AT FACE VALUE:
HOW INTERNET ACCESS, PUBERTAL TIMING, ENVIRONMENTAL HARSHNESS, AND POPULATION FAMILIARITY INFLUENCE FACIAL PREFERENCES

Carlota Batres

A Thesis Submitted for the Degree of PhD at the University of St Andrews

2016

At face value: How internet access, pubertal timing, environmental harshness, and population familiarity influence facial preferences

Carlota Batres

University of St Andrews

This thesis is submitted in partial fulfilment for the degree of PhD at the

University of St Andrews

February 15, 2016

Declarations

Candidate's declarations:

I, Julia Carlota Batres, hereby certify that this thesis, which is approximately 29,329 words in length, has been written by me, and that it is the record of work carried out by me, or principally by myself in collaboration with others as acknowledged, and that it has not been submitted in any previous application for a higher degree.

I was admitted as a research student in September 2012 and as a candidate for the degree of Doctor in Philosophy in June 2013; the higher study for which this is a record was carried out in the University of St Andrews between 2012 and 2016.

Date __________________________ Signature of Candidate __________________________

Supervisor's declaration:

I hereby certify that the candidate has fulfilled the conditions of the Resolution and Regulations appropriate for the degree of Doctor in Philosophy in the University of St Andrews and that the candidate is qualified to submit this thesis in application for that degree.

Date __________________________ Signature of Supervisor __________________________

Permission for publication

In submitting this thesis to the University of St Andrews I understand that I am giving permission for it to be made available for use in accordance with the regulations of the University Library for the time being in force, subject to any copyright vested in the work not being affected thereby. I also understand that the title and the abstract will be published, and that a copy of the work may be made and supplied to any bona fide library or research worker, that my thesis will be electronically accessible for personal or research use unless exempt by award of an embargo as requested below, and that the library has the right to migrate my thesis into new electronic forms as required to ensure continued access to the thesis. I have obtained any third-party copyright permissions that may be required in order to allow such access and migration, or have requested the appropriate embargo below. The following is an agreed request by candidate and supervisor regarding the publication of this thesis:

PRINTED COPY

b) Embargo on all or part of print copy for a period of 2 years (maximum five) on the following ground(s):

- Publication would preclude future publication

Supporting statement for printed embargo request:

Two chapters in this thesis are based on research articles that are currently under review in peer-reviewed journals. The review process can often take over a year, thus two years are requested to allow for publication of these research articles.

ELECTRONIC COPY

b) Embargo on all or part of electronic copy for a period of 2 years (maximum five) on the following ground(s):

- Publication would preclude future publication

Supporting statement for electronic embargo request:

Two chapters in this thesis are based on research articles that are currently under review in peer-reviewed journals. The review process can often take over a year, thus two years are requested to allow for publication of these research articles.

Date ________________________ Signature of Candidate ________________________

Date ________________________ Signature of Supervisor ________________________

Collaboration Statement

Throughout this thesis, the use of the pronoun “we” reflects the collaborative nature of experiments conducted in the Perception Lab at the University of St Andrews. The use of “I” would betray the joint effort in running studies. The design, analysis, and discussion of the experiments as detailed in the present work, however, is my own under the guidance of my supervisor.

This thesis is partly based on works submitted to and accepted for publication in peer-reviewed academic journals. These articles are identified at the beginning of the chapter in which they are featured. Chapter Five includes a co-author, Mallini Kannan, an undergraduate student at the University of St Andrews who helped collect data in Malaysia.

Additionally, I would like to acknowledge the following for their help in each empirical chapter. Chapters Two-Five: Dengke Xiao for the experimental interfaces, Anne Perrett for proofreading, and Lesley Ferrier for logistical support. Chapter Two: Daniel Re for his assistance with stimuli preparation, Lisa DeBruine and Benedict Jones for their comments, and the Escuela de Comunicación Mónica Herrera for their collaboration. Chapter Three: Benedict Jones, David Feinberg, and Lisa DeBruine for the initial setup of the BBC survey. Chapter Four: Tayforth Universities Officer Training Corps, Training Major Dwyer, Lieutenant Colonel Lindsay, and Tom Whelan for recruitment support, Audrey Henderson and Sean Talamas for providing transportation, and Richard Byrne for his comments. Chapter Five: the Escuela de Comunicación Mónica Herrera, Directora de Comunicaciones Integradas Nicole Paetz, Julie Batres, Carlos Batres, SEGi University, Taylor's College Sri Hartamas, Anne Moses, Anjalai Kannan, Ida Chin, Tok Batin Alias, and Ganason Periathamby for their help with organising data collection.

