. If age has an effect upon mate choice copying, then the age difference between these two samples may be a possible explanation for conflicting results. Without stating the mean age and range of participants it is not possible for a reader to even hypothesise that age maybe have been an influencing factor in the differing results. Whilst this is a hypothetical example, the above cited research I used as an example of the lack of age data do present mixed results. Some are positive replications others failed replications. It may be that the mean age or variance in age was an influencing factor. Without clear demographics it is hard to state whether this hypothesis is likely to affect data or not. Nevertheless, two prominent studies have directly checked for such age modulation and present mixed results.

Bowers et al. (2012) noted that in a group of 40 female participants (18-23 years old, mean age: 19.6, SD: 1.4) those under mean age of 19 demonstrated a different response to trait based mate choice copying than those over 19 years of age. There was some limited evidence that younger participants copied the mate choices of others whilst the older group did not. This was not a significant difference but changes in ratings were in the predicted direction. In order to confirm if this effect, they recruited a further 40 women aged 18-19 (mean: 18.6 SD: 0.5) and found that participants indeed copied the mate choice of others. They report an overall trend for younger observers to mate choice copy the trait preferences of older women. Conversely, older participants failed to mate choice copy women of a similar age. There are

two issues with this approach. First, in the replication of their original experiment they recruited only younger participants without a corresponding older participant group. Whilst this allows experimenters to infer mate choice copying in this young group, it does not allow them to directly state whether younger women are more likely to copy than older women. Given that the number of older women from their first experiment totalled 16, it is possible that this difference is sample specific and not generalizable to older participants. Second, their purpose for conducting their replication experiment was based upon a non-significant difference between older and younger women. Whilst they are tentative over conclusions, without recruiting a further group of older participants as a point of comparison, inferring meaning to non-significant findings can be problematic.

However, Little et al. (2015) found that in their sample of participants aged between 17 and 52 (mean = 24.6, SD = 7.7) correlational analysis suggested that younger participants were more likely to be influenced by the mate choices of high status women than older participants. Waynforth (2007) did not find an effect of age upon mate choice copying but lacked the impressive age range found in Little et al.'s work. Data showing that the effects of age upon human mate choice copying are mixed. In animal species data are similarly mixed. Whilst the naïve guppy population of Dugatkin and Godin (1993) demonstrated age dependent mate choice copying, a species of Japanese quail [*Coturnix japonica*] failed to demonstrate age or experience based mate choice copying (Ophir & Galef, 2004). This study will seek to clarify these mixed data by directly comparing the responses of school aged adolescents between the ages of 15-16 to a standard university aged population. We would hypothesise that mate choice copying should be evident in both groups of participants, older and younger, but should be more pronounced in younger participants than older participants. Whilst the age of a participant is not a direct correlate for her experience of the mating market, data suggests that younger participants are less likely to have engaged in sexual behaviour. For example, a large study found that only 25% of women had sexual experience under the age of 16 (Wellings et al., 2001). In university aged participants roughly two thirds had experience of

sexual encounters (Cooper, 2002). The mean number of sexual partners in Cooper's university sample was 10.8 with a range of 0 to 65 sexual partners per year. In comparison, of those under 16 who had sexual experience their average number of sexual partners was 4.5 (Ybarra, Rosario, Saewyc, & Goodenow, 2016). Age then, should, to some degree, be reflective of experience.

5.2.1: Hypotheses

H1: if mate choice copying affects responses then, men presented as though in a relationship with a woman should be rated as more attractive than men presented as though single.

H2: if mate choice copying is affected by age then, younger participants should rate men with women more attractive than men without women but this change should be more pronounced in younger women than older women.

5.3: The boundaries of choice copying behaviour

In social species such as humans, social learning forms an important aspect of how individuals learn to navigate both the world and social structures (Boyd, Richerson, & Henrich, 2011). Given that mate choice copying is intrinsically social, i.e. is a means of using social information provided by other females, an interesting question arises. Is mate choice copying its own distinct set of behaviours or is it that mate choice copying is merely social learning which only appears to be mate choice copying because it is researched and framed in a mate selection context? If choice copying extends beyond mate choice into more social realms then it is possible that the literature may be implying a specialised evolved mate selection mechanism when, in fact, mate choice copying is adequately explained by a more generalised social copying. There are a number of reasons for thinking this may be so.

First, data in animal species show that where a task or challenge is complex – as is the case with mate selection—and the cost of trial and error problem solving methods are high, then animals are likely to employ social copying in order to reduce potential cost (Laland,

2004). It has been argued that human societies and cultures have become so complex that most humans could not function or successfully navigate without social learning and copying (Boyd & Richerson, 1995, 1996; Boyd et al., 2011). Second, data show that “copy from the most successful” strategies often permeate both human culture and animal society. For example, in animal studies, low ranking social members are less influential over the behaviour of others than high ranking members (Drea & Wallen, 1999; Nicol & Pope, 1994). In human societies a good example of this can be found in celebrity culture. Despite having few formal qualifications celebrity status regularly informs public opinion on specialised topics such as politics, health and scientific endeavours. On less formal topics celebrity status strongly influences fashion and cultural trends. In mate choice copying research this status copying is reflected in Vakirtzis and Roberts’ mate quality bias research (Vakirtzis & Roberts 2010, 2012). These arguments suggest that copying should occur in multiple differing contexts, including mate choice and social choices.

To date, though not exactly a measure of social copying, the closest examination of this delineation between social and mating copying can be found in Little et al. (2015). In this experiment they carried out a mate choice copying experiment in which men were paired with women who had been physically manipulated to either appear socially unpopular or socially popular. They did this to investigate how the social popularity of the copied woman altered participant mate choice copying behaviour. Men who were paired with popular women received higher ratings of attractiveness compared to men paired with less popular women. In a follow up experiment they reversed the target and model so that participants had to rate the attractiveness of women paired with men of varying popularity. This was done to check whether the influence of social popularity over choice copying was specific to a mating context (i.e. to judging men romantically) or to wider non-mating contexts (i.e. to judging women). They found no effect of pairing on the rated attractiveness of women and conclude that this shows that the impact of social popularity upon choice copying appears to be specific to a mating contextualisation.

In mate choice copying research it is reasonably well established that pairing images of men with images of women improves the perception of various attributes possessed by men. For the sake of clarity, call this simple comparison between single and paired men a “primary pairing effect”. Within this primary pairing effect exist other subtle secondary pairing effects e.g. the attractiveness or, as is the case here, the popularity of the man’s partner modulating ratings given to men. Little et al establish that the perceived popularity of a man does not alter the attractiveness ratings given to same sex individuals. Essentially, they establish that this specific secondary pairing effect does not influence ratings in a social as opposed to a mate choice copying context. However, it is not clear whether a primary copying effect exists for social contextualisation in the same way that it does for a mate contextualisation. That is to say, it is unknown whether presenting a same sex model alone or paired with another individual would generate a copying effect. In assessing a secondary copying effect Little et al assume, whether correctly or not, that a primary pairing effect exists outside of a mate choice context. This needs to be clarified because if a socially driven primary pairing effect does not exist then this serves to reinforce the conclusion that mate choice copying is separate from social copying. If a primary pairing effect does exist, then it is possible that the differing results reported by Little are of methodological origin rather than existing because of a delineation between mate choice copying and social copying.

5.3.1: Delineating boundary effects in this experiment

Little et al. (2015) kept men and women in both of their contextual mate choice copying and contextual social choice copy conditions. The experiment conducted in this chapter sought to follow the more rigorous methodological separation used within Godin et al.’s animal study by removing the influence of men entirely from social choice stimuli. To address a point of potential criticism, if a social and mate choice copying effect are found, it could be argued that both of these behaviours are a part of a more generalised rule by which a “copy everything” heuristic is applied rather than a context specific social or mate choice driven copying behaviour. In order to pre-emptively address this, a control condition was

added to provide a condition with both no mate choice connotations and a reduced social connotation. Thus three experimental conditions were developed. First, the standard mate choice copying stimuli set was used. This served as a replication attempt for mate choice copying following the failed replication of the previous chapter and provided the mating specific context to this experiment. Second, a social copying pack was used. All males were removed from the stimuli set and were replaced with images of women. Third, an object copying stimuli set assessed the “copy anything” objection described above. In this stimuli set target image were replaced with a fashion item. Though it is not possible to remove all social influence from this object set, this minimised social judgement by enforcing ownership judgement rather than social judgements. Please see section 5.4 for further details on the production of stimuli.

5.3.1: Hypotheses

If choice copying only exists in a mating context, then this adds to the argument that mate choice copying is an evolved adaptive and mating specific behaviour expressed by humans. If choice copying applies outside of a mating specific context, then it is possible that a more general copying exists and that literature is assigning meaning to human mate choice copying where it need not be applied. Given that choice copying – specifically the influence of high status others – underpins a lot of advertisement and product placement marketing strategies, one would expect copying to exist outside of mating specific contexts. Therefore, the following hypotheses can be generated

H3: If choice copying is mating specific then participants should rate paired targets more attractive in mate choice copying stimuli set only.

H4: If copying is socially driven rather than mating specific then participants should rate paired targets more attractive in both mating and social contexts only.

H5: If copying is a product of a “copy everything” heuristic then participants should rate all paired objects more attractive than unpaired objects.

5.4: Method

5.4.1: Design

In the age comparison analysis, a two (pre-rated attractive male vs pre-rated unattractive male) by three (pairing condition: single vs attractive pairing vs unattractive pairing) by two (age: young vs old) experimental design was used. Ratings of attractiveness provided to pre-rated attractive and pre-rated unattractive men were dependent variables. Age group and pairing condition formed between subject measures. This design used ratings provided to male images as the unit of analysis whilst also including participant information (i.e. age data). Consequently, a MANOVA was used for analysis. The boundary check ran an additional ANOVA analysis. This ANOVA was comprised of a two (age: young vs old) by two (pairing: paired vs unpaired) by two (stimuli type: social vs object) mixed design with age group and stimuli pairing being between subject elements and the image pairing state being a repeated measures element.

5.4.2: Participants

Two groups of participants were recruited: 35 participants aged between 15-16, with a mean age of 15.57 (SD = 0.55) and 112 university aged participants aged between 18-38 with a mean of 20.22 (SD = 3.38). All women in the older participant group were heterosexual. For ethical purposes, the sexuality of the younger participant group was not recorded. . Participants from the young group were recruited from local schools. They also completed the research via an online survey. University aged participants were recruited online and completed the questionnaires online. They were rewarded with course credit for taking part

5.4.3: Materials

Three variants of the standard experimental stimuli set were used. Each of the stimuli sets contained 20 images. The mate choice copying stimuli set contained its standard pairing configuration: men unpaired, men paired with an attractive woman, and men paired with an unattractive woman. The social and object copying sets had two versions: one in which stimuli

were presented unpaired and one in which stimuli were presented paired with a woman. These three stimuli sets are detailed below.

1. Mate choice copying: The standard mate choice copying stimuli sets were used. These were accompanied by a statement describing men as either single or in a relationship with the pictured woman. A 1-9 Likert scale was used for measuring perceived attractiveness. See chapter 3 for more details.
2. Social choice copying: This was very similar to the above stimuli set except that all pictures of men were replaced with pictures of women. In the unpaired condition participants would see an instructional statement which read “*on the following pages you will see a number of women. Please rate them on how attractive you think they are*”. In the paired stimuli set two women would be pictured together. These were the same women used in the pairing conditions of the mate choice copying set. The images were accompanied by an instructional statement which read “*On the following pages you will see images of close friends. Please rate the woman on the left on how attractive you think she is*”. This design reduced the contextualised mate selection focus of the stimuli.
3. Object copying: this stimuli set was similar to the two above sets. In this set target people were replaced with a fashion object, in this case a handbag. Participants rated them alone or with another woman. In the unpaired condition participants were presented with the following text instruction: “*On the following pages you will be presented with a series of handbags. Please rate them on how attractive you think they are*”. For the paired condition participants saw the following text instruction: “*On the following pages you will be presented with pictures showing a series of handbags and their owners. Please rate the bags on how attractive you think they are*”. Though this does not fully reduce the social context of stimuli, the focus on ownership should be sufficient to differentiate between socially driven copying and a generalised copy anything bias.

Though not presented in this chapter, participants over the age of 16 also completed the following personality questionnaires: ‘Socio-sexual Orientation Inventory’ (Penke & Asendorpf, 2008), ‘Self-perceived Mating Success Scale’ (Landolt, Lalumière, & Quinsey, 1995), ‘Big 5 Personality Inventory’ (Benet-Martinez & John, 1998), and the ‘Dark Triad Measure’ (Jones & Paulhus, 2014). This was done to investigate the effects of participant personality upon mate choice copying. Results of this and the rationale for inclusion can be found in chapter 9. Finally, a brief demographics questionnaire was included to record participant age and sexuality (for the older participant group), and to ask participants what they thought the purpose of the research was. This last question was used as a manipulation check. No participant guessed the purpose of the research. All questionnaires were presented on the Qualtrics online survey software (Snow & Mann, 2013).

5.4.4: Procedure

The following experimental procedure was ethically approved by the Department of Psychology Ethics Committee faculty at Northumbria University. Consent was given by the schools for the recruitment of participants under the age of 16. Upon entering the online system, participants stated whether they were under or over the age of 16. Differing answers took participants down a different experimental procedure. Participants saw an information sheet detailing what they would need to do, tailored to their age group.

Participants under the age of 16 were presented with a version of the mate choice copying stimuli set, the social copying set and the object copying sets. Within each set category (mating, social or object contextualisation) participants were randomly assigned either a paired stimuli set or an unpaired stimuli set. These were counterbalanced and randomly ordered between the three stimuli set types. Following completion of these questionnaires participants were presented with the demographics questionnaire before being debriefed and finishing the experiment.

Those over the age of 16 took part in the same procedure but in addition, following the completion of the copying stimuli sets, participants also completed the personality

measures in a randomised order before completing the demographics questionnaire and being debriefed. All participants reported what they thought the purpose of the experiment was and also reported their age. This was so that participants could be categorised correctly if they had accidentally selected an incorrect age bracket at the beginning of the procedure.

5.5: Results

5.5.1: Age effects

In this subsection I report the effects of mate choice copying upon the rated attractiveness of men and how age interacts with mate choice copying. No mate choice copying effect was present in the data [Figure 5.1; $F(4,280) = .808, p = .521, \eta^2 = .11$]. Attractive men paired with women, regardless of the woman's attractiveness, were not rated as more attractive than single men [$F(2,141) = 1.730, p = .266$] (Figure 5.1). Similarly, unattractive men did not receive different ratings when they were paired compared with unpaired [$F(2,141) = .505, p = .333$] (Figure 5.2). A marginally significant effect of age exists on ratings [$F(2,140) = 3.06, p = .050, \eta^2 = 0.42$]. Attractive men were rated significantly less attractive by the younger group of participants (mean = 4.196, SE = .195) compared to the older group of participants (mean = 4.653, SE = 0.107) [$F(1,141) = 4.211, p = .042, \eta^2 = .29$]. No significant difference exists in ratings of attractiveness given to unattractive men by the younger group (mean = 2.710, SE = .211) compared to the older group (mean = 2.515, SE = .116) [$F(1,141) = .651, p = .421, \eta^2 = .005$]. No significant interaction exists between age group and image pairing condition [$F(4,280) = .231, p = .921, \eta^2 = .003$].

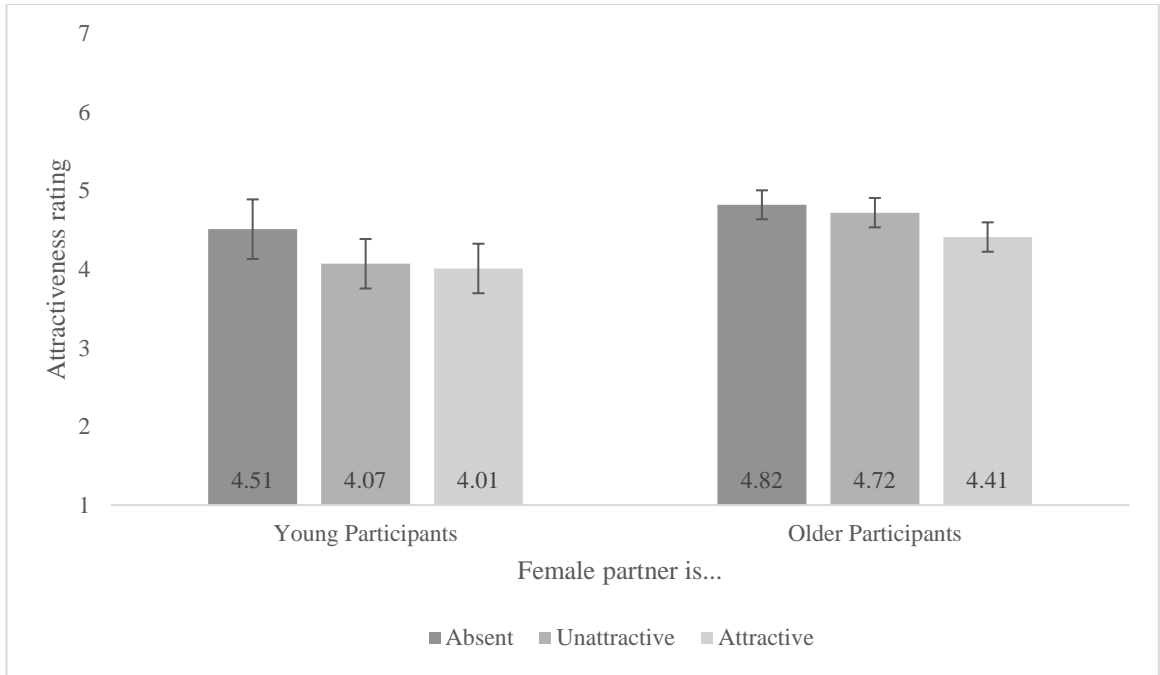


Figure 5.1: shows the mean and standard error for attractiveness ratings provided by both younger and older participants for pre-rated attractive males in each of the three pairing conditions.