Acknowledgments

The completion of this thesis would not have been possible if not for the incredible support I have received from numerous people. While it is not possible to mention everybody, I would like to acknowledge the help of some people who have been instrumental in making this achievement possible.

I would first like to thank those individuals who sparked this entire journey by introducing me to the field of evolutionary psychology during my undergraduate degree: Margery Lucas, Nancy Genero, and Andy Wells. Were it not for these people, my journey to complete a PhD may have never even begun.

I would like to recognize the Wellesley College Graduate Trust, the Russell Trust, and the Saltire Trust for their financial support during my PhD. Thank you as well to Amanda Seed for being my second supervisor and always providing guidance when needed.

I would also like to thank the Perception Lab members for their emotional support. In particular, Daniel Re, Iris Holzleitner, Martha Borras, Audrey Henderson, Sean Talamas, Stepheni Uh, and Jing Ma. The completion of this PhD would have been much less enjoyable without all of you. Within the Perception Lab, I would also like to acknowledge Dengke Xiao for help with all the experimental interfaces and Lesley Ferrier for logistical support and always offering a helping hand. I am also grateful to Anne Perrett for her constant support of my work through her enviable editing skills.

An enormous thank you to my supervisor, David Perrett, for believing in me and taking me on as his PhD student. I am forever indebted for the impact he has had on me as an academic. He has been a truly outstanding supervisor: someone who has helped me, challenged me, motivated me, and inspired me. Dave has brought so much colour into my life and I hope that our collaborations continue past the completion of this PhD.

I would also like to thank my friends and family for their instrumental role. Thank you to my friends and family from El Salvador, to my Wellesley women, and to all of my friends in St Andrews who have supported me through this process. A very special thank you to the one person who has been with me through it all: Joaquin Villarreal. His support in my pursuing a PhD is something that I am eternally grateful for. He has put up with my ups and downs through this process and has always provided a much needed voice of reason. His kindness and love have seen me through this PhD and I am blessed to soon be able to call him my husband.

Lastly, thank you very much to my incredible parents: Julie and Carlos Batres. They have shaped who I am today and I am forever grateful for their constant love and support. I could not have asked for better parents who have provided me with so many opportunities and more importantly, have always inspired me to pursue my dreams. Mami and papi, this is my Fitzcarraldo.

General Abstract

Chapter One introduces the field of evolutionary psychology as well as provides a review of factors influencing facial attractiveness. Chapter Two presents empirical evidence that online studies may provide a distorted perspective on cross-cultural face preferences since online samples are not representative of the populations in developing countries. In El Salvador, participants without internet access preferred more feminine men as well as heavier and more masculine women when compared to participants with internet access. One possible explanation for such findings is that the level of harshness in the environment may be influencing preferences. One individual difference that is influenced by environmental harshness is age of menarche. Chapter Three thus provides exploratory evidence that age of menarche also influences masculinity preferences.

Chapter Four further examines this environmental harshness hypothesis by repeatedly testing students undergoing intensive training at an army camp. Increases in the harshness of the environment led to an increased male attraction to cues of higher weight in female faces. Such changes in preferences may be adaptive because they allow for more opportunities to form partnerships with individuals who are better equipped to survive.

An alternative explanation for the empirical findings in Chapters Two and Four is that familiarity may also influence preferences. Chapter Five tests this familiarity hypothesis by examining the faces of participants in different areas of El Salvador and Malaysia. Rural participants preferred heavier female faces than urban participants. Additionally, the faces of female participants from rural areas were rated as looking heavier. This finding suggests that familiarity may indeed influence attractiveness perceptions. Lastly, Chapter Six draws conclusions from the empirical findings reported in Chapters Two-Five and lists proposals of future research that could further enhance our understanding of what we find attractive.