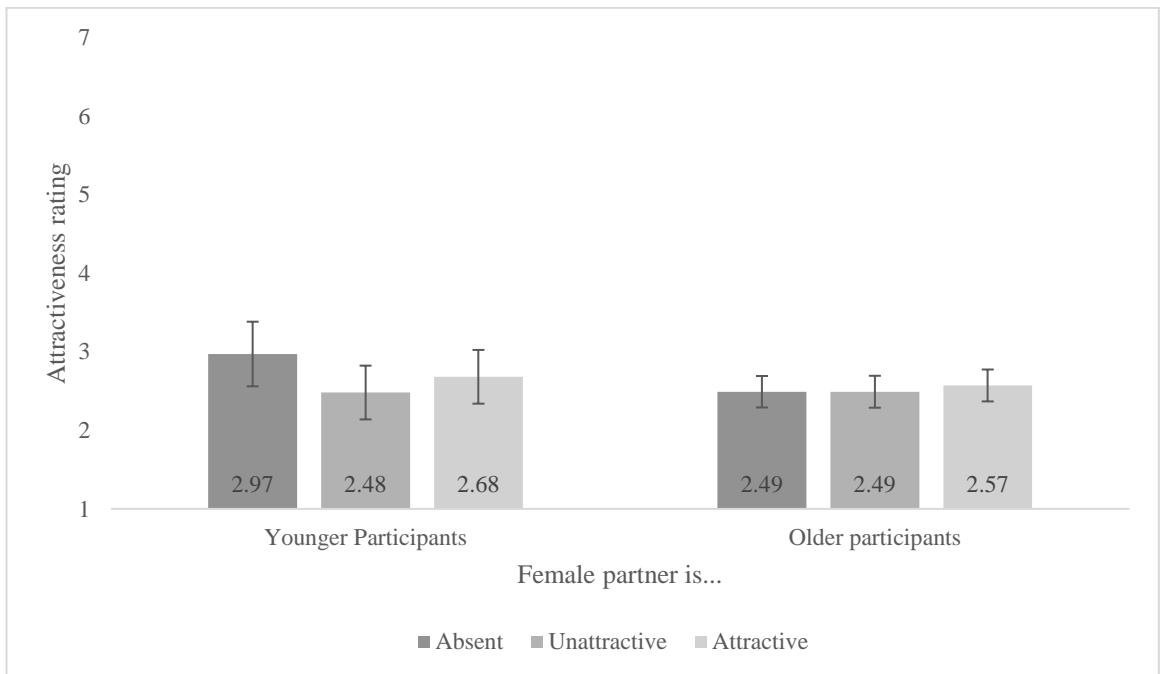


Figure 5.2: shows the mean and standard error for attractiveness ratings provided by both younger and older participants for pre-rated unattractive males in each of the three pairing conditions.

5.5.2: Boundary effects

Here I report inferential statistics for attractiveness ratings provided to targets in the social copying and object copying stimuli sets (Figure 5.3). There was an overall significant effect of copying [$F(1,38) = 6.914, p = .012, \eta^2 = .154$]. A significant overall effect of pairing was found [$F(1,38) = 4.885, p = .033, \eta^2 = .114$]. Paired images (mean = 4.666, SE = .090) were rated overall as less attractive than unpaired images (mean = 4.897, SE = .093). As a group, objects (mean = 4.535, SE = .119) were rated as significantly less attractive than women in the social stimuli set (mean = 5.028, SE = .121). Finally, a marginally significant effect of age existed [$F(1,38) = 4.099, p = .050, \eta^2 = .097$]. Younger participants (mean = 4.630, SE = .106) rated stimuli, regardless of whether they belonged to the object or social stimuli set, as less attractive than older participants did (mean = 4.934, SE = .106). No interaction existed between age and stimuli set category, age and pairing condition, or between age, stimuli type and pairing condition (all p 's >0.05). Though no significant interaction effect between age and pairing condition was present, it is likely that the significant effect of image pairing was driven non-significant interactions. Namely, by a combination of non-significantly lower ratings given to women in the socially paired stimuli set by younger participants and non-significantly lower ratings given to paired objects by the older participants.

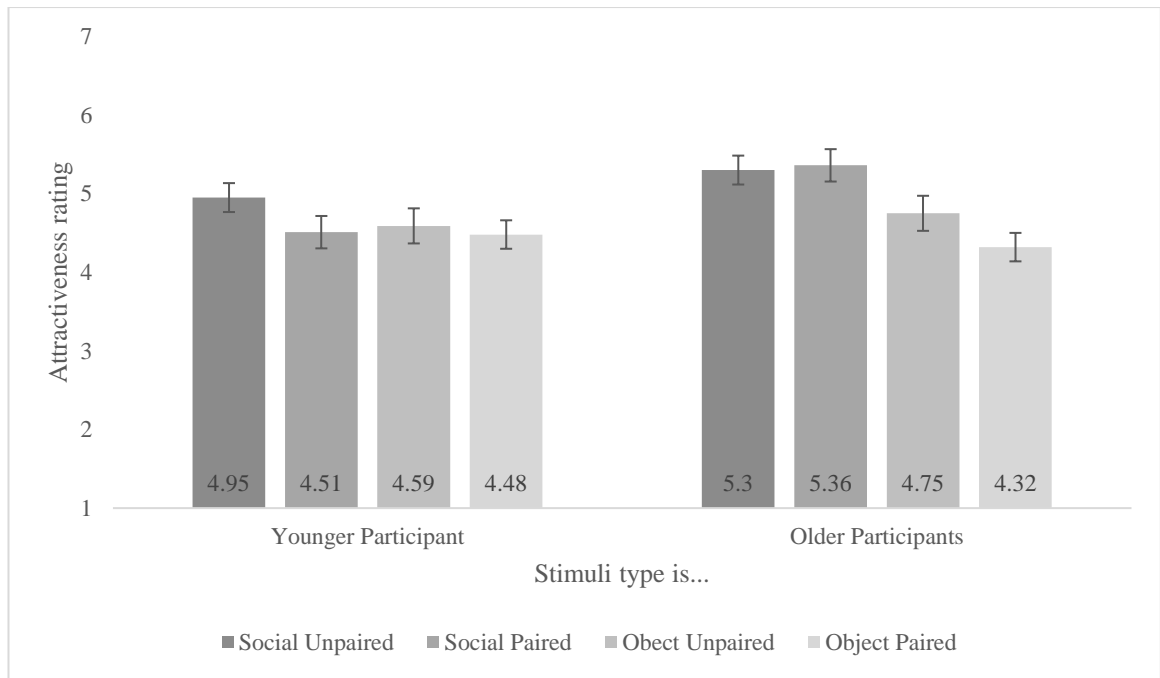


Figure 5.3: shows the mean and standard error for attractiveness ratings provided by both younger and older participants for social and object stimuli.

5.6: Discussion

5.6.1: Age effects

It was hypothesised that younger participants would either show mate choice copying to a greater extent than older participants or that older participants would not demonstrate mate choice copying whilst younger participants did. Interestingly, despite predictions to the contrary, both younger and older women demonstrated a similar response pattern. Neither age group demonstrated mate choice copying behaviour. The only difference between the two age groups was that younger women were less willing to award higher attractiveness ratings to pre-rated attractive men than older participants were. Animal literature suggests that younger, inexperienced females are likely to copy the choice of more experienced females (Dugatkin & Godin, 1993). This has also been tested in humans in a number of recent publications (Bowers et al., 2012; Little et al., 2015). However, this was not replicated in present data. There are a number of possible explanations for why results do not match expectations.

It is possible that adolescents between the ages of 15 and 16 are still too old to be considered naïve to mate selection in the same way that Dugatkin's fish were. Recent research investigating the sexual behaviour and sexual identities of adolescent girls found that the mean age of heterosexual girls' first sexual experience was 13.8 (SD = 0.6) years old (Ybarra et al., 2016). Further, in their sample of 13 to 18 years olds the average number of total sexual partners was 4.5 (SD = 0.1). In the population of fish used to inspire many of the hypotheses about human age related effects, fish were virgin and entirely naïve to the mating market. They had not engaged in mate selection prior to experimental manipulation and so had no experience to draw upon. If adolescent women are engaging in sexual activity at an average age of 13.8 then it is likely that by the age of 15-16 they are no longer naïve to mate selection nor are they likely to be naïve to the mate preferences of peers. Therefore, where a truly naïve population may express mate choice copying, the sample recruited here were not truly naïve and may not express mate choice copying for this reason. An important point of consideration, however, is that the school from which the adolescents were recruited was single sex. It is possible that they may have less sexual experience than a population of a similar age from a mixed school and the population of Ybarra et al. (2016).

A further point is that adolescents are not devoid of feedback over which type of men are socially preferable. Media exposure can dramatically influence attractiveness preferences (see Swami & Tovée, 2005 for a discussion). It is possible that by the age of testing, social learning derived from media may already be sufficient to impact upon any possible mate choice copying effects. This latter point poses a major issue for age related mate choice copying research for the following reasons: research shows that mate choice copying is likely to occur when the model is considered high value (Vakirtzis & Roberts, 2010). Additional research shows that when mate choice copying occurs it can alter trait preferences of women both immediately and for future mate selections (Kniel, et al., 2015). Thus mate choice copying does not just benefit the man who was originally selected but also benefits men who possess similar traits. As younger individuals are exposed to media rich in high quality, same

sex peers, who regularly express mate preferences, it is possible that trait preferences have already been influenced by media exposure by the time of testing. This is important because, if mate choice copying is most likely to occur when females are fully naive to mate choice, then where people are exposed to sufficient media to have their preference for male traits altered, it may not be possible to cleanly test the effects of age upon mate choice copying.

A final possibility is that age may not influence whether mate choice copying occurs in humans. In the previous chapter we found that mate choice copying was not present in the data. In that chapter the likely low power of the research meant that interpretation of results was difficult. Data in this chapter likely do not suffer from being underpowered – analysis shows that sufficient participants were recruited to detect effects at the both the *a-priori* estimated effect size and the actual effect size of reported results – and yet still does not produce a mate choice copying effect. The possibility arises that either the stimuli do not trigger a mate choice copying effect or that mate choice copying may be less apparent than the literature suggests.

Two points to address these possibilities: first, wider research has used similar photographic stimuli as an experimental manipulation and has produced a mate choice copying effect (see chapter 2 and 3 for a number of examples). Stimuli issues are therefore unlikely to be responsible for a lack of a measured mate choice copying effect. Second, mate choice copying literature is mixed. Some research has previously failed to find mate choice copying effects (Brooks, 1996; Koranyi, Gast, & Rothermund, 2013; Uller & Johansson, 2003) but such research is in the minority of published literature. In order to support the hypothesis that mate choice copying is less replicable than is reported in literature, it is necessary to run a replication experiment. This because the previous experimental chapter lacked power and because a single null experiment (presented in this chapter) is not sufficient to confidently draw conclusions. It was hypothesised that younger women should demonstrate more mate choice copying than older participants but in this experiment neither group displayed a mate choice copying effect. If mate choice copying is less apparent than is suggested by the

literature, then age would not have a visible effect except in those who actively display mate choice copying. Of the experiments investigating the effects of age upon mate choice copying, two, Bowers et al (2012) and this experiment have produced null results. Unlike Bowers et al., however, there was no evidence of mate choice copying in this data set. Only Little et al. (2015) produce a positive result. One possibility is that Little et al.'s wide age range (they recruited participants up to age 52) made differences in the recorded expression of mate choice copying visible. In this case the point at which age becomes a factor would be in older participants rather than in the very young or university aged participants. The lack of mate choice copying make conclusions are difficult to draw, however.

5.6.2: Boundary conditions

It was hypothesised that if choice copying was a mating specific adaptation, then copying would occur in a mating specific context only. If choice copying was a more general social copying, then it should be expected that copying would occur for both mate choice and social choice stimuli sets. If choice copying is simply a “copy anything” heuristic, then all three stimuli sets would provoke choice copying. No effect of choice copying was found for mate choice, social choice or object choice copying stimuli sets. Paired objects were rated less attractive overall compared with single objects. This is most likely due to non-significantly lower scores provided by young participants to socially paired women and non-significantly lower scores provided to paired objects by older women.

There are number of distinct reasons why the stimuli may have failed to produce copying effects. For contextually social stimuli, the presence of a single female image may not be sufficient to generate social choice copying. Real world social interaction and judgment occur in an information rich environment. For example, information is gathered from social status judgements, the known behaviour of a potential target, and the desirability of either the individual being copied or of the target (Benzeval et al., 2013; Mast & Hall, 2004; Quist, DeBruine, Little, & Jones, 2012). In photographic stimuli very little of that information is

readily available. It is therefore possible that whatever information is contained in an image, it is insufficient to cross the threshold to trigger social copying.

For object stimuli, it is possible that mate choice copying, social copying and object copying are assessed and influenced by differing underlying processes. As an example, the objects which participants rated were handbags – a fashion item. An important element of fashion preference is that items make a unique statements about a person (Stanforth, 1995). Research shows that those with a keen fashion sense view themselves as more colourful, vain and domineering than those who are less fashionable (Goldsmith, Flynn, & Moore, 1996). Presenting handbags together with another woman may instantly have devalued the item because it would no longer contribute towards crafting an image of uniqueness, therefore copying effects would not occur. This would explain the lower scores for objects when they were paired with women compared to when they were presented alone. Note however, that fashion advertisement works by presenting objects with high status individuals. This would seemingly stand in contrast with the above reasoning but if object copying is triggered by extremely high status individuals (i.e. fashion models and celebrities) then the devaluing explanation may still hold. It is possible that because the females who were paired with the bags were not sufficiently high status, copying behaviour may not have been triggered.

Wider literature shows that presenting men with other women increases the value of the man rather than decreases his value (see Vakirtzis, 2011 for a review). This research shows that social or object stimuli sets are rated lower when they are paired with women than when they are unpaired. It is possible that the motivation underpinning object judgement or social judgement is distinctly different from the motivation reported to underpin mate choice copying. Combining these two above stated points offers tentative support to Little et al. (2015)'s conclusion that social copying does not occur in the same context as mate choice copying. This, however, is stated with an important caveat: the lack of mate choice copying in this experiment does not allow us to conclude that social copying is separate from mate choice copying merely that, as with Little et al, we were not able to generate social copying. This null

result is true even when the possible confound of mate choice contextualisation was removed from Little et al.'s original social manipulation.

5.7: Chapter and section overview

In both this and the previous chapter I investigated factors internal to or possessed by a woman which may influence her expression of mate choice copying behaviour. I examined how ovulatory shifts in hormones and the participants' age alter mate choice copying behaviour. I also investigated whether choice copying was mate selection specific or whether mate choice copying is hedged within a wider social copying behaviour. I found that age and ovulation had no visible effect on the expression of choice copying behaviour. Nor did I find any evidence of a more general copying effect. Indeed, contrary to prediction, mate choice copying itself did not present in any of the data collected so far. In section 2 of this thesis I will look at how mate choice copying alters the perception of traits possessed by men themselves. Specifically, in the next chapters I will investigate two important male attributes which can dramatically affect a woman's mate selection behaviour: perceptions of men's faithfulness and perceived mate attainability – or how easy it is to acquire a given man as a potential partner. Further, in order to check that the stimuli actually generate a mate choice copying effect I will further replicate the standard mate choice copying questionnaire.

Section 2:

Mate Choice Copying and The Perception of Male Traits

Chapter Six: The Perceptions of Faithfulness

6.0: Chapter overview

In the previous section, two experiments investigated how aspects of biology influenced mate choice copying. Neither of these experiments generated a mate choice copying effect. This implies either that the stimuli are insufficient to trigger mate choice copying, or that the mate choice copying effect is less reliable than is suggested by the wider literature. In this section of the thesis, we will turn our attention towards the effect mate choice copying has upon the perception of traits possessed by males. With the above in mind, this chapter has two primary goals. First, a replication of the mate choice copying effect is needed in order to confirm whether the stimuli manipulation is capable of producing a mate choice copying effect. Second, we will investigate how mate choice copying alters the perceived faithfulness of males as potential partners.

6.1: Riskiness of mate selection

Mate selection is a costly and time intensive activity for females (Andersson & Simmons, 2006). Because the cost of reproduction is high, potential mates must be carefully vetted in order to reduce the risks associated with mate choice. One risk to women is that potential partners may exaggerate their willingness to commit in order to gain access to reproduction. To contextualise this, consider that infidelity in a relationship is cited as one of the primary causes of relationship breakdown and divorce (Amato & Rogers, 1997). More recent research shows that even in circumstances where professional help is sought to resolve marital issues and save relationships post infidelity, relationships still often fail. For example, during counselling 43% of couples who reveal infidelity end up divorcing, whilst 80% of individuals who try to keep infidelity secret end up divorcing (Marín, Christensen, & Atkins, 2014). It is estimated that on average 25% of married men and 15% of married women commit infidelity at least once across a lifetime (Laumann, 1994), although some research suggests that men and women commit infidelity at roughly the same rate (Brand, Markey, Mills, &

Hodges, 2007). Note that such statistics refer specifically to sexual infidelity. Given that infidelity need not be sexual in intent, i.e. can be categorised as emotional only, sexual only, or a combination of the two, this figure likely underestimates the total average number of infidelities committed across a lifetime by individuals (Blow & Hartnett, 2005). Researchers who report on how individuals respond to imagined infidelity generally agree that men and women respond somewhat differently to infidelity. Men tend to display an increased negative response to the sexual infidelity of their partners whereas women tend to show a heightened negative response to emotional infidelities (Regan, 2015), although, not all research supports this position (Harris, 2000). More generally, deception to gain access to sexual relations produces significantly more psychological distress in women than it does in men (Haselton et al., 2005). It is argued that these differing responses exist due to differing reproductive strategies, costs of reproduction, and impact of the consequences of infidelity.

6.2: Consequences of infidelity

The consequences of infidelity were detailed in section 1.5 but, to briefly recap, both relationship unhappiness and potential abandonment during pregnancy or child rearing can negatively affect both a woman's own and her offspring's reproductive success. Where infidelity does not lead to relationship breakup it can lead to an unhappy environment. Infidelity leaves individuals feeling betrayed, untrusting, and can negatively impact upon self-image which often creates a hostile environment (Regan, 2015). Children of parents who were in unhappy relationships have been shown to suffer negative consequences to their own relationship success later in life (Booth & Edwards, 1990). More recent research replicates this and finds that children of unhappy relationships tend to be at greater risk of substance abuse, poorer academic achievement and earlier relationship breakdown than those raised in happy relationships (Musick & Meier, 2010). Where infidelity does lead to relationship breakdown, this can increase the likelihood of having to raise potential offspring alone. Depending upon the socio-economic status of the woman at the time of relationship breakdown, the loss of resources and care giving provided by the male can negatively impact

upon her own ability to provide resources for her children. This is important because lower socio-economic status impacts upon brain development (Jenkins, Woolley, Hooper, & De Bellis, 2013), and the general health of children (Beach et al., 2016a; Beach et al., 2016b). Consequently, the future reproductive success of offspring can be negatively affected by such events. Therefore, selecting a partner who is unlikely to commit infidelity is of evolutionary benefit to women and their offspring.

6.3: The role of mate choice copying

Assessing the likelihood of infidelity prior to engaging an individual in a relationship poses a challenge to women. It requires a significant amount of effort and time to assess the hidden personality traits and quality of a given mate. A possible shortcut to assessing this comes via mate choice copying. Recent research shows that men in relationships are thought to possess more positive personality traits than the same man who is presented as single. For example, participants rate men who are depicted with attractive women as more intelligent, trustworthy, humorous, wealthy, romantic, goal driven, adventurous, generous, and attentive to the needs of others than men who are depicted without women (Rodeheffer et al., 2016). If men are considered more trustworthy and attentive to the needs of others when paired with women then it stands to reason that men with women should be perceived as more faithful potential partners. This is because a trustworthy and attentive individual should be less likely to engage in activity, such as infidelity, which damages or breaks the trust of others. With the above in mind, the following hypotheses can be generated.

6.4: Hypotheses

H1: If mate choice copying alters how men are perceived, then men presented as though they are in a relationship with a woman should be rated as more attractive than men who are presented as though they are romantically single.

H2: If mate choice copying alters how faithful men are perceived, then men presented as though they are in a relationship with a woman should be rated as more faithful than men who are presented as though they are romantically single.

H3: If quality biased mate choice copying occurs, then men who are presented as though they are in a relationship with attractive women should be rated as more attractive and faithful than men who are presented as in a relationship with less attractive women or who are presented as romantically single.

6.5: Methodology

6.5.1: Design

A 2 (male attractiveness: attractive vs unattractive) by 3 (pairing condition: males are presented without a woman and as romantically single, men are presented as in a relationship with an unattractive woman, or men are presented in a relationship with an attractive woman) mixed experimental design was used. Because multiple dependent variables exist and because responses given to attractive and unattractive men are correlated, MANOVA analysis was used to test differences between mean ratings for attractive and unattractive men. This analysis technique was chosen because it more powerfully detects differences in variables that are correlated whilst simultaneously reducing the chance of incorrectly rejecting the null hypothesis across when multiple dependent variables are analysed together (Frost, 2014). There were three dependent variables tested: perceived attractiveness, faithfulness to the pictured woman and likely faithfulness to the participant herself.

6.5.2: Participants

Ninety-three female undergraduate participants were recruited opportunistically from local universities. Participants were aged between 18 and 36 (mean = 20.41; SD = 3.07). All participants described themselves as heterosexual. 46 of the participants described themselves as in a relationship (length varied between 2 month and 16 years with an average length of 1.89 years). 42 described themselves as single and 5 did not declare.

6.5.3: Materials

A modified version of the mate choice copying pack was used. This included the standard attractiveness rating Likert scale but also two questions asking participants to rate both “If you were to select this man as a partner, do you think he would remain faithful?” and

“Do you think this man would remain faithful to his partner?”. Note that for this final question, where the male was described as single, this question was phrased “If this man had a partner, do you think he would remain faithful to her?”. These differing questions were asked to ascertain whether the male was thought of as generally faithful or whether any perceptual difference depended upon whether it was framed in reference to the participant herself or to the man’s fictional partner. Packs were printed on paper together with a short demographics questionnaire. The demographics questionnaire requested information about participant age, relationship status and sexual orientation.

6.5.4: Procedure

This procedure was approved by the Department of Psychology Ethics Committee at Northumbria University. The same script was used to initiate participant recruitment: “I am recruiting participants to take part in a study for a psychology PhD. Would you like to take part?”. If participants were interested they were provided with an information sheet and gave informed consent. Due to the nature of opportunistic recruitment occasionally participants were recruited in groups. Where this was the case participants were instructed to “Please keep your responses to the questionnaire private and try not to confer over responses”. This was done to protect the manipulation of the mate choice copying packs. Because each male was paired with a different female in each pack, if participants were to confer over answers then they would see men paired with different women and thus destroy the illusion that they were couples. With manipulation preservation taken care of participants were presented with the mate choice copying pack and demographics questionnaire. Order of the two questionnaires was counterbalanced and randomly ordered. Order of the individual stimuli within the pack was also randomly ordered and counter balanced. Participants were fully debriefed following completion of the questionnaire packs.

6.6: Results

6.6.1: Overall effects

MANOVA analysis showed a significant overall main effect of initial male attractiveness upon the three dependent variables [Wilks' lambda $F(3, 16) = 17.572, p < .001, \eta^2 = .767$]. First, pre-rated attractive men (mean = 4.91, SE = 1.91) were rated as more attractive than pre-rated unattractive men (mean = 2.88, standard error = 1.91) [$F(1,18) = 56.334, p < .001, \eta^2 = .758$]. Second, no statistically significant difference between the perceived faithfulness of attractive men (mean = 5.78, SE = 1.52) and unattractive men (mean = 6.218, SE = 1.91) towards the woman he was pictured with was evident [$F(1,18) = 4.148, p = .057, \eta^2 = .187$]. Third, there was no difference between the perceived faithfulness of attractive men (mean = 5.84, SE = 1.45) and unattractive men (mean = 6.172, SE = 1.45) towards the participant herself [$F(1,18) = 2.693, p = .118, \eta^2 = .130$].

A significant overall main effect was found between the pairing condition of images and the three dependent variables [Wilks' lambda $F(6,13) = 7.158, p = .002, \eta^2 = .768$]. First, attractiveness ratings were affected by image pairing [$F(2,36) = 6.364, p = .004, \eta^2 = .261$]. Men who were presented as romantically single were rated less attractive than men presented in a relationship with women who belonged to a different attractiveness grouping than themselves (i.e. unattractive men with attractive women and vice versa) (mean difference = -2.73, SE = .73, $p = .004$). No significant differences exist between the congruent pairing and any other pairing (all p 's $> .05$). Second, men's faithfulness to the pictured woman was significantly affected by pairing condition [$F(2,36) = 18.786, p < .001, \eta^2 = .497$]. Men paired with women of the opposite attractiveness grouping were perceived as more faithful partners than single men (mean difference = .381, SE = .058, $p < .001$) and men paired with women of the same attractiveness grouping (mean difference = .353, SE = .073, $p < .001$). No difference existed between single men and men paired with women of the same attractiveness (mean difference = -.027, SE = .081, $p = 1.00$). Third, perceived faithfulness towards the participant herself was also significantly affected by image pairing [$F(2,36) = 8.858, p = .001, \eta^2 = .330$].

Men paired with women of the opposite attractiveness group were perceived as more faithful than single men (mean difference = .246, SE = .051, $p < .001$) and more faithful than men paired with women of the same attractiveness grouping (mean difference = .241, SE = .076, $p = .011$). No difference existed between single men and men paired with women of the same attractiveness (mean difference = -.005, SE = .071, $p = 1.00$).

A significant interaction effect existed between male attractiveness and pairing condition [Wilks' lambda $F(6,13) = 13.00$, $p = .001$, $\eta^2 = .790$]. Therefore, in order to investigate this interaction, data were split by male attractiveness grouping and the analysis re-run.

6.6.2: Interaction effects

6.6.2.1: Attractive men

No overall effect was present for image pairing in relation to any of the dependent variables [Wilks' lambda $F(6, 32) = 1.163$, $p = .350$, $\eta^2 = .179$] (Figure 6.1).

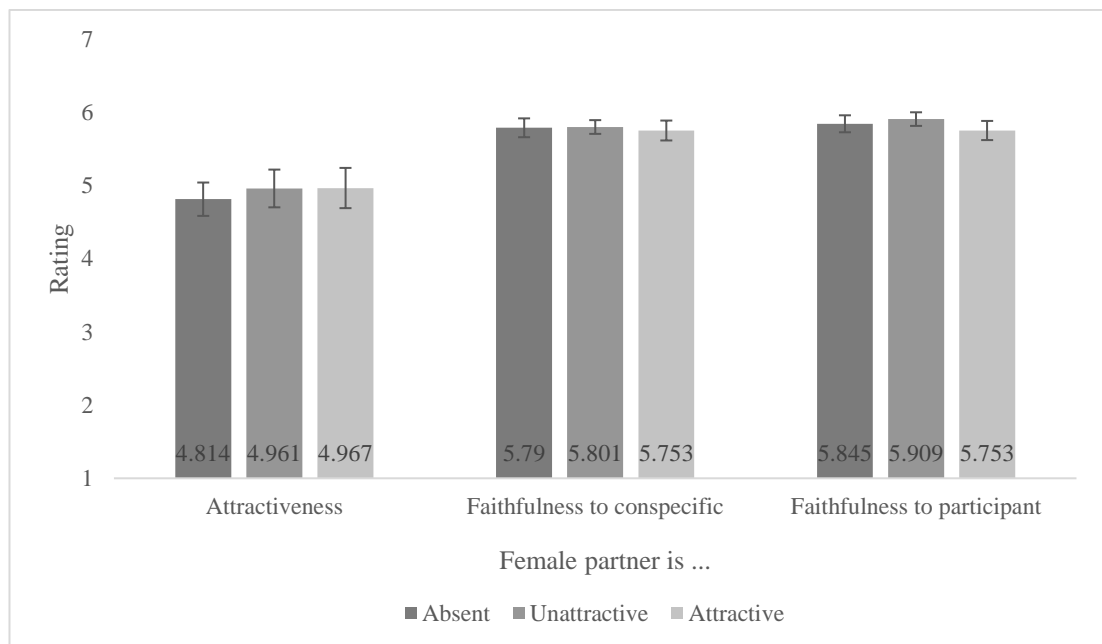


Figure 6.1: Ratings of attractiveness, faithfulness to pictured woman and faithfulness to participant given to pre-rated attractive men in each of the three pairing conditions.

6.6.2.2: Unattractive Men

A significant overall main effect exists for image pairing in relation to the three dependent variables [Wilks' lambda $F(6,32) = 10.254, p < .001, \eta^2 = .843$]. There was a significant effect of pairing on attractiveness ratings [$F(2,18) = 12.869, p = .001, \eta^2 = .588$] (Figure 6.2). There was no difference between single men (mean = 2.67, SE = .90) and men paired with less attractive women (mean = 2.91, SE = .143) [mean difference = -.239, $p = .082$]. However, men were rated as significantly less attractive when they were single compared to when they were paired with attractive women (mean = 3.07, SE = .149) [mean difference = -.399, $p = .002$]. (Figure 6.2).

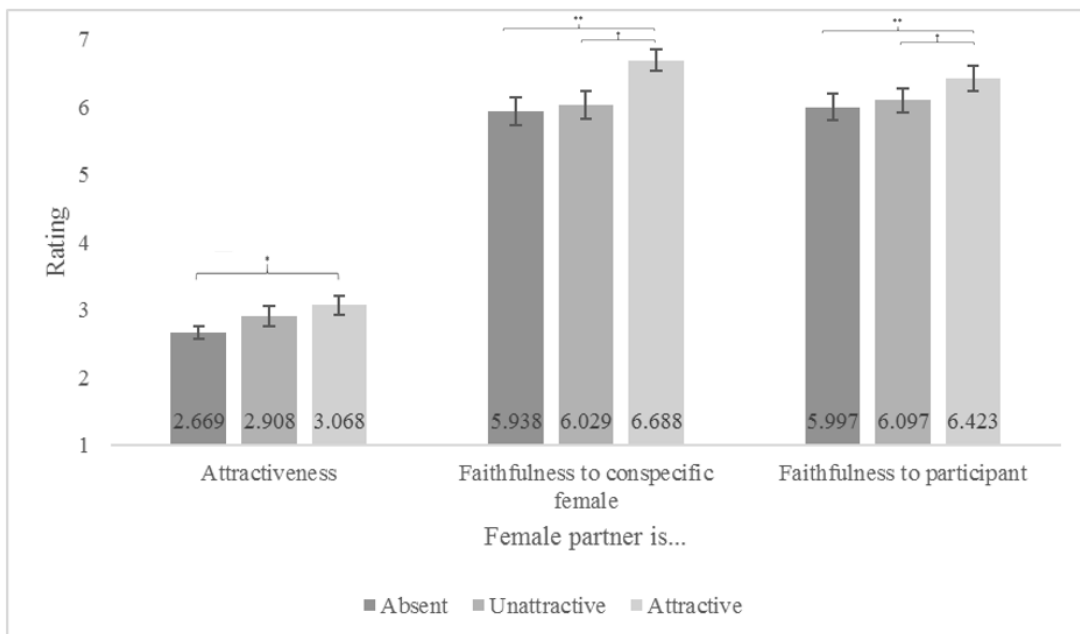


Figure 6.2: Ratings of attractiveness, faithfulness to pictured woman and faithfulness to participant given to pre-rated unattractive men in each of the three pairing conditions. * $p < .05$, ** $p < .001$.

There was a significant effect of image pairing upon rated faithfulness to the pictured woman [$F(2,18) = 36.641, p < .001, \eta^2 = .803$] (Figure 6.3). There was no statistically significant difference between single men (mean = 5.94, SE = .207) and men paired with unattractive women (mean = 6.03, SE = .211) [mean difference = -.91, $p = 1.00$]. Men paired

with attractive rated women (mean = 6.69, SE = .165) were rated as significantly more faithful to the pictured woman than single men [mean difference = .750, $p < .001$]. Similarly, men paired with attractive rated women were perceived as significantly more faithful than men paired with less attractive women [mean difference = .659, $p < .001$]. (Figure 6.2).

There was a significant effect of image pairing upon ratings of faithfulness towards the participant herself [$F(2,18) = 12.690$, $p = .001$, $\eta^2 = .585$] (Figure 6.4). There was no statistically significant difference between single men (mean = 5.997, SE = .190) and men paired with unattractive women (mean = 6.10, SE = .178) [mean difference = -.101, $p = .999$]. Single men were rated as significantly less likely to be faithful to the participant than men paired with attractive rated women (mean = 6.42, SE = .192) [mean difference = -.427, $p = .001$]. Men with unattractive women were rated as significantly less likely to be faithful to the participant than men with attractive rated women [mean difference = -.326, $p = .19$]. (Figure 6.2).

6.7: Discussion

It was hypothesised that men perceived as in a relationship with women would be rated as more attractive and more faithful than men perceived as romantically single. Regardless of the questions asked, ratings provided to pre-rated attractive men were not influenced by mate choice copying. This was not the case for unattractive rated men who were rated highest, both for attractiveness and faithfulness, when they were with attractive rated women.

In the animal literature, mate choice copying has been shown to influence trait perception mainly when it is difficult to differentiate between the quality of potential mates. For example, where females are presented with a choice between males who are similar in quality, then mate choice copying is employed. Where males differ significantly in quality then females do not rely upon mate choice copying (Brooks, 1996). Brooks (1996) argue that

because it is beneficial to select the highest quality mates, even when male quality differs only slightly, it is in the interest of females to use any information which allows quality to be ascertained. Using experienced others to aid in quality differentiation when it is difficult to identify male quality is a viable means of reducing the uncertainty associated with selecting a mate. Therefore, where quality is not clearly visible, mate choice copying is likely to occur. Where quality is plainly visible, as is the case with attractive men, then there is no need to employ mate choice copying as a means of identifying quality. This may explain why attractive men do not benefit from the effects of mate choice copying. All male stimuli were presented together – attractive men alongside unattractive men – and so the quality of these attractive men was therefore plainly differentiated from less attractive men. Mate choice copying was not employed for attractive men because there was no need to infer their quality when it was visible. Correlates for this type of behaviour have been observed previously. For example, evidence suggests that attractive individuals are thought to possess more positive traits than less attractive individuals, regardless of the actual traits they possess (Benzeval et al., 2013). The same above reasoning can also explain why unattractive men did benefit from mate choice copying. They do not have plainly visible quality and therefore participants seek information with which to assess quality, i.e. the presence of other females. That mate choice copying was observed for unattractive men has a number of important implications.

First, because unattractive men were rated as more attractive when paired with attractive rated women compared to when single this shows that stimuli are capable of generating a mate choice copying effect. In the previous section we were unable to replicate any mate choice copying. This solidifies usage of stimuli for further research but also suggests that mate choice copying may not be as reliable as is suggested by literature. Second, this evidence supports the idea of quality biased mate choice copying (Vakirtzis, 2011; Vakirtzis & Roberts, 2010). This is because only the most attractive women generated a mate choice copying effect. Data are suggestive of a further modification to this quality biased mate choice copying in that only the most attractive females generate mate choice copying whilst only the

lowest quality males benefit from this effect. Third, there was no difference in rating patterns between perceived faithfulness towards the pictured woman or the participant herself. One of the possible criticisms of presenting participants with images of men and women together and having them rate men on faithfulness is that it is difficult to know whether judgements of faithfulness are a true reflection of the perceived trait possessed by the male or whether intra-sex comparison fundamentally influences this perception. In other words, when assigning a faithfulness rating to a male, is the judgement of the participant a function of comparing her own value to that of the photographed woman and judging the likelihood of the male remaining faithful in light of her own attractiveness? If this was the case, then a difference between the two faithfulness rating questions would be expected. Ratings of faithfulness to herself would present as an inverse relationship to the ratings she provided for faithfulness to the photographed woman (a woman thought of as less attractive would generate low faithfulness scores to the photographed woman whilst simultaneously generating high faithfulness scores to herself). No such difference was found. The similarity in response patterns suggests participants are rating male faithfulness more generally as a trait possessed by the individual. In which case, for unattractive men, mate choice copying appears to influence the perception of this particular hidden trait.