Table of Contents

List of Figures

List of Tables

Chapter 1: General introduction

1.1. Introduction

In this thesis, I study factors affecting mate choice. More specifically, I explore the influences of internet access, pubertal timing, environmental harshness, and population familiarity on masculinity and adiposity preferences. This thesis develops an account of mate choice as adaptations to cultural, sexual, and evolutionary selection pressures. To that end, I first provide a framework by briefly overviewing evolutionary theory.

1.2. Natural selection

In 1859, Darwin published the landmark book "On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life". In it, he introduced natural selection as a force of modification among species (Darwin, 1859), where traits that help an individual survive are favoured (Sundie et al., 2011). An example of natural selection can be found in the changing colour of the geometrid moth (*Biston betularia*) in the United Kingdom during the industrial revolution (Grant & Owen, 1996). Before the industrial revolution, the majority of geometrid moths in the industrial centres had light colouration. Increased pollution levels, however, caused the moth's habitat to be blackened by soot and thus made light coloured geometrid moths more conspicuous to predators. As a result, the formerly rare dark colouration became more prevalent and by the turn of the nineteenth century, 90% of the geometrid moths in the industrial centres had dark colouration. Meanwhile, the colouration of geometrid moths away from the industrial centres remained unchanged. When the air quality in the industrial centres began to improve, the frequency of dark coloured geometrid moths began to drop. Such patterns of change in the colouration of the geometrid moth illustrate how the mechanisms of natural selection favour traits that aid survival.

1.3. Sexual selection

Certain traits, however, defy explanation through Darwin's theory of natural selection. For instance, the ornamental peacock's tail hinders survival by making it difficult to evade predators (Sundie et al., 2011). Under the theory of natural selection, such maladaptive traits should be eliminated (Cronin, 1991). Yet traits that hinder the survival of the bearer are found across species and more importantly, these disadvantageous traits have persisted from one generation to the next. Darwin (1871) proposed that these traits are selected for because they give the bearer an advantage when competing for mates. As a result, maladaptive traits can be selected for under a second evolutionary process, which Darwin termed sexual selection.

Sexual selection can operate through two mechanisms: intrasexual selection and intersexual selection (Moore, 1990). The first mechanism refers to the selection of traits that provide an advantage when engaging in same-sex competition (Buss, 1998; Puts, 2010). For example, the males of several beetle species (e.g. *Macrodontia cervicornis*) have enlarged horns which serve as weapons in competition with other males in order to gain sexual access to females (Emlen, Marangelo, Ball, & Cunningham, 2005). The second mechanism refers to the selection of traits that are found attractive by the opposite sex (Buss, 1998). For instance, female house finches (*Carpodacus mexicanus*) show a preference for the most colourful males (Hill, 1990). Sexual selection thus refers to the evolution of traits that provide some reproductive advantage (Buss, 1998). It is argued that both intra and inter sexual selection have played a role in human evolution (Buss, 1998; Puts, 2010; Simpson, Gangestad, Christensen, & Leck, 1999). It is important to note, however, that these evolutionary pressures do not deny the additional pressures from society and culture which will be addressed later on (Section 1.7.5).

1.4. Handicap principle

Zahavi (1975) expanded on the idea of intersexual selection by suggesting that the traits that are found attractive by the opposite sex are a marker of quality. He proposed that such traits confer handicaps on the survival of the bearer and are therefore costly to maintain. As a result, the traits are honest indicators of mate quality since they are impossible to fake (Luxen & Buunk, 2006). For example, the plumage colouration of male house finches is a result of the type and quantity of carotenoids in their diet. Therefore, colouration in male house finches is a good indicator of their overall mate quality since it signals their ability to access foods with carotenoid pigments (Hill, 1990).