A number of recent research articles have shown that male hidden characteristics benefit from mate choice copying (Rodeheffer et al., 2016). Further, recent research suggests that quality biased mate choice copying works because the attractiveness of the male's partner indicates the quality of hidden traits possessed by men (Vakirtzis & Roberts, 2012). Data presented in this chapter offer additional support to this hypothesis. Males with attractive women are perceived as more faithful partners which, together with the above cited research, contribute towards overall mate value and therefore to the desirability of the man as a potential partner. An interesting question can be drawn from these findings. If men are perceived as higher value, with more desirable personality traits, and are thought of as potentially more faithful partners, then does this increase the likelihood that these desired men are chosen as

mates? Indeed, some research shows that mate choice copying can alter how likely women are to express an interest in both long and short term relationships with men (Place et al., 2010). It may well be that men are, in fact, preferred as partners when mate choice copying occurs. In this case, women would be likely to pursue chosen men as potential mates. Equally it may be that this preference does not correspond to actual mate choice behaviour. Men already either involved with another woman or desired by many other women may be perceived as less available mates. If the former is true, then this would act to increase the likelihood that men benefitting from mate choice copying are actually chosen as mates. In the next chapter we will investigate this by checking whether men in relationships are perceived as more attainable mates than single men are.

Chapter Seven: Mate Choice Copying and Perceived Attainability

7.0: Introduction

7.1: Chapter overview

In the previous chapter we saw that less-attractive men paired with women were perceived as more faithful partners than single men. Data show that men subject to the mate choice copying effect are thought to possess more positive traits than single men and are therefore likely to be considered desirable mates. Whether this increase in desirability directly translates to an increased probability of selection is unknown. In this chapter I will investigate one such measure of this increased probability of selection – perceived attainability. To be clear, by perceived attainability I mean a woman's belief in the likelihood that a man would reject or accept her attempt to engage in a romantic or sexual relationship with him. For example, a man who is likely to reject the approach of a woman would be considered less attainable than a man who would likely accept the advances of a woman.

7.2: Mate choice copying and attainability

Consider the following: mate choice copying increases the attractiveness of men (Vakirtzis & Roberts, 2010), increases the women's openness to engaging in both short and long term relationships with men (Waynforth, 2007), and alters the perceived possession of hidden but desirable personality traits (Rodeheffer et al., 2016). All of the above taken together suggest that mate choice copying should make men in relationships or men who are desired by other women the preferred choice of mate over men who are not in relationships or desired by others. However, showing a preference for taken or desired men introduces the possibility of costly intra-sexual competition. Attempting to acquire a mate who is already in a relationship, for example, requires actively taking someone else's mate. A man not in a relationship should, on account of being a less costly choice, be a preferable choice. Whether a man is perceived to be attainable, that is, available as a new relationship partner, should therefore depend upon his current relationship status. Consequently, how likely a woman is to attempt to acquire a man in a relationship as partner could be affected by mate choice copying.

The existing literature suggests two ways that the mating mind – the evolved mate selection preferences of women – could interact with mate choice copying to influence the perceived attainability of a man. The first is that the preference for high quality men may bias women into interpreting high quality men as attainable so that women are pushed into pursuing high quality mates. The second is that the costs associated with intra-sexual competition may mean that whilst women perceive men in relationships as higher value, they may also view them as less attainable mates.

7.3: The positive effect of mate choice copying upon attainability

There are two observations which exist to support the hypothesis that women may view paired men as more attainable than single men. The first can be found in the highly selective nature of women. Females of many species, humans included, are highly selective over the mates they choose (see chapter 1). This selectiveness varies to a greater or lesser extent depending upon the woman's own mate value but, importantly, the selective skew is almost always towards acquiring the highest quality male attainable to her (Pawlowski & Jasienska, 2008). Attractive men are highly competitive on the mating market. Their desirability means that high value men can also be selective over the mates they choose (Burriss, Welling, & Puts, 2011). Thus acquiring a high quality man often necessitates that women engage in intense intra-sexual competition to attract such a mate. Yet despite the competition required to obtain high quality men, women still selectively skew their mating efforts towards the highest quality men in a given mating market.

The second observation comes from mate switching research – this is the act of exiting a current relationship for a new partner who is of higher quality. A recent review of this field has revealed that women regularly monitor the quality of men around them so that, should the chance arise, they can acquire or switch to a higher quality mate (Buss et al., 2017; Conroy-Beam, Goetz, & Buss, 2016). This mate switching happens even in the presence of substantial costs such as social repercussions to ending relationships or retribution from her own ex-partner or the ex-partners of the target man. The above two lines of evidence suggest that when

deciding to pursue a mate, the costs associated with intra-sex competition may not exceed the benefits of pursuing high quality men. It is possible that, regardless of his relationship status or intra-sexual competition, so long as the benefits of obtaining a high quality man outweigh the costs of pursuit, then women may be expected to pursue such men. Therefore, in a mate choice copying situation, the above would suggest that men presented as in a relationship with women would not be perceived as less attainable mates both because of an inflation of value associated with mate choice copying and because of a reduced concern over intra-sex competition.

7.4: The negative effect of mate choice copying upon attainability

An alternative outcome to the above is that mate choice copying makes men more attractive and desirable but also decreases their perceived attainability. There are two main lines of argument to support this hypothesis. The first can be found in mating market and mate matching hypotheses. Individuals judge their own value against that of available competition (Little, Burt, Penton-Voak, & Perrett, 2001a; B Pawłowski & Dunbar, 1999). They then choose a mate who has similar value to their own. A partner with a mate value that is substantially lower than her own would be undesirable because selecting such a mate would damage the future reproductive success of herself and offspring (see chapter 1). Whereas, selecting a partner whose mate value is substantially higher than her own could waste a significant amount of resources in the pursuit of a mate who would either not be interested or would be likely to mate switch away. Thus, significant variation from her own value, regardless of direction, decreases the desirability of a potential partner. If mate choice copying increases the perceived value of men, then, depending upon the original value of the man, it may push men away from or towards her own value and alter perceived attainability.

The second line of reasoning comes from mate poaching research. Whilst data do show that mate switching and mate poaching attempts are often made in the population, more often than not attempts are unsuccessful and mate switching is relatively rare. For example, Schmitt and Buss (2001) report that 93% of men claim to have had a woman attempt to take

them from a partner on one occasion across their life, 63% of these men reported at least one successful lifetime poaching attempt. Yet successful poaching is an infrequent occurrence. For example, 0% of these men reported having received frequent poaching attempts for short-term relationships and only 20% of men reported receiving frequent attempts at poaching for a long-term relationship. Only 38%-58% of women report having attempted to poach a partner at least once in their life, but such behaviour is expressed relatively infrequently. Similar to the above statistics for men, 0% of women report attempting to frequently poach someone for short-term relationships and only 24% report having attempted to frequently poach a mate for long-term relationships. Further, infidelity rates are reported to be between 15% and 50%, depending upon culture and measure used. More frequently than not, such infidelities do not result in partner switching (Stone, Goetz, & Shackelford, 2005).

7.5: Hypotheses

The above cited data suggest that it is unlikely that men already in a relationship – as they would be presented in a mate choice copying experiment – would be perceived as more attainable. If it was the case that women pursued higher value men regardless of the costs imposed by intra-sex competition (as hypothesised in section 7.2), then the reported rates of mate poaching would likely be higher than they are. With this in mind, if mate choice copying increases mate value, then this may reduce the likelihood of pursuit. Given the relative rarity and limited success of poaching, women appear to not be overly inclined to pursue men already in relationships. Thus, men who are presented with women may be considered more attractive and desirable, in line with mate choice copying research, but may also be considered less attainable mates and thereby less likely to be pursued. Further, if quality biased mate choice copying is correct and men presented with the most attractive women receive higher ratings of attractiveness over men with less attractive women, then one may expect women to rate men with the most attractive women as the least attainable partners. This is because the woman he is pictured with is highly attractive and therefore may pose greater intra-sexual competition to the participant rating the images than a less attractive woman. Further, the presence of the

attractive woman may increase the perceived value of the man over and above the increase caused by the less attractive woman. Therefore, If the above line of reasoning is correct then the following hypotheses would be true:

H1: Men presented in relationships with women will be rated as less attainable partners compared to those men who are presented without a woman and as single.

H2: Men presented as in a relationship with the most attractive women will be perceived as less attainable mates compared to men who are either presented as in a relationship with less attractive women or presented without a woman and as romantically single.

7.6: Methodology

7.6.1: Design

A 2 (men's initial attractiveness: attractive vs unattractive) by 3 (pairing condition: men presented as single without a pictured woman, men presented as in a relationship with a congruently rated woman [i.e. a woman who is rated similar in attractiveness to the pictured man], men presented as in a relationship with an incongruently rated woman [i.e. with a woman who is of the opposite attractiveness grouping]). Dependent variables were the men's perceived attainability and comparative attractiveness. Comparative attractiveness is a rating provided by the participant in which she estimates the attractiveness of the man compared to her own attractiveness. Whilst this does not play a role in this chapter it is used in analyses presented in chapter 8. The independent variable was the image pairing condition the male image was presented in.

7.6.2: Participants

Ninety British female participants were recruited opportunistically from a university in the north east of England. Participants were aged between 18 and 30 (mean = 20.80; SD = 3.39) years. Of the 90 participants, 84 identified as heterosexual, and 6 as bisexual. 50 of the participants described themselves as in a relationship, 37 as single and 3 did not declare.

Participants in relationships had been in relationships between 1 month and 9 years (mean = 2.77; SD = 2.21).

7.6.3: Materials

Participants were presented with paper versions of the standard experimental stimuli packs. Chapter 2: general method provides a detailed description of the stimuli used. Participants also completed a demographics questionnaire which asked for their age, sexual orientation, relationship status and a rating of self-perceived attractiveness. In addition, participants were presented with three personality questionnaires: The Socio-sexual Orientation Inventory (Penke & Asendorpf, 2008), the Self Esteem scale (Crandall, 1973) and the Self Perceived Mating Success Scale (Landolt et al., 1995).

7.6.4: Procedure

The following procedure was ethically approved by the Department of Psychology Ethics Committee at Northumbria University. The following script was used to initiate recruitment: *“Hello, I am recruiting participants to take part in research for a psychology PhD. It should take about 15 to 20 minutes to complete. Would you be interested in taking part?”* Participants were then handed an experimental pack. Each participant was briefed and provided informed consent. Participants were asked if they had any questions or concerns before they began the experiment and were given the chance to withdraw. As recruitment was opportunistic, sometimes participants were recruited in groups rather than in isolation. Those that were recruited in groups were instructed that *“for the purposes of this research it is very important that you do not confer with your friends over the ratings you give. Try to keep your responses private, at least until each of you have completed the experiment. Thank you”*. The researcher remained in sight to encourage compliance but stayed far enough away to reduce interference caused by the presence of the researcher.

Each experimental pack contained a demographics questionnaire that included a self-perceived attractiveness rating, the three personality questionnaires and a mate choice copying experiment pack. The images of males in the mate choice copying packs were accompanied

by two questions. The first asked women to rate “*If you were to show romantic interest in this man do you think he would reject or encourage you?*”. This was used as a measure of attainability. The second question asked the participants “*Please rate how attractive you think this man is compared to yourself?*”. This was used as a measure of comparative attractiveness. Each of the two questionnaires used a 1 – 9 Likert scale with 1 being definitely reject/much less attractive than me and 9 being definitely encourage/much more attractive than me. The order of presentation of questionnaires was counterbalanced so that in each of the three conditions half the participants received the mate choice copying pack first and half received the personality questionnaire packs first. Within the stimuli pack and questionnaire pack order was randomised so that participants saw the images of the men and received the personality questionnaires in a different order. Following completion of the experiment, participants were fully debriefed and any questions answered. Participants were asked if they knew the identity of the individuals contained in the pack. This was done because if an individual was identified and the participant was aware of their current relationship status then it would cast doubt over the stimuli. The participant would know then that the individuals were not a real couple and thus would void the experiment. None of the participants recognised the individuals in the stimuli pack.

7.7: Results

Data were analysed using ANOVA conducted in SPSS v.21 with perceived attainability as the dependent variable and image pairing condition as the independent variable. Analysis showed a significant main effect of pre-rated attractiveness upon ratings of attainability [$F(2,53) = 100.87, p < .001$]. Attractive men were rated significantly less attainable (mean = 5.27, SE = .05) than unattractive males (mean = 5.68, SE = .05).

Pairing condition also produced a significant main effect on the perception of attainability [$F(4, 106) = 14.37, p < .001$]. Men paired with congruently rated women were rated as significantly more attainable than single men (mean difference = .43, SE = .087, $p < .001$). They were also rated as more attainable than men paired with incongruently rated

women (mean difference = .384, SE = .087, $p < .001$). No statistical difference existed between ratings of attainability provided to men in the incongruent pairing condition and men in the single condition ($p = 1.00$)

However, these findings were moderated by a significant interaction between pairing condition and the initial attractiveness rating of men [$F(4,106) = 5.80$, $p = .001$; see Figures 7.1 and 7.2]. Attractive men were rated significantly more attainable when presented with attractive women compared to when they were presented as single (mean difference = .36, SE = .139, $p = .043$) or with unattractive women (mean difference = .68, SE = .139, $p < .001$). Unattractive men when paired with unattractive women were rated as significantly more attainable than when they were presented as single (mean difference = .496, SE = .105, $p < .001$). Similarly, when paired with attractive women they were rated as significantly more attainable than when they were presented as single (mean difference = .413, SE = .105, $p = .002$). The two paired conditions showed no difference in ratings (mean difference = .083, SE = .105, $p = 1.00$).

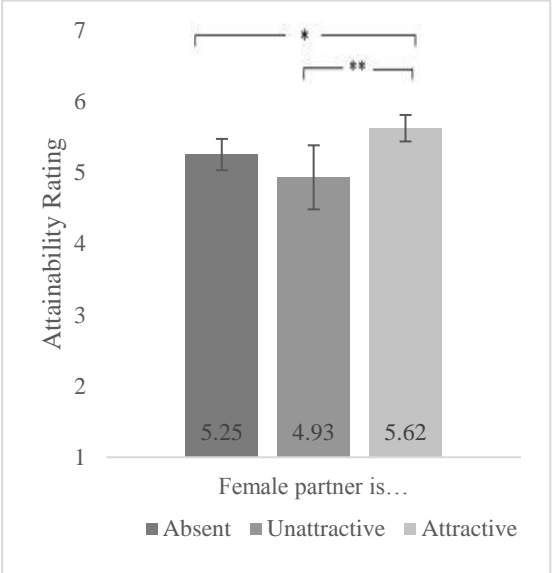


Figure 7.1: Mean (+/- standard error) of rated attainability given to attractive men in each of the three pairing conditions. * $p < .05$, ** $p < .001$.

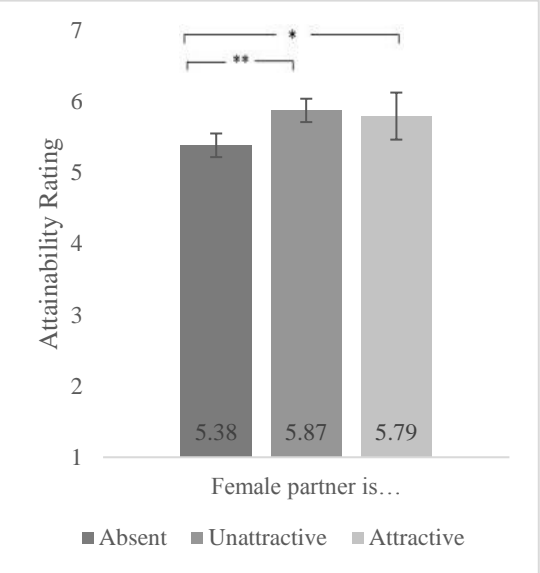


Figure 7.2: Mean (+/- standard error) of rated attainability given to unattractive men in each of the three pairing conditions. * $p < .05$, ** $p < .001$.

7.8: Discussion

7.8.1: Results overview

In this experiment I tested whether mate choice copying and the attractiveness of the male altered the perception of attainability. It was hypothesised that women would rate men with women as less attainable mates. To test this, images of the same men were presented to women as either romantically single, with an unattractive rated woman or with an attractive rated woman. Men in relationships were generally viewed as more attainable mates than men who were presented as single and without women. Specifically, attractive men were rated as more attainable when with attractive women compared to when single or with less attractive women. Unattractive men were rated as more attainable with any woman, regardless of her attractiveness, compared to when single. For both attractive and unattractive men, being paired with women increased their perceived attainability. The only exception to this was when attractive men were paired with unattractive women. This will be addressed in the below sections. Unlike the previous experiment there was no evidence to suggest that Vakirtzis and Roberts (2010) quality bias altered perceived attainability. A general mate choice copying effect is present however. Though this finding is counter-intuitive and ran counter to predictions there are a number of potential reasons why mate choice copying may have increased rated attainability. These are explored below.

7.8.2: Attractiveness-attainability-pursuit bias

Mate choice copying is hypothesised to function as a means of assuring the quality of a potential mate, specifically with regards to hidden personality traits. Consequently, men benefiting from the mate choice copying effect should be perceived as higher value mates possessing more desirable traits. As support for this, consider that literature reports that men are both more attractive and more preferred for both long and short term relationships when presented as though in a relationship with a woman (please see chapter 2: literature review for details of this). Given that women skew their mate selection efforts towards the highest quality men in a given mating market (Tyson, Perta, Haddadi, & Seto, 2016), it is expected that men benefiting from a mate choice copying effect would be the preferred choice of mate. There are

a number of ways that women could act upon such preferences. One such mechanism of action is to alter the perceived attainability of men so that women are likely to pursue high quality men. If the primary driver of women's mate selection is for quality rather than opportunity, then only the highest value men would likely ever be considered as potential mates. Therefore, altered attainability perceptions resulting from mate choice copying could bias the mating efforts of women towards selecting only higher quality men. Tentative evidentiary support can be found for this.

Research demonstrates that women frequently monitor the mating market and bias their selection towards only the highest quality men (Buss et al., 2017). On the dating app Tinder, for example, women are far less likely than men to indicate attraction by liking a man's profile. Tyson et al. (2016) conducted an experiment in which they monitored the "likes" received by the men and women on tinder over a period of time. Across the period of study women's profiles generated 8,248 likes whereas men's profiles generated only 532 likes. Women then are selecting only 6.45% the number of profiles that men select. Further, Tyson et al provide data showing that, as the mating market grows on tinder and as women spend more time on the app, women become increasingly selective over the mates they choose and provide likes only to the most attractive men. Additional findings suggest that women largely agree, and agree more frequently than men, on what constitutes a high value mate (Olderbak, Malter, Wolf, Jones, & Figueredo, 2017). These two data points show that women are both in large agreement over which men are high value, and are actively biasing their choices towards these high value men at the expense of lower value men. If the highest value men were considered less attainable due to either being beyond the "market value" of the woman in question or because of the competition which exists over such high quality men, then women would not attempt to attract such men and the above cited data would not exist. If, however, women's perception of attainability is skewed so that high value men are considered attainable, then this would both increase the likelihood that women would attempt to attract such a man and explain recent data from dating apps.

To the author's knowledge, no such bias – a bias in which attractive men are considered more attainable in order to promote pursuit—has been hypothesised before but other such biases are well documented. Attractiveness is known to alter perceptions of many characteristics possessed by men. For example, because they are attractive, and regardless of their actual ability, men are considered more competent (Jackson, Hunter, & Hodge, 1995), more socially successful (Poutvaara, 2014) and more trustworthy (Bascandziev & Harris, 2014; Khan & Sutcliffe, 2014) than those who possess less mate value. Data in this experiment do indeed show that men with women are perceived as more attainable therefore, in a similar way to the above traits.

7.8.3: Halo effects

A potential criticism or proposed alternative explanation to the above is that observed results are a simple halo effect (Nisbett & Wilson, 1977) combined with a ceiling effect. That is, men benefit from the pictured woman's attractiveness halo: the men are given higher ratings irrespective of the trait being rated merely because they are in the presence of an attractive female. Some evidence does exist to show that a general bias exists which makes people think positively of attractive individuals and those accompanied by attractive individuals (Verhulst, Lodge, & Lavine, 2010). However, this is not fully reflected in the data. If a halo effect was present, then ratings of attainability should increase in line with the attractiveness of the women paired with the man, i.e. a single man would be rated at a given level of attainability, the same man paired with a woman who is more attractive than himself would be rated higher and this would scale with the attractiveness of the woman. This is not what was found.

Attractive men do fit with expectations of a halo effect. Attainability ratings were higher when attractive men were paired with attractive women only. Attractive women were rated more attractive than men (see chapter 3) and so a halo effect may be expected. Unattractive women were rated less attractive than the attractive men and would therefore not have produced a halo effect. However, this explanation fails when unattractive men are examined. Unattractive men were rated more attainable with any woman but no difference

existed between the paired conditions. If the halo effect alone was responsible for results, then unattractive men would have been rated highest when with attractive women, a middle ground rating would have been provided when they were with unattractive women and single men would have formed a base rating. It is possible that this did not occur due to a ceiling effect present with the attainability ratings of unattractive men. However, it is difficult to rationalise why a ceiling effect on a trait such as perceived attainability would be present. For a judgement of physical attractiveness, for example, it is understandable why a ceiling effect would exist. Physical attractiveness is constrained by visual information so a positive halo effect can only alter rating by a given amount before visual inspection creates a ceiling and prevents further inflation of ratings. However, perception of attainability does not have clear mechanism for generating a ceiling effect. This makes a combined halo/ceiling effect non-parsimonious and an unlikely explanation.

7.8.4: Comparison effects

An alternative explanation that could be put forward as a potential explanation of perceived attainability comes as a result of attractiveness comparisons between the two pictured individuals. It is possible that pairing a man with a woman provides a context to his attractiveness that is missing in single photographs. For example, if single man A is rated as a 4 on an attractiveness scale and single woman B is rated an 8 then pairing the two together may make man A look less attractive. Because man A is viewed as less attractive he is therefore also viewed as more attainable. Thus increased ratings of attainability exist because pairing men with women who are more attractive than themselves makes them appear less attractive and therefore more attainable. This would explain why attractive men paired with unattractive women are rated as less attainable compared to when paired with attractive women. This is the only pairing in which men appear more attractive than the women they are paired with.

There are two issues with this explanation. First, mate choice copying research shows that men with women are consistently rated as more attractive than when no women are present.

Second, and most importantly, a ceiling effect would have to again be applied to unattractive males to account for unexpected attainability ratings. If this explanation was true, then a predictable pattern would exist. Unattractive men with the most attractive women would be rated the most attainable, single men would be rated least attainable and men with unattractive women would produce a middle ground. This is not reflected in the data. There is no apparent logical explanation for why ceiling effects would exist for a simple comparison between the attractiveness of two individuals. Instead, it is likely that both attractive and unattractive men benefit equally from being paired with women but that attractive men paired with unattractive women speak of hidden traits possessed by the attractive male. To explain further, the argument is that an attractive man is competitive on the mating market. He has a choice of high value women and yet stays with a woman who has a lower value than his own. It is possible then that he would be perceived as highly committed and therefore more likely to reject hypothetical approaches by the participant.

7.9: Chapter and section conclusions

As a whole this section demonstrates that men presented with women are generally thought of as both more faithful partners and more attainable mates. Specifically, in the previous chapter, unattractive rated men were considered to be more faithful potential partners when they were paired with attractive rated women compared to when they were presented as single or with unattractive partners. In this chapter men were perceived as more attainable when paired with women compared to when they were presented without women and as romantically single. This was particularly the case for unattractive rated men. I hypothesised that this was because the mating mind skews the judgement of women to make men benefiting from the mate choice copying effect appear both higher value and more attainable potential mates. It was hypothesised that this attainability bias exists to encourage the pursuit of higher value men. However, how attainable a male is perceived to be can depend upon a number of factors that are personal to the individual participant. For example, personality factors such as self-esteem or socio-sexual orientation which differ between participants may moderate how

likely women are to act upon this perceived attainability. In the next section of this thesis we will investigate how personal characteristics of individual participants interact with mate choice copying.

Section 3:

Individual Differences and Mate Choice Copying

Chapter Eight: Attainability, Mate Choice Copying and Personality

8.1: Chapter overview

The previous chapter indicated that men paired with women were rated as more attainable partners than men without women. Specifically, attractive rated men were perceived as more attainable when they were with attractive rated women compared to when they were paired with less attractive women or when they were presented as single. Unattractive men were perceived as more attainable when they were with any woman, regardless of her attractiveness, compared to men who were presented as single. It was hypothesised that individual differences amongst participants may be a contributing factor in the ratings of attainability provided to men. Therefore, before attributing changes in rated attainability solely to mate choice copying, it is important to investigate how individual differences interact with mate choice copying to alter attainability. In this chapter I will use multi-level modelling to factor in individual differences to the results obtained in chapter 7.

8.2: Personality and mate choice

Chapter 1 reviewed the evolutionary psychology of women's mate choice behaviour. Much of the review focused on traits possessed by men and women's responses to such traits. Factors internal to the individual woman are equally important in influencing her mate selection behaviour. For example, a woman's self-perceived value interacts with evolved mate selection criteria to inform her mate choices (Buston & Emlen, 2003). An important manifestation of this interaction can be found in the 'Matching Hypothesis'. This suggests that individuals match their choice of mate to those who are similar to themselves in terms of value, lifestyles and personality (Taylor, Fiore, Mendelsohn, & Cheshire, 2011). Some evidence suggests that self-worth predicts both the value of the partner a person selects and also how successful initial romantic meetings are. For women and not men the extremes of self-worth predict how mates are selected. Taylor et al conducted an online study investigating how self-worth – measured by self-report—affected how participants selected mates. Women with the

highest self-worth were 34% less likely to contact lower value men than would otherwise have been expected. They were also 28% less likely to receive messages from lower value males than expected. Conversely, women with lower self-worth were 32% less likely to be contacted by higher value mates and 21% less likely to contact higher value mates. Such evidence shows how individual differences can impact upon mate choice behaviour. There are a number of personal characteristics that vary amongst individuals which may interact with mate choice copying to alter the perceived attainability of men. These are outlined below.

8.3: Self-perceived mating success

Self-perceived mate value has been much studied in literature. Its effect upon various aspects of mate selection are well documented. For example, women who have a higher self-perceived attractiveness show a preference for attractive masculinised males compared to those with lower self-perceived attractiveness (Little, Burt, Penton-Voak, & Perrett, 2001b). In a study investigating how attractiveness biases attentional memory, women with a higher self-rated attractiveness show biased attention towards more attractive men whilst women with lower self-rated attractiveness show a bias towards the attractiveness of other women and not the attractiveness of men (Watkins et al., 2017). Further, some evidence suggests that self-perceived overall mate value predicts mate poaching behaviour. Those high in self-perceived value are more willing to mate poach than those with low in self-perceived value (Erik & Bhogal, 2016). Together the above suggest that those who have a higher perceived value/attractiveness are more likely to favour attractive partners, more likely to bias their attention to attractive partners and show less aversion to engaging in intra-sexual competition. Finally, they may be more likely to act upon mate poaching behaviour compared to those with a lower self-perceived value. Accordingly, women with lower self-perceived attractiveness and value should rate men less attainable, particularly for men in the paired conditions, than those with higher self-perceived attractiveness and value.

8.4: Socio-sexual orientation

Another aspect of personality that could account for between participant variation in perceived attainability and mate choice copying is socio-sexual orientation. Socio-sexual orientation is a measure of a person's attitudes towards engaging in sexual activity without the need for a deep emotional connection. Individuals scoring highly on the measure are described as "unrestricted". Unrestricted individuals tend to show a preference for physically attractive individuals, short term relationships, tend to be more willing to commit infidelity, are less committed to current partners and, importantly, are more willing to attempt to take the partners of others (Foster et al., 2014; Muggleton & Fincher, 2017; Schmitt & Buss, 2001). Those individuals scoring low are classified as "restricted" and tend to show a preference for longer term, committed relationships, and for resource accrual based personality traits e.g. ambition and hard-working over a preference for physical attractiveness (Penke & Asendorpf, 2008; Penke & Denissen, 2008; Schmitt, 2005). Given that participants are rating male attainability in a mate choice copying frame, it is possible that such behavioural differences would impact the ratings given to men when they are paired with other women.

8.5: Self-esteem

In addition to socio-sexual orientation it has been shown that self-esteem can influence both mate preference and mate choice behaviour. Research has shown that self-esteem is reflective of mating success in both men and women. Those with the most success tend to have the highest ratings of self-esteem and those with the least success the lowest (Penke & Denissen, 2008). The effect of self-esteem upon attraction and mate selection has been long researched. It is known, for example, that a woman's self-esteem predicts how likely she is to pursue an ideal, as opposed to a merely available, mate (Brown & Brown, 2015). Self-esteem is correlated to how attractive individuals are perceived (Bale & Archer, 2013) and how much intra-sexual competition they will willingly engage in (Patrick, Neighbors, & Knee, 2004). The socio-meter hypothesis suggests that self-esteem is an adaptive measure that can be used to monitor one's own value in comparison to potential competition. Increased mating success

and high perceived value predict higher esteem and lower levels of image enhancement behaviour. Conversely, poor mating success predicts lower self-esteem and increased image enhancement behaviour (Brase & Guy, 2004). Further, self-esteem is positively correlated to successful mate poaching (Sunderani, Arnocky, & Vaillancourt, 2013). Which, as detailed previously with socio-sexuality, suggests that self-esteem may play a role in mate choice copying judgements and attainability perception.

8.6: Hypotheses

Given the above and in order to assess accurately whether mate choice copying contributes to the altered perceived attainability scores found in the previous chapter, it is important to assess the contribution of these individual differences. It is hypothesised that those scoring high in self-perceived mating success, self-esteem and those with an unrestricted socio-sexuality score will be more likely to rate men with women as attainable compared to those with lower self-rating scores or those who are restricted in their socio-sexuality.

8.7: Methodology

Data were taken from the experiment detailed in the previous chapter. This methodological section will highlight the treatment of questionnaire data relevant to this chapter. All other methodological procedures are the same as in previous chapter.

8.7.1: Handling of additional questionnaire data

To measure self-perceived mating success, the ‘Self-Perceived Mating Success Scale’ was used (Landolt et al., 1995). The 10 item self-esteem scale was used to measure participant self-esteem (Crandall, 1973). The amended SOI-R scale was used to measure socio-sexuality (Penke & Asendorpf, 2008). All questionnaires were scored as per instructions. The SOI-R scale responses were amalgamated to produce an overall score for socio-sexuality. As a measurement of self-rated attractiveness, participants provided a rating of how attractive they thought they were on a 1 to 9 (1 – highly unattractive, 9 highly attractive) Likert scale.

8.8: Results

A mixed multilevel regression model was used for the purpose of investigating the interaction between mate choice copying pairings, individual differences and perceived mate attainability. Level 1 data encompass the total responses given by raters. Level 2 data encompass the three between subject mate choice copying pairings. Because each participant rated multiple male images, these responses were classified as a repeated measure element. Experimental grouping, whether men were presented with or without women, were classified as a between subject measure. Attainability ratings were used as the outcome factor and socio-sexuality (mean = 32.30, SD = 12.74), self-perceived mating success (mean = 35.95, SD = 8.03), self-esteem (mean = 19.58, SD = 4.58), self-rated attractiveness (mean = 5.87, SD = 1.23), comparative attractiveness (mean = 3.98, SD = 1.82) and age (mean = 21.03, SD = 2.55) were used as predictor factors. Initial male attractiveness was used to investigate any cross level interaction effects between the pairing condition images were presented in and male attractiveness. Laying out the regression model as above closely mirrored the analyses conducted in the previous chapter. Table 1 shows the estimate of effects and fit statistics for the modelling process.

8.8.1: Summary of main effects

No overall mate choice copying effect on attainability was found. Men paired with women were not rated significantly more or less attainable than single men. However, men who were paired with congruently rated women were rated as more attainable mates than men who were paired with incongruently rated women. There was no interaction effect between pairing condition and male attractiveness. Instead rated attainability was primarily explained by a participant's self-perceived mating success, their self-rated attractiveness, and their comparative attractiveness. Each of these attributes correlated positively with perceived attainability so that increased attainability scores were predicted by positive self-perception and increased comparative attractiveness. Participant age also contributed towards perceived

attainability. This, however, presented as a negative correlation to perceived attainability so that as participant age increased rated attainability decreased.

8.8.2: Modelling process

First a null model was produced. This null model generated overall model fit statistics for rated attainability. This acted as a point of comparison for subsequent models and thus allowed the inference of statistical significance and the measurement of fit improvement. Full statistics can be found in table 1.

Model 1 allowed the intercept for participant responses to vary. This produced a significant improvement in model fit [$X^2(1) = 1049.32, p < .001$]. Allowing intercept variation accounted for 46.67% of the residual variance compared to the null model.

Model 2 introduced the covariates sexuality, relationship status, and age into the model. The between subject class level 2 variable (pairing condition) was also introduced into the regression equation. This produced a significant improvement in model fit [$X^2(3) = 239.2, p < .001$]. Age was a significant contributor to model fit with older women rating men as less attainable than younger women (estimate = $-.31, SE .14$) [$F(1,82) = 5.08, p = .03$]. Pairing condition did not significantly contribute to model fit [$F(2,82) = .66, p = .52$].

Model 3 introduced the main predictors into the equation. This produced a significant improvement in model fit [$X^2(5) = 122.30, p < .001$]. Age remained a significant predictor with younger women rating men more attainable than older women (estimate = $-.29, SE = .14$) [$F(1,78) = 4.46, p = .04$]. Comparative attractiveness was also a significant predictor of attainability (estimate = $-.37, SE = .03$) with men who were thought of as more attractive compared to the participant herself being rated as less attainable partners compared to men rated as less attractive than the participant [$F(1,1613) = 128.04, p < .001$]. Socio-sexual orientation (estimate = $.01, SE = 0.14$) [$F(1,78) = 0.01, p = .94$], self-perceived mating success (estimate = $.23, SE = .15$) [$F(1,78) = 2.15, p = .15$], self-esteem (estimate = $.13, SE = .17$) [$F(1,78) = 0.59, p = .44$], self-rated attractiveness (estimate = $.18, SE = .17$) [$F(1,78) = 1.17,$

$p = .28$], pairing condition [$F(2,78) = 0.75, p = .47$] and initial male attractiveness (estimate = $-.02$ SE = $.07$) [$F(1,1602) = 0.07, p = .786$] did not significantly contribute to model fit.

Model 4. Predictor variables were entered into a scatter plot against the predicted variable (attainability) to check for slope variation amongst participant responses. Only comparative attractiveness and age showed evidence of slope variation. Model 4a allowed the slope to vary for age across participant responses. This produced a significant improvement in fit compared to model 3 [$X^2(3) = 14.8, p < .01$]. Model 4b conducted a separate analysis to allow for comparative attractiveness slope variation. Compared to model 3, this also produced a significant improvement in model fit [$X^2(3) = 418.20, p < .001$]. Model 4c allowed the slope to vary for both age and comparative attractiveness. This produced a further improvement in model fit [$X^2(6) = 24.2, p < .001$].

Model 5: A final model removed the non-significant predictors self-esteem and socio-sexual orientation from the model. Finally, cross level interaction between the initial attractiveness of men's photographs and pairing condition were checked to see if ratings differed between attractive and unattractive males. No significant interaction was found and no improvement in model fit was produced [$p > .05$]. Participants rated men as more attainable when they view themselves as more attractive than the man in question (estimate = $-.33$ SE = $.09, p < .001$), when participants think they are successful at attracting partners (estimate = $.28$ SE = $.09, p = .005$), and when they view themselves as attractive (estimate = $.26$ SE = $.10, p = .01$). Comparing single men to either of the paired conditions did not alter their perceived attainability. Only when men were paired with congruently rated, compared to men paired with incongruently rated women, did participants rate men as more attainable. Finally, the attractiveness of men themselves did not significantly alter ratings of attainability given to men.

Table 8.1: Estimates (and standard error) for all model iterations. This shows the fit statistics for attainability ratings given to men. * p<.05 **p<.001.

	Null Model		Model 1		Model 2		Model 3		Model 4a		Model 4b		Model 4c		Model 5	
	mean	SE	Mean	SE	mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
<i>Fit Statistics</i>																
<i>Intercept</i>	5.48	0.04	5.48	0.14	5.41	0.24	5.48	0.24	5.44	0.21	5.28	0.21	5.22	0.17	5.37**	0.18
<i>Residual</i>	3.06	0.10	1.43	0.05	1.45	0.05	1.35	0.05	1.35	0.05	0.94	0.03	0.94	0.03	0.94**	0.03
<i>-2 reduced likelihood</i>	6909.40		5860.1		5620.9		5501.9		5487.1		5083.8		5059.8		5052.8	
<i>AICC</i>	6911.4		5864.1		5624.9		5505.9		5495.1		5091.8		5073.8		5066.9	
<i>BIC</i>	6916.9		5869.1		5629.8		5510.8		5504.9		5101.6		5091.0		5084.0	
<i>Estimates</i>																
<i>Participant</i>			1.64**	0.25	1.61**	0.26	1.48**	0.25	1.04**	0.33	1.15**	0.25	0.93**	0.21	0.91**	0.21
<i>PC 1 vs PC3</i>					-0.43	0.34	-0.18	0.35	-0.10	0.29	-0.13	0.32	0.2	0.22	0.22	0.21
<i>PC2 vs PC3</i>					0.32	0.34	0.24	0.33	0.45	0.26	0.43	0.31	0.44*	0.20	0.45*	0.19
<i>Age</i>					-0.32*	0.14	-0.29*	0.14	-0.178	0.20	-0.37	0.13	-0.23	0.17	-0.23	0.16
<i>AM vs UM</i>							-0.02	0.07	-0.03	0.07	-0.02	0.07	0.02	0.07	0.02	0.07
<i>Comparative attractiveness</i>							-0.36**	0.04	-0.36**	0.04	-0.36**	0.04	-0.33**	0.08	-0.33**	0.09
<i>SSOI</i>							0.01	0.14	0.12	0.12	-0.06	0.14	0.03	0.09		
<i>SPMS</i>							0.23	0.15	0.17	0.14	0.25*	0.15	0.25*	0.10	0.28**	0.10
<i>SE</i>							0.13	0.17	0.09	0.16	0.07	0.15	0.07	0.12		
<i>SA</i>							0.18	0.17	0.12	0.16	0.28	0.16	0.23	0.12	0.26*	0.10

Key: **PC**= pairing condition (1- single, 2- with a female of the same attractiveness, 3- with a female of the opposite attractiveness), **AM** = attractive men, **UM** = unattractive men **SOI** = Socio-sexuality, **SPMS** = self-perceived mating success, **SE** = self-esteem, **SA** = self-rated attractiveness

8.9: Discussion

8.9.1: Difference to previous results

In the last chapter it was revealed that men who were paired with women were rated as more attainable mates compared to those without women. This effect differed depending upon the attractiveness of the rated man and differed further depending upon the attractiveness of the woman he was paired with. To be specific, attractive men were rated most attainable when they were presented with attractive women compared to when single or with less attractive women. Unattractive men were rated as more attainable when they were with any woman regardless of her attractiveness compared to when they were presented as single. In the previous experiment the male image was used as the unit of analysis and therefore an ANOVA was used to assess data. This analysis did not factor in individual differences amongst participants themselves. Current results challenge the findings of the previous chapter. No significant difference between single and paired conditions exist. Further, no effect of male initial attractiveness was found, nor were there any significant interaction effects between male attractiveness and pairing condition. Why might this be the case and what are the implications for wider literature? This section will explore both the implications of a lack of a mate choice copying effect and will discuss the findings of this chapter.

8.9.2: Lack of mate choice copying effects

One of the primary benefits of using multi-level modelling over ANOVA analysis is that multi-level modelling allows for the accurate correlation of response variance at both group level and participant level. In other words, ANOVA analysis makes the assumption that variance attributed to participant level data within a particular grouping is homogenous when it may, in fact, not be so (Hoffman & Rovine, 2007). Thus imposing a static group level intercept for participants in each of the pairing conditions may produce results that do not accurately reflect participant responses. Using multi-level modelling allows for variance between participant and group level to be analysed in a single test. It is possible that collapsing mean scores across an entire condition grouping without factoring in participant level variance, as was done in the previous chapters 6 and 7, masked participant level effects and consequently

produced a mate choice copying effect which exists only because group level intercepts were imposed upon data. It is true to say, however, that absence of evidence does not equal evidence of absence – in this case the lack of replication of mate choice copying does not necessarily mean that mate choice copying does not exist. It may, in fact, be that the multi-level model did not pick up a mate choice copying effect or that the inclusion of individual differences masks a real mate choice copying effect. It does, however, offer an intriguing explanation for why the same data analysed with different technique produced different results.

Almost all previous mate choice copying research has used ANOVA analysis to assess results. To the best of the author's knowledge, only one analysis has used multi-level modelling to investigate any interaction between mate choice copying and participant individual differences (Place et al., 2010). Place et al. found that self-rated attractiveness modulated mate choice copying effects for men. Where men thought they were more attractive than the individuals they were observing they were less likely to be influenced by the mate choice copying effect. For women, they found that self-rated attractiveness had no significant modulatory effect on mate choice copying. They argue that this is because women are less likely to deviate from initial quality assessment than men are. I report that both self-rated attractiveness and comparative attractiveness significantly predict women's ratings of a man's attainability. So much so that any effects attributed to mate choice copying ceases to exist once these traits are accounted for. This raises two interesting possibilities. The first is that effects commonly found in literature may be methodological rather than an actual effect of mate choice copying. Second, it could be that mate choice copying does exist but asking participants to rate perceived attainability may be independent of the effects of mate choice copying. This would make these results applicable to only to the question asked in chapter 7 and not to wider literature. To test this, and to make results applicable to the wider literature, it is necessary to repeat the above personality led multi-level model with the standard mate choice question. In the following chapter we will repeat the analysis but with rated attractiveness rather than rated attainability. This will allow for meaningful comparison to the extant literature.

8.9.3: Personality

It was hypothesised that because socio-sexuality and self-esteem influence the likelihood that women would attempt to mate poach that these two traits would therefore increase the likelihood participants would mate choice copy. This was not the case. Neither socio-sexuality nor self-esteem contributed to model fit. A possible explanation for this can be found in research conducted by Clark (2004). Clark found that self-perceived attractiveness was highly correlated to socio-sexuality. Therefore, any variance which may have been attributable to socio-sexuality is otherwise explained by the self-perceived mating success of participants. In a similar way, whilst research does suggest that self-esteem plays a role in mate selection (for a brief review please see Montoya, 2008), some research shows that self-perceived mate value affects self-esteem (Bale & Archer, 2013) such that self-esteem is reactive to mating success rather than formative of mating decisions (Penke & Denissen, 2008). Because attainability judgements are likely to be strongly related to mate value comparison it is probable that model variance is explained by traits, like self-rated attractiveness and self-perceived mating success, that are overtly related to attractiveness unlike self-esteem or socio-sexual orientation which are indirectly linked to attractiveness.

Self-perceived mating success, self-rated attractiveness and comparative attractiveness predicted ratings of attainability given to men. Women who thought they were more attractive than men, who thought of themselves as attractive and who had a successful mating history rated men as more attainable than those who viewed themselves more negatively. Evidence suggests that individuals with higher self-perceived mate value are more likely to select mates of higher quality. That is, they actively select individuals who are more attractive than those who rate their mate value lower (Buston & Emlen, 2003). Further research shows that those with higher self-perceived mate value are more likely to pursue individuals as mates, to have higher self-esteem and to be more confident in making mating decisions compared to those with lower self-perceived mate value. See Penke et al. (2007) for a review. The matching hypothesis, which states that individuals try to acquire the highest quality mate

they can but ultimately match their mate selection to their own perceived value, offers an explanation of these results. Those with higher self-rated attractiveness and mating success aim for more attractive mates. They have higher confidence and esteem and are thus likely think that they are more capable of obtaining a potential mate than those viewing themselves as less attractive or successful.

Age was another factor which influenced the perceived attainability of men. Older women rated men less attainable compared to younger women. There are two plausible reasons for this. The first is that older women, having had experience of the mating market, have a more accurate assessment of their own mate value and therefore are more nuanced in their rating of men. The second is that women are aware of the importance of youth in men's mate selection behaviour. It is well established that men show a preference for youth when selecting mates (Buunk, Dijkstra, Kenrick, & Warntjes, 2001; Sohn, 2017). Women's attractiveness and youthfulness are intrinsically linked (Buss & Schmitt, 1993). Research does suggest that, at least to some extent, women are aware of this link. For example, women who are partnered with high status men actively employ mate guarding tactics when they are around younger more attractive women (Buss, 2002). It is possible that, for the above reasons, younger women are likely to view themselves as higher value and consequently are likely to judge men to be more attainable than older women.

8.10: Conclusions

In this chapter I looked at the effect self-perceptions had upon the perceived attainability of men in a mate choice copying context. Results suggest that individuals who consider themselves more attractive than a given male target, are younger, and who have had a successful mating history consider men to be generally more attainable as partners than those with a more negative view of themselves and their mating history. In chapter 7, conducting ANOVA analysis on group level data (the pairing condition male images are presented in) generated an expected mate choice copying effect. Multi-level modelling conducted in this chapter does not replicate this effect. Any mate choice copying effect disappeared and variance

was explained by individual differences amongst participant personality traits. In the next chapter I will replicate the multi-level model analyses with ratings of attractiveness — a question that is more representative of wider literature – rather than attainability to check whether wider results are likely to be explained by individual differences or whether this effect is specific to rated attainability.

Chapter Nine: Mate Choice copying, Rated Attractiveness and Individual Differences

9.0: Chapter overview

In the previous chapters two key findings were reported. The first was that, using ANOVA and ratings given to male images as the unit of analysis, male attainability ratings appeared to be altered by the mate choice copying effect. Men who were presented with women were rated as more attainable partners than men without women. The second was that multi-level modelling suggested that any differences in rated attainability were more likely to be due to individual differences attributable to the rater than differences due to mate choice copying. Situating this data into wider literature was difficult because the metric analysed (male attainability) is not standard. Therefore, comparison to the attractiveness judgements more widely used to identify mate choice copying in literature was difficult. In this chapter I will use the more commonly tested measure of rated attractiveness and run this through a similar multi-level model in order to check whether differences in rated attractiveness are similarly attributable to individual differences rather than mate choice copying. This will allow for ease of comparison to wider literature.

In the previous chapter, individual differences specific to the perception of mate attainability were used in the modelling process. Self-rated attractiveness and comparative attractiveness were the significant predictors of rated attainability. As this current chapter focused upon rated attractiveness rather than attainability, these two variables were not used in this experiment. Self-perceived mating success was kept as a predictor for the modelling process of this experiment. Full justification for the inclusion can be found in chapter 8 but to briefly reiterate: Self-perceived mating success has been shown to influence mate selection (Little et al., 2001b). It not only correlates to the quality of mates targeted (Watkins et al., 2017) but also to measure of mate poaching and effort put into attracting mates (Erik & Bhogal, 2016). It is probable that this measure will therefore influence ratings of attractiveness women

give to men. Socio-sexuality, though not significant in predicting attainability, was retained in the model. This was because socio-sexuality is hypothesised to be reflective of a woman's reproductive strategy and the importance women place on a man's physical attractiveness (Schmitt, 2005). Because rated attractiveness is a more direct measure of mate selection than perceived attainability, it is important to consider socio-sexuality as a potential influencing variable. There are additional individual differences which could play an important role in direct judgement of attractiveness and mate choice copying.

9.1: The Big 5 personality

An individual's personality can play a role in how they perceive the attractiveness of others. As a demonstration of this consider the following experiment. Participants took part in a real speed dating event. Both men and women completed personality batteries and provided judgements of attractiveness for each of their opposite sex partners. It was found that women's judgement of men's attractiveness was influenced more by traits internal to herself than traits possessed by her partner (Luo & Zhang, 2009). For example, men were rated as more attractive when they were taller and sporty (traits possessed by the male himself) but also when the woman herself was open, extraverted, had a positive effect, was younger, heavier and was socially active. Conversely, men in this sample rated women as more attractive when the woman was slightly older, lighter, physically attractive, conscientious, stable, extraverted, open and agreeable. Only 3 of 22 possible traits internal to the man were statistically significant predictors of how attractive they thought women were. Of the total possible influences, both external or internal, women's judgement of men's attractiveness was weighted towards internal traits over external traits. Thus, the big 5 personality factors should not be ignored as a potential moderator of judgements of male attractiveness

The Big 5 personality traits are extraversion, neuroticism, openness, agreeableness and conscientiousness. Some evidence suggests that elements of the big 5 traits can influence judgements of attractiveness. Schmitt and Shackelford (2008) conducted a large study across 46 nations and involving 13,242 participants to investigate the relationship between the Big 5

personality traits and mating preferences. Participants were handed a series of questionnaires to complete. These questionnaires measured the participant's attitudes towards romantic attraction, their short term mating strategies and took a measure of the Big 5 personality factors. Higher levels of extraversion in women was associated with increased short term mating in western countries, increased short term mate poaching attempts in most countries and unrestricted socio-sexuality in some countries. Lower agreeableness in women was associated primarily with lower relationship exclusivity as well as increased preference for short term mating and mate poaching strategies in all countries. Conscientiousness was associated with women's decreased relationship exclusivity, increased short term mating and increased mate poaching. With exception to north America, neuroticism was not significantly related to short term mating strategies. Similarly, openness was associated with an unrestricted socio-sexuality within north America and western Europe but was not correlated with any measures of short term relationship preference or socio-sexuality across the rest of the world.

Further to this, personality features also affect the long term stability of relationships (Solomon & Jackson, 2014). Those who are high in neuroticism, low in agreeableness and conscientiousness increases the risk of future relationship breakdown. Conversely, those low in neuroticism, high in agreeableness and conscientiousness are less likely to suffer future breakdown. What the above shows is that, for both long and short term relationships, the personality of the individual affects mating behaviour. To date, there is no data exploring the relationship between Big 5 personality traits and mate choice copying. Thus it is unclear what to predict. However, given mate choice copying involves the value judgment of men already in relationships, it would be expected that those high in extraversion, low in conscientiousness and low agreeableness would be most influenced by the mate choice copying effect.

9.2: The dark triad

Another possible modulator of mate choice copying behaviour is the dark triad of sub-clinical neuroticism, psychopathy and Machiavellianism. Dark triad personality traits have been linked to the Big 5 personality traits (Jakobwitz & Egan, 2006; Paulhus & Williams,

2002). Though the two constructs both account for some shared variance in mate preference research, they are in fact distinct. In a recent review the dark triad was found to be predictive of long and short term mating preference. Experimenters found that the dark triad accounted for variance in attractiveness judgements even after controlling for the effects of the Big 5 personality traits (Jonason, Valentine, Li, & Harbeson, 2011).

Individuals who score highly on dark triad testing are more likely to employ an opportunistic, aggressive and impulsive social interaction style than those who score low (Jones & Paulhus, 2009; Jones & Paulhus, 2010). Further, women scoring higher on dark triad traits are increasingly likely to engage in sexual and general competition than those scoring lower (Carter, Montanaro, Linney, & Campbell, 2015). Combined with findings which show that those scoring highly on psychopathy are more likely to attempt mate poaching (Erik & Bhogal, 2016) and are more likely to be successful at mate poaching (Jonason et al., 2010), it is likely that these traits would influence mate choice copying behaviour. No research has investigated the role of the dark triad in mate choice copying but if possession of dark triad traits affects mate choice copying behaviour then two possible outcomes exist. First, women with high dark triad traits will rate men with women as more attractive. This may occur because increased Machiavellianism, lower agreeableness and increased willingness to compete may mean that the potential competition represented by the presence of a same sex peer will not alter the mating decisions of women. Those scoring lower in dark triad traits may offset any increase of male attractiveness caused by the mate choice copying effect because of the presence of potential competition. Therefore, those scoring lower may be likely to rate men with women as less attractive than those women scoring higher in dark triad traits. Second, because women high in dark triad traits show an increased preference for short term mating and consequently a preference for physical attractiveness, then mate choice copying effects may differ between attractive and unattractive men.

9.3: Expectations

It is unclear whether mate choice copying will be found in this experiment. It is possible that, like with rated attainability, mate choice copying may be explained by individual variation between participants rather than an inflation of attractiveness ratings caused by the perceived mate selection of other women. If this is the case, then ANOVA should show a mate choice copying effect but multi-level modelling should show no significant mate choice copying effect, once individual variation is accounted for. This is because ANOVA analysis would not factor the individual differences of each participant and would instead collapse participant level variance within groups (i.e. in each of the pairing conditions) to a single intercept. Multi-level modelling preserves within group participant variation and so a positive replication in ANOVA and a failed replication in multi-level modelling would offer support for to the hypothesis that data are explained by individual variation rather than mate choice copying. Conversely, if the null results of the previous chapter were an artefact of the attainability question, and mate choice copying does exist, then it should remain a significant predictor of variance even after individual differences have been entered into the model.

9.4: Methodology

9.4.1: Design

This data was collected together with data from chapter 5. For this reason, only experiment-specific details will be outlined below.

A mixed design was used to analyse data. The between subject measure included the pairing condition male images were presented in. Participants saw males either alone and described as single, with a congruently rated woman (i.e. a woman of the same rated attractiveness) or an incongruently rated woman (i.e. a women of opposite attractiveness. For example, an unattractive man with an attractive woman). Within subject measures were represented by each of the male images and the attractiveness group to which they belonged. (i.e. attractive or unattractive males). This formed a 2 (male attractiveness) by 3 (Pairing condition) design.

To test for the effects of individual differences a multi-level regression analysis was used to predict rated attractiveness. Socio-sexuality, age, self-perceived mating success, the big 5 and the dark triad personality traits were used as predictors. Level 1 data included all participant responses to each individual male in the experimental stimuli set they completed. Level 2 data were the group level mate choice copying pairing conditions.

9.4.2: Participants

107 heterosexual females with an average age of 20.19 (SD = 3.35) years were recruited. These participants were recruited opportunistically from the student population of local universities. No monetary reward was given for participation though some participants took part in return for course credit. All participants were heterosexual.

9.4.3: Materials

The standard mate choice copying stimuli set was used. In this experiment rated attractiveness was the unit of measurement. In addition to this a social copying questionnaire and an object copying questionnaire were used. For details on these extra packs and their purpose please refer back to chapter 5. The following questionnaires were used to measure personality: the Self-Perceived Mating Success Scale (Landolt et al., 1995), the Socio-sexual Orientation Inventory (Penke & Asendorpf, 2008), the Big 5 Personality Inventory (Benet-Martinez & John, 1998), and the Dark Triad Measure (Jones & Paulhus, 2014). A demographics questionnaire was used to record participant age, relationship status, and sexuality. The demographics questionnaire included a manipulation check to see if any participants knew what the purpose of the research was. No participants successfully guessed the manipulation.

9.4.4: Procedure

This procedure was ethically assessed and approved by the Department of Psychology Ethics Committee of Northumbria University. Participants were presented with an information sheet, allowed to question any details they were unclear of and then completed consent forms. Once consent was received they were provided with a link to a Qualtrics questionnaire survey

where they completed the mate choice copying pack. Each of the images within the questionnaire pack was randomly ordered and each of the three pack versions were randomly assigned and counterbalanced by Qualtrics. Participants were then presented with the randomly ordered and counterbalanced personality questionnaires followed finally by the demographics questionnaire. Following completion of this participants were fully debriefed on the purpose of the research.

9.5: Results

9.5.1: Overview of results

No mate choice copying effect was present in the data [$F(2,95) = 0.44, p = .65$], participant individual differences explained variance present between the differing pairing conditions. No single participant individual difference reached significance but together age (estimate = .04, SE = .09) [$F(1,95) = 0.25, p = .62$], socio-sexuality (estimate = .001, SE = .01) [$F(1,94) = 0.01, p = .92$], machiavellianism (estimate = -.02, SE = .01) [$F(1,95) = 0.70, p = .41$], psychoticism (estimate = .04, SE = .02) [$F(1,95) = 2.04, p = .15$], and agreeableness (estimate = -.02, SE = .01) [$F(1,95) = 2.90, p = .91$] contributed significantly to improving overall model fit. Self-perceived mating success, openness, extraversion, neuroticism and narcissism did not contribute to significantly to model fit (all p 's > .05). Of the predictors, the only significant predictor was initial male attractiveness [$F(1,108) = 868.50, p < .001$]. Pre-rated attractive men were rated as more attractive than pre-rated unattractive men (estimate = 2.18, SE = .07). The final model accounted for 44.7% of variance in the data. Full results of the modelling process can be found in table 9.1.

9.5.2: Modelling process

First a null model was produced. This allowed for comparison to future models and for the assessment of model fit. A significant intercept exists for rated attractiveness (estimate = 3.56, SE = .04, $p < .001$).

Model 1: allowed the intercept for each participant to vary. This allowed for comparison between participants and allowed for the assessment of the amount of variance

attributable to the participant themselves. A significant improvement in model fit was found [$X^2(1) = 248.3, p < .001$]. Participant variance accounted for 18.4% of the variance in the data.

Model 2: introduced the following class level variables into the model; pairing condition (whether men were present as single, or paired with an attractive or unattractive woman), initial male attractiveness, and age. This significantly improved model fit [$X^2(5) = 1130.1, p < .001$]. Age and pairing condition were not significant predictors of model fit but removal of the predictors reduced overall model fit. Initial male attractiveness was, understandably, a predictor of overall ratings of attractiveness. Attractive men were rated significantly more attractive than unattractive men (estimate = 2.18, SE = .06) [$F(1,2007) = 1531.29, p < .001$].

Model 3: went through the process of adding personality measures in one at a time. Multiple orders of addition and subtraction were tried. Altering the order in which predictors were added or subtracted did not alter overall results. Non-significant predictors which did not impact upon model fit were removed. This model showed a significant improvement in overall model fit [$X^2(4) = 252.6, p < .001$]. Openness, narcissism, extraversion, neuroticism, and conscientiousness made no significant contribution as predictors or to overall model fit. They were consequently removed from the regression equation. None of the main predictors except initial male attractiveness reached significance but all contributed to improved model fit. Removal of any significantly reduced overall model fit. The main predictors for this model were initial mate attractiveness [$F(1,2193.2) = 1473.97, p < .001$] with attractive males being rated more attractive than unattractive males (estimate = 2.18, SE = .06), age [$F(1,95.1) = 0.27, p = .61$], socio-sexuality [$F(1,95) = 0.001, p = .94$], agreeableness [$F(1,94.9) = 2.82, p = .09$], Machiavellianism [$F(1,94.8) = 0.84, p = .15$], and psychoticism [$F(1,95) = 2.11, p = .15$].

Model 4: tested for cross level interaction between pairing condition and initial male attractiveness. No significant interaction effect between male attractiveness groupings and pairing condition existed and no significant improvement in model fit was found. However,

allowing for random slope variation between initial male attractiveness groups did significantly improve overall model fit [$\chi^2(1) = 19.1, p < .01$]. To be specific, those individuals who rate men as more attractive show a faster predicted change in attractiveness ratings as a function of the contributing predictors compared to those who rated men as less attractive. Final model details are presented both in table 1 and in the results overview paragraph at the beginning of this section.

Table 9.1: Regression statistics showing the interaction between participant personality and the rated attractiveness of men presented as single, or with women of varying attractiveness. ** p<.001, *p<.05.

	Null Model		Model 1		Model 2		Model 3		Final Model	
	Estimate	St. Error	Estimate	St. Error	Estimate	St. Error	Estimate	St. Error	Estimate	St. Error
Fit Statistics										
<i>Intercept</i>	3.55**	0.04	3.55**	0.08	2.37**	0.16	2.75**	1.25	2.66**	1.25
<i>Residual</i>	3.53**	0.11	2.88**	0.09	1.64**	0.05	1.65**	0.05	1.58**	0.05
<i>-2 log likelihood</i>	8676.1		8427.8		7297.7		7045.1		7026.0	
<i>AIC</i>	8678.1		8431.8		7301.7		7049.1		7040.0	
<i>BIC</i>	8683.8		8437.2		7307.0		7054.4		7058.5	
Model Predictors										
<i>Participant (un1,1)</i>			0.66**	0.11	0.73**	0.11	0.65**	0.11	0.60**	0.12
<i>Participant (un2,1)</i>									0.001	0.07
<i>Participant (un2,2)</i>									0.17*	0.08
<i>IMA: Am vs UM</i>					2.18**	0.06	2.18**	0.05	2.18**	0.07
<i>Pairing: S vs I</i>					0.21	0.22	0.8	0.21	0.16	0.21
<i>Pairing: C vs I</i>					0.01	0.22	-0.02	0.21	-0.004	0.21
<i>Age</i>					0.08	0.08	0.05	0.09	0.04	.009
<i>SOI</i>							-0.001	0.01	0.001	0.001
<i>Machiavellianism</i>							-0.02	0.01	-0.02	0.02
<i>Psychoticism</i>							0.04	0.02	0.04	0.02
<i>Agreeableness</i>							-0.02	0.01	-0.02	0.01

Key= IMA= initial male attractiveness, AM= attractive male, UM= Unattractive male, S= single, I= incongruently paired, C= Congruently paired, SOI= socio-sexual orientation inventory score. Un1,1= random intercept for participant ratings, Un2,1= random slope for IMA groupings, Un2,2 = interaction between random intercept for participant and random slope for IMA groupings.

9.6: Discussion

In chapter 2 ANOVA analysis was used to investigate both the effects of age upon mate choice copying and to investigate where the boundary of choice copying fell. This analysis also contained the standard measure used for assessing mate choice copying, i.e. ratings of attractiveness for men paired with women of varying attractiveness. ANOVA showed that no mate choice copying effect was found and, unlike with previous analyses, no interaction existed between initial male attractiveness and the condition men were paired in. In this chapter multi-level modelling corroborated results. Men's attractiveness ratings are not influenced by how they are paired with women. Further, though non-significant, regression modelling shows that the personality traits Machiavellianism, psychoticism, agreeableness and socio-sexuality contribute to and improve the overall model fit. In the previous chapter, through the usage of multi-level modelling, differing attainability ratings were shown to vary as a result of self-perceived mating success and comparative attractiveness. Originally this was thought to be a result of both mate choice copying and a result of an ANOVA testing not taking into account variance found only at the participant level (e.g. the personality features of participants). Please refer to the previous chapter for a detailed explanation of this. This chapter attempted to replicate this finding with rated attractiveness so that results could be more reliably compared to literature at large.

Previous mate choice copying literature has repeatedly shown that men paired with images of women are rated as more attractive than when they are single (see literature review for full details). In the only other mate choice copying study using both multi-level modelling and a personality measure, a positive effect of mate choice copying was found. Further, socio-sexuality was also predictive of this mate choice copying effect (Place et al., 2010). This, however, was not the case in this experiment. Both ANOVA analysis and multi-level modelling failed to produce a mate choice copying effect. Indeed, more generally, this thesis has provided mixed results. There are two plausible explanations for this. The first is that mate choice copying does not exist and

that it is either an artefact of analysis choice, as was the case in the last chapter, or may be a result of bias inherent in the publication of data. The second is that wider literature is correct and a flaw exists in the methodology used in this study. Before exploring and expanding upon these points it is important to explore how personality features impacted upon the rated attractiveness of men within this study.

9.6.1: Socio-sexuality

One of the key differences between this and the previous model was that socio-sexuality played a role in predicting ratings of attractiveness but not in predicting ratings of attainability. This is possibly because socio-sexuality plays a role in how much weight participants place on features important to short term mate selection, i.e. how attractive a man is (Schmitt, 2005), compared with rated attainability— a measure related to self-perceived mating success rather than socio-sexuality. Consequently, the positive relationship between socio-sexuality and attractiveness ratings can be explained as follows: women who are unrestricted (i.e. those who score higher) in their sexuality judge men to be more attractive because physical attractiveness is weighed more heavily in their mate quality assessment. Those scoring restricted (i.e. lower) on socio-sexuality show a preference for hidden personality traits over physical attractiveness and therefore weigh attractiveness lower in the judgement of mate quality (Penke & Asendorpf, 2008; Penke & Denissen, 2008). However, socio-sexuality itself did not significantly contribute to model fit. It is possible that socio-sexuality does not contribute to the ratings of attractiveness given to men but that socio-sexuality shares variance with a factor untested in the model. This would explain why socio-sexuality significantly improves model fit whilst simultaneously not being a significant predictor of attractiveness. Because the other personality factors contained within the model also share this feature of improved model fit and non-significance, details of this will be discussed further through this section.

9.6.2: The dark triad

Of the dark triad components Machiavellianism and psychopathy both significantly improved model fit. Psychopathy has been linked with an opportunistic, impulsive and open style of mate selection (Figueredo, Sefcek, & Jones, 2006; Jonason et al., 2009). Machiavellianism has been shown to correlate with an increased preference for short term mating which generates a strong, emotional and “love-struck” attachment style (Furnham, Richards, & Paulhus, 2013; McHoskey, 2001). However, see (Jonason et al., 2011) for conflicting evidence on this. In both men and women who possess personalities high on the dark triad scale a shift towards short term mating strategies has repeatedly been shown to exist (Jonason et al., 2010; Jonason, Luevano, & Adams, 2012). The above cited data are important because the direction of results found in this experiment tentatively support these findings. If participants are judging targets on physical attractiveness, which is of importance for short term mating habits (Li & Kenrick, 2006), then a positive relationship should be expected between psychopathy and rated attractiveness. This is due to the impulsive short term mating focus of those high in psychopathy. Equally, if those high in Machiavellianism do demonstrate a need for “love-struck” emotional attachment, then they may be expected to shift their quality assessment towards traits more conducive of emotional attachment and away from physical attractiveness judgements. This hypothesis is supported by the direction of results. However, it is important not to inflate the impact of these traits in relation to this study. Any predictive influence was small and both traits did not reach statistical significance. The large increase in overall model fit with the inclusion of these traits highlight, as with socio-sexuality, shared variance is likely to exist with an untested trait or trait cluster.

9.6.3: The Big 5

Of the big 5 personality features only agreeableness contributed to model fit. This was a negative relationship where rated attractiveness increased as agreeableness decreased. Extraversion, openness, neuroticism and conscientiousness did not alter overall model fit. This

would be expected based upon the traits which have influenced attractiveness ratings so far (e.g. unrestricted SSOI, psychopathy and Machiavellianism). Each of these traits is associated with reduced agreeableness (Jonason et al., 2011; Paulhus & Williams, 2002). Previous research suggests that extraversion, neuroticism and openness should influence rated attractiveness but this was not found in the multi-level model analysis of this chapter. It is possible that the difference in ratings comes from a key difference in experimental methodology. Previous research has used questionnaire based studies to measure mate preferences (for example please see Jonason et al., 2011) whereas this study used images of males to obtain a measure of mate preference. It may be that when participants are asked to think about their preference whilst completing questionnaires, personality factors influence the imagined preference they are reporting. Conversely, when participants rate physical stimuli it is possible that all the information needed to form an opinion about an image's physical qualities are plainly visible and do not require input from personality traits. The implication being that Big 5 personality traits may affect mate preferences only in a context where some ambiguity exists over the target which is being rated. In a similar manner to previous personality measures discussed so far, agreeableness was not significantly predictive of attractiveness.

9.6.4: Untested influence

Whilst it is unclear what this hypothesised trait is, a possible candidate comes from the HEXACO personality measure. The HEXACO measure is a modified big 5 inventory with Humility-honesty, emotionality, extraversion, agreeableness, conscientiousness and openness replacing the standard big 5 construct (Lee & Ashton, 2004). Analysis shows that the honest-humility facet of fairness, sincerity, greed avoidance and modesty strongly correlate with aspects of the dark triad (Lee & Ashton, 2005). The predictors used in this model all correlate strongly with each other. Agreeableness, Machiavellianism, psychoticism and socio-sexuality are correlated with each other and share variance. It may be the case that honesty-humility traits may

be the hidden main predictor of this model. Indeed, recent research highlights that HEXACO traits are predictive of numerous evolutionarily important aspects of mate selection. For example: life history strategy is predicted by all aspects of the HEXACO model except openness; honesty-humility and emotionality are important predictors of both the short and long term mating strategies measured by socio-sexuality (Strouts, Brase, & Dillon, 2017). Socio-sexuality and a woman's mating strategy are intrinsically linked with life history (Kruger & Fisher, 2008). Future research could incorporate these measures into analysis to further elucidate the findings of this experiment.

9.6.5: Questioning mate choice copying

Both the multi-level model and ANOVA analysis show no evidence of a simple mate choice copying as predicted by wider literature. Indeed, much of the data provided during this thesis has produced mixed results. In chapter 4 and 5 no evidence of mate choice copying was found. In chapter 6 and 7 men paired with women were rated as more faithful partners and more attainable mates, respectively, than single men. Multi-level modelling in chapter 8 did not find that single men were rated more highly than men with women, even with the most replicated of measurements: rated attractiveness. To reiterate, the aim of this chapter was to replicate the multi-level model finding for attainability ratings with a more representative question that could be compared to wider literature. There are a two plausible main explanations for this contradictory result.

The first is that because the effect size of mate choice copying is small (i.e. the difference between men rated when single and men rated when paired tend to be small), it is possible that the failure to replicate the ANOVA finding could be a type 1 error. However, mixed results have been reported previously in literature and two distinct analyses both produce results contrary to literature. Further, with an overall partial η^2 of 0.732 for the ANOVA, the analysis is unlikely to be underpowered sufficiently to generate type 1 error. The second possible reason for the failure

to produce expected results is that mate choice copying in humans may not exist. To help visualise this imagine if we considered the null hypothesis to be a zero point on a z-score graph. Results which fall on the negative side of zero represent negative replications and results which fall on the positive side of zero represent positive replications. Though literature points mainly to positive findings, results are still mixed and fall on both sides of the zero point (see the literature review for examples). It is possible that a publication bias exists in literature towards positive results. Though it is unknown whether publication bias exists in mate choice copying specifically, in wider psychological research this has been highlighted as an issue (Kühberger, Fritz, & Scherndl, 2014). To date, no meta-analysis of the extant human mate choice copying literature has been conducted. At present, it isn't possible to state whether wider research is bias or even whether reported results do hover around the above imagined zero point. However, the mixed results of this thesis highlights the need to interpret data with caution.

Chapter Ten: General Discussion

In the previous experimental chapters, I laid out a number of experiments which attempted to replicate and expand upon wider mate choice copying literature. In this chapter a brief overview will be provided of these experimental chapters. I will discuss how these findings add to our understanding of mate choice copying as a whole and how some potential limitations, both of this thesis and wider literature, may explain why replication of mate choice copying was problematic. Finally, I will discuss some important considerations for future research before concluding this thesis.

10.1: Experimental overview

10.1.1: Section 1 – Biological factors influencing mate choice copying

Chapter 4 - In this chapter I investigated whether ovulatory shifts in hormones influence mate choice copying. Research has shown that the hormonal flux associated with the ovulation process may influence how women engage in mate selection (Gildersleeve et al., 2014a) however, Wood et al. (2014) provides counter evidence to this. Some animal research has shown that ovulation affects whether mate choice copying occurs (Choleris et al., 2009). When tested in humans I found that a mate choice copying effect was not present in the data. Men's attractiveness was not affected by pairing them with women. Nor was mate choice copying influenced by ovulation. Further, no effect of ovulation was found on rated attractiveness. Men were neither rated more nor less attractive at peak fertility than at low fertility. However, this experiment lacked statistical power so it is unclear whether the failure to replicate mate choice copying was a result of power issues or a wider issue with the replicability of mate choice copying more generally. Further, this lack of power meant that it was not possible to convincingly conclude whether ovulation affected mate choice copying behaviour.

Chapter 5 – This chapter had two primary goals. The first investigated the effects of age upon mate choice copying. Previous research has suggested that mate choice copying should be influenced by age. In the fish species *Poecilia reticulata* females have been observed to copy the choice of older females only when they are young and naïve to the mating market (Amlacher & Dugatkin, 2005; Dugatkin & Godin, 1993). Human research has attempted to replicate this with mixed findings. It was argued that the literature was mixed for two primary reasons: First, the literature lacked sufficient variance in age to see differences between younger and older participants. Second, the population described as young in the literature may have been too old and therefore too exposed to mating markets to employ mate choice copying. I compared a standard university aged sample with a sample of school aged adolescents. I found no age related effects upon mate choice copying. Again, mate choice copying itself failed to replicate. Men with women were not rated as more attractive than single men, regardless of the age of the rater or the attractiveness of the woman he was paired with. The second aim of this chapter was to establish the boundary of where choice copying occurs. In fish species this has been established. Fish operate mate choice copying independently of social copying (Godin et al., 2005). To test this in humans, participants were presented with three versions of the mate choice copying stimuli: social copying stimuli, object copying stimuli, and mate choice copying stimuli. Younger women were less likely to award higher ratings in general compared to older women but neither participant group showed any evidence of any type of choice copying behaviour.

10.1.2: Section 2 – The influence of mate choice copying over the perception of male traits

Chapter 6 – This chapter served two main purposes. First, as the previous two experiments failed to produce a mate choice copying effect it was necessary to replicate mate choice copying effects in order to confirm whether the stimuli were capable of triggering mate choice copying. Second, because literature shows that mate choice copying can alter the perception of positive traits possessed by men (Rodeheffer et al., 2016), it was of interest to know whether

men were perceived as more potentially faithful partners with women than men without women. A mate choice copying effect was observed for the unattractive rated men only. This confirmed that the stimuli were capable of producing a mate choice copying effect. Mate choice copying also increased the perceived faithfulness of unattractive men in relationships. Specifically, less attractive men with more attractive women were rated as significantly more attractive and significantly more faithful partners than men who were either presented as single or presented with less attractive women. No effect of mate choice copying was found on either the rated attractiveness or the rated faithfulness of attractive men.

Chapter 7- Mate choice copying increases the positive perception of personality characteristics possessed by men (Rodeheffer et al., 2016). At least for less attractive rated men, mate choice copying also increases their perceived faithfulness as partners. This chapter investigated whether mate choice copying affected how likely women were to select men as potential partners. This was measured via the males rated attainability as a partner. Men presented with women, specifically the more attractive women, were rated as more attainable mates than men without women. Specifically, attractive rated men with attractive rated women were rated as more attainable mates than when they were single. Unattractive men were rated as more attainable mates when they were with any woman, regardless of her attractiveness, compared to when they were single. It was argued that mate choice copying may bias perception of men so that women are more likely to pursue men who are chosen, and presumably higher quality, compared to single and potentially lower quality men.

10.1.3: Section 3 – The interaction between individual differences and mate choice copying

In the previous chapters, ratings provided to male images had been used as the unit of analysis. This was so that changes in the perception of men could be discussed. In this section, the participants themselves became the unit of analysis. This allowed the investigation of aspects of the participant herself that contributed to mate choice copying.

Chapter 8 – The purpose of this chapter was to investigate the interaction between participant self-perceived mate value, socio-sexuality, and the attainability scores given by participants in chapter 7. A multi-level model was used to analyse the data. Factoring in personality differences removed any effect that pairing men with women had upon the perceptions of male attainability. Instead, differences in attainability scores were explained by differences in participant self-perceived attractiveness and comparative attractiveness between the rated man and the participant herself. A possible explanation is that ANOVA analysis collapses data within a group around a single intercept in order to compare means between groups. Multi-level modelling allows the individual intercept points within groups to be kept. It is possible that the collapse of intercepts within a group may have artificially created differences between groups where, when intercepts are maintained, a difference does not exist. This calls into question whether previous positive results are in fact mate choice copying or whether they are an artefact of analysis choice. Equally, however, it may be that multi-level modelling produces a false negative. Regardless, further testing of this analysis technique in this research area is required.

Chapter 9 – This chapter replicated the standard mate choice copying question – asking participants to rate male attractiveness in various image pairing conditions— in order to check whether personality or multi-level modelling would remove the effects of mate choice copying in a similar way to data presented in chapter 8. Participants completed measures of socio-sexuality, self-perceived mating success, big 5 personality traits and dark triad traits together with providing ratings of attractiveness for men in the three pairing conditions. There was no evidence for an effect of mate choice copying on rated attractiveness. Though none of the personality measures were significant contributors to model fit individually, together they explained significantly more variance in data than pairing males with women did. As the basic mate choice copying effect did not replicate, it was not possible to know whether the hypothesis about intercept collapsing altering results was occurring. This means that it is not possible to know whether results reported in chapter

8 are dataset specific or whether it is likely to be generalisable across data sets. This is discussed further in section 10.3.

10.1.4: The overall picture

Little convincing support was found for the idea that single men are rated more highly than paired men (later referred to as simplistic mate choice copying) across this thesis. Where support was found in chapter 6 and 7, it was called into question by multi-level modelling which removed the effects observed when ANOVA analysis was used in chapter 7. Whilst it is worth noting that the individual elements hypothesised to affect mate choice copying (e.g. age, ovulation, personality or boundary effects) had no effect on mate choice copying, this misses the more important point demonstrated by this thesis. Mate choice copying itself fails to replicate convincingly. It would be remiss to hold the positive results in chapter 6 and 7 as particularly informative when results of chapter 7 were called into question by multi-level modelling and other chapters failed to replicate the main finding. This would leave chapter 6 as the only positive example of simplistic mate choice copying. Even within chapter 7, however, mate choice copying occurred only for unattractive rated men and not attractive rated men. This does not fully fit with the expectations of mate choice copying (where the presence of any woman should increase ratings provided to men compared to when he is single). Instead some support is given to the quality biased mate choice copying alternative (where the presence of attractive women specifically increases ratings provided to men). In the multi-level model of chapter 8, the attractiveness of the woman did influence ratings given to men and in chapter 6 and 7 data show a subtle effect of the attractiveness of women upon male ratings. Though, it should be noted that this effect does not manifest as clearly as literature suggests it should. Consequently, evidence from this thesis is mixed.

10.2: Why the lack of support for mate choice copying?

There are a number of possible reasons for the lack of replicability within this thesis. These reasons fall within two categories: i) potential limitations with the stimuli used to generate the mate choice copying effect and ii) issues with mate choice copying more generally. The stimuli used within this research program differed slightly from standard mate choice copying images in that effort was made to present men and women on the same image as if they had both been present at the time the photograph was taken. This was done to increase the believability of the image pairings. Two potential manipulation issues arise from this which may have contributed to the failed replication of mate choice copying.

First, it is possible that the manipulation used within this thesis was not convincing enough to generate a mate choice copying effect. There are two reasons why this may be the case: the information that pictured men and women were romantically involved was stated at the beginning of the experimental pack and only at the beginning of the experimental pack. Participants could have skipped across this important information and therefore rated images without the important mate selection context necessary for mate choice copying to occur. Second, because it was untested, it was not clear whether placing an image of a male and a female on the same photograph in such a controlled manner produces a qualitatively different observational experience than having them pictured separately or with less control over facial expression. In other words, does having two people with neutral facial expressions in the same image alter the perceived emotional salience of the individuals pictured within the image differently than two individuals with natural expressions pictured separately?

In the above stated scenarios, mate choice copying would be a verifiable and replicable phenomenon but the stimuli used here were not able to generate a mate choice copying effect. There are a number of issues with this interpretation of results, however. First, if the stimuli were not able to produce a discernible mate choice copying effect then the results of chapter 6 and 7

would not have been found. Whilst I question how conclusive these results are, they would not exist if stimuli were not sufficient to trigger the pattern of results commonly found in mate choice copying research. It is still possible that the manipulation, whilst not wholly unconvincing, was not as strong as it could have been. In the wider literature, where similar facial image stimuli are used, the believability of the manipulation has not caused an issue in producing mate choice copying. For example, in Little et al. (2008), participants see morphed, averaged and partially masked faces (i.e. with hair that was masked out). This produces faces that are modified and may be less convincing, yet mate choice copying effects are still present in their data. Further, Yorzinski and Platt (2010) use a similar manipulation technique and still produce a mate choice copying effect. Stimuli in this thesis present males and females on the same image as if taken together with very little visible editing. This should improve the believability of the manipulation. Indeed, every time the manipulation was checked by asking what participants thought the purpose of the research was, no evidence was found to suggest that participants guessed or criticised the manipulation. Consequently, it is unlikely that the believability of the manipulation is an issue throughout this thesis.

The second possible reason for the lack of replication is a further potential criticism of the way in which stimuli were produced. In pairing men and women together in a single photograph an unintended confound may have been introduced. One of the most demonstrable and repeatedly desired attractive traits a male possesses is his height. For example, taller than average men are considered more attractive than smaller men (Pawlowski & Jasienska, 2005) and report greater reproductive success than smaller men (Frederick & Jenkins, 2015; Pawlowski et al., 2000). When presenting male images in the romantically single condition there is no way to infer the height of men. This is because they are presented on a plain grey background with no other objects or people to offer a point of comparison. In combining men and women on the same photograph it is possible that height inferences then became a factor which altered the perception of male attractiveness. In

all stimuli men were made taller than women. In all stimuli the height difference was standardised. However, this height difference was such that men would have appeared to have been approximately one inch taller than the woman he is paired with. In general, men tend to be taller than women. Where a man's height is similar to or only slightly taller than that of the woman he is pictured with, it is possible that participants may have interpreted this as a lack of height in men. Therefore, if a mate choice copying effect was present, its small positive effect on attractiveness may have been suppressed by the inference of men's smaller stature. Whilst this is unlikely to have had a large influence on participant judgement – i.e. if height inferences exist in paired but not unpaired conditions and ratings are negatively affected, then a drop in rated attractiveness for all paired individuals would be expected. This trend is not seen in data – it is not possible to rule this out as a possible interference mechanism. Ruling out height interference would add further weight and support to the third and final explanation for why mate choice copying effects were not observed.

A final possible explanation is that mate choice copying itself may be less powerful than is reported in the literature. The majority of research published in human mate choice copying literature reports positive findings (refer to chapter 2 for a detailed overview of this). There are three main reasons for questioning the replicability of mate choice copying. First, within this thesis, only 1 of the 3 direct experimental replications report a mate choice copying effect. Though one of these null replications may have been underpowered. The remaining three chapters present a mixed picture of mate choice copying. It should be noted, however, that none of these experimental chapters are direct replications of mate choice copying. Consequently, null results may be an artefact of this. With this caveat in mind, there is little reason to think that the stimuli presented in this thesis are less likely to produce a viable mate choice copying effect than stimuli used in the wider literature. Second, no meta-analysis has been conducted on extant data, and so it is not known whether a publication bias exists. The lack of meta-analytic data also means that

because the heterogeneity of effect sizes in wider literature is not known it is difficult to accurately estimate the power required to replicate findings (Kenny & Judd, In Press). To clarify this point, table 10.1 shows a comparison of sample sizes used within the most commonly cited human mate choice copying literature and this thesis.

Table 10.1: A comparison between mate choice copying replication status and the total female sample size used in this thesis and commonly cited literature.

Publication Source	Sample Size	Replication Status
From This Thesis		
Chapter 5: Age and Boundary	137	Null
Chapter 9: Attractiveness and Personality	112	Null
Chapter 6: Faithfulness	93	Positive
Chapter 7: Attainability	90	Mixed
Chapter 8: Attainability and personality	90	Mixed
Chapter 4: Ovulation	19	Null
Published Research		
Waynforth (2007)	112	Positive
Uller and Johansson (2003)	97	Null
Vakirtzis and Roberts (2012)	52	Positive
Vakirtzis and Roberts (2010)	40	Positive
Bowers et al. (2012)	40 women, 40 men	Positive
Place et al. (2010)	40 women, 40 men	Positive
Eva and Wood (2006)	38	Positive
Yorzinski and Platt (2010)	30 women, 30 men	Positive

Only two of the most commonly cited research papers have comparable participant numbers compared to this thesis. The consequence of this is that it raises the possibility that extant

literature may be under powered which can increase the risk of error when reporting results. The third reason for raising questions about extant data is this: of the two studies presented which replicate mate choice copying, one result was made non-significant by factoring in individual differences and by preventing the within group intercept collapse which occurs when data are analysed via ANOVA. Given that much of the extant research does not consider in individual differences and is analysed via analysis techniques which performs this same data collapsing, it is possible that wider literature detects results which may not exist if individual level data are not collapsed to a single group level intercept. Whilst there is little reason to presume that ANOVA per se increase the likelihood of false positives, attempts in chapter 9 to check this hypothesis failed. Consequently, it is not possible to rule out this as a potential explanation of results. Combined with the lack of replicability present in this thesis, these three points suggest that mate choice copying itself may be questionable. There are a number of future directions which could help clarify the overall position of mate choice copying.

10.3 Future directions

There are two main directions future research could take, both of which seek to clarify mate choice copying as an actual effect. First, a meta-analysis should be conducted on extant data. Because no meta-analysis has been conducted, the heterogeneity of effects common to the mate choice copying literature is not known. The consequence of this is that it is not clear whether extant data are tapping into the same overall effect or whether there are various independent or co-dependent effects being measured. This could account for mixed results (Fletcher, 2007; Higgins & Thompson, 2002). To clarify, when researchers ask women to rate images of male attractiveness in a mate choice copying study and another set of researchers ask women to rate preference for long or short term relationships (both of these questions have been asked in literature, see Place et al. (2010) and Waynforth (2007) for examples) it is assumed that it is the same underlying process which accounts for changes in ratings given to men. Knowing whether

effects are heterogeneous or not will allow this assumption to be clarified. A heterogeneous selection of effects indicates that multiple effects are being studied rather than a single underlying effect. A further consequence is that, because it is not clear whether extant data are measuring a single effect, it becomes difficult to accurately estimate the statistical power needed to detect effects and therefore estimate participant requirement numbers (Borenstein, Hedges, Higgins, & Rothstein, 2011; Kenny & Judd, In Press; Shrout & Rodgers, 2017). It is possible then that the lack of overall replication found in this thesis could be a result of studies which either do not tap the same overall effect or do not have sufficient power to detect effects. The studies in this thesis (excluding chapter 4) recruit comparable, and in most cases a greater numbers of participants than wider literature. If this research program is underpowered then it is likely that wider research is also underpowered. Further, it is not known whether mate choice copying literature suffers from publication bias, but such a bias has been a point of concern for many psychological fields (Kühberger et al., 2014). Future research should reach out to researchers for unpublished data in order to confirm publication bias. Meta-analysis could therefore serve multiple useful functions: i) to confirm if one or multiple effects are responsible for data, ii) to confirm the required power for future recruitment, and iii) shed light on possible publication bias.

The second general direction which could be recommended for future research relates to the finding in chapter 8 that positive results change when individual differences are factored into the analysis. New and/or previous data could be (re)analysed using multi-level regression modelling as a means of preventing the collapse of individual intercepts within group level data. This would not necessarily mean capturing personality information from participants for each experiment, as was done in this research, but using multilevel modelling would confirm and prevent any false positives which may have resulted from collapsing intercepts around a single group (Hoffman & Rovine, 2007). Whether this is an issue present in the wider data is not known but, as with the above noted concerns over heterogeneity, testing for such effects can only

elucidate the true standing of data within the field. A final note for future research direction relates to the stimuli used within this research project. It is important to confirm if the more realistic stimuli used within this research project are indeed affected by the height interference hypothesised above. This can be done by altering the height difference between men and women and comparing ratings of attractiveness. If men who are taller produce the expected mate choice copying effect whilst men who are perceived as shorter do not, then data presented here within this thesis may have been confounded by height. If this is the case, then the lack of replicable mate choice copying would likely be methodological rather than representative of a wider issue of replicability. If, however, height does not alter results then this suggests that the more realistic stimuli are a viable manipulation and enforces the call for checks over the replicability of the wider research findings.

10.4: Conclusions

This thesis aimed to investigate how mate choice copying altered the perception of male traits and how aspects of the female herself altered the expression of mate choice copying behaviour. This was addressed in three sections. Section 1 investigated the impact of ovulatory hormonal shifts and age upon mate choice copying. Section 2 investigated how mate choice copying influenced the perception of male faithfulness and attainability. Section 3 investigated the interaction between participant personality and mate choice copying. Overall, data failed to convincingly replicate a mate choice copying effect. Where data did show a viable mate choice copying effect (e.g. in chapter 6 and 7) this was called into question by positive replications being dependent upon the type of statistical tool used to analyse data. ANOVA analysis showed a mate choice copying effect whereas multi-level modelling did not show a mate choice copying effect. It was hypothesised that this occurred either because ANOVA forced data to fit around a single group level mean intercept whereas multi-level modelling allowed for variation of intercept at both the group and individual level. Alternatively, because the inclusion of individual differences

accounts for or merely masks the mate choice copying effect. Combined with a lack of replicability, this thesis concludes that extant literature should be viewed with caution. I call for meta-analysis to both highlight any publication bias and to discover homogeneity variance in order to ascertain if effects are generalizable. Further, I call for the reanalysis of previous data via multi-level modelling in order to confirm whether collapsing of data around a group level mean intercept alters the detection of mate choice copying.

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Appendices

Ovulation Questionnaire

In order to ensure that we are collecting data from you correctly, we would ask that you complete the following questions as honestly and as fully as you can. Please remember that this data is anonymous and will be protected under the data protection act.

- 1. Age:**
- 2. Relationship Status:**
- 3. Sexual Orientation:**
- 4. Are you currently involved in a relationship (if not please skip to question 5)?**
 - 4a. How long have you been together?**
- 5. Do you personally use any hormonal contraceptives (e.g. birth control pills, injections, implants, patches, intrauterine systems or hormonal coils)? If so, please state what contraceptive you use and provide the name of the product if you can.**
- 6. Have you used any of these products in the last 3 months?**
- 7. On the calendar on the next page please mark, as accurately as possible, the date your last menstruation (period) started:**

December

M	T	W	T	F	S	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

January

M	T	W	T	F	S	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

February

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28					

March

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

8. Please indicate how sure you are of this information (please circle)?

Absolutely Sure

Sure

Unsure

Do Not Know

9. Is your menstruation regular?

9b. what is the average length of your cycle? Please provide the details of this as accurately as you can because this information will allow us to tell you when to use the LH testing kits. **Note:** by cycle we mean the length of time from the start of one period to the start of the next period

10. How sure are you of this?

Absolutely Sure

Sure

Unsure

Do Not Know