1.5. What about humans?

In humans (*Homo sapiens*), skin colouration also influences attractiveness (Scott, Pound, Stephen, Clark, & Penton-Voak, 2010). Research has found that there are three main skin colour components: redness, lightness, and yellowness (Stephen, Smith, Stirrat, & Perrett, 2009a). One study asked participants to increase the apparent health of faces by manipulating their colour and found that participants increased skin redness, lightness, and yellowness (Stephen et al., 2009a). Skin redness increases the appearance of health because the level of skin blood oxygenation depends upon cardiovascular and circulatory health (Stephen, Coetzee, Law-Smith, & Perrett, 2009b). When participants are allowed to manipulate the level of oxygenated and deoxygenated blood colour in faces, they particularly increase oxygenated levels to increase attractiveness (Stephen et al., 2009b). In contrast, the role of skin lightness on health is more complex. Melanin provides protection from ultraviolet radiation, which reduces the chances of skin cancer and sunburn (Robins, 1991). By protecting from ultraviolet radiation, however, melanin also impairs vitamin D synthesis, which is necessary for normal bone formation (Murray, 1934). Lastly, high levels of skin yellowness are obtained through the dietary consumption of carotenoids (Stahl et al., 1998), which are found in fruits and vegetables (Alaluf, Heinrich, Stahl, Tronnier, & Wiseman, 2002). Yellowness, therefore, increases the appearance of health (Alexander, Newmark, & Miller, 1985). More specifically, research has found a robust link between carotenoid intake and the appearance of health in faces (Stephen et al., 2009a; Stephen et al., 2009b). The cues to health that skin colour provides affect mate choice by contributing to facial attractiveness (Fink, Grammer, & Matts, 2006; Matts, Fink, Grammer, & Burquest, 2007).

Skin colour is not the only dimension that influences facial attractiveness. Averageness (Rhodes, Sumich, & Byatt, 1999), symmetry (Grammer & Thornhill, 1994), skin texture (Fink et al., 2006), sexual dimorphism (Penton-Voak & Perrett, 2000), and adiposity (Coetzee, Perrett, & Stephen, 2009) have also been found to have an impact on mate choice. These cues will all be covered in detail later on (Sections 1.7.1- 1.7.5) but for now, I will dwell briefly on why this thesis investigates attractiveness in faces and more generally, why this part of the human body is the focus of many studies on mate choice.

1.6. Why faces?

It appears that humans may be born with a disposition to attend to faces (Goren, Sarty, & Wu, 1975). As early as nine minutes after birth, human neonates who have not seen any faces before, show greater responsiveness to face-like stimuli than to stimuli made up of the same facial features but with different arrangements (Goren et al., 1975). Such responsiveness is adaptive because it promotes attention towards their caregivers. It must be noted, however, that humans are not born with a bias towards the specific geometry of human faces but rather a domain-general bias towards top-heavy patterns (Macchi, Turati, & Simion, 2004), which occur in faces. Hence neonate attention is drawn by a geometric heuristic to attend to faces.

Faces convey a wide array of information such as species, sex, and age. They are also the most distinctive and used piece of information when identifying an individual (Bruce & Young, 1986). In addition, faces convey emotional states. Research has found that, across different cultures, there are universal facial expressions that signal certain emotions (Ekman et al., 1987; though see counter arguments by Jack, Blais, Scheepers, Schyns, & Caldara, 2009). Infants as young as four months old respond differently to certain facial expressions, such as fear (Serrano, Iglesias, & Loeches, 1992). In adults, responses to anger are especially pronounced, perhaps because it would be advantageous for humans to respond rapidly to a potential threat (Fox et al., 2000). One study found that humans detect angry faces quicker and more accurately than friendly faces (Ashwin, Wheelwright, & Baron-Cohen, 2006). These studies suggest that, from an early age, humans can differentiate emotional states from cues in the face (Serrano et al., 1992).

Another important piece of information that faces convey is level of attractiveness. Although several body characteristics influence judgments of attractiveness, such as waist-to-hip ratio in women and waist-to-shoulder ratio in men (Braun & Bryan, 2006), facial attractiveness has been found to act as a first-pass filter when assessing attractiveness (Furnham, Lavanchy, & McClelland, 2006). One study asked men to list the characteristics they use to evaluate women and found that men listed the face as the most important factor followed by body shape, weight, intelligence, and sense of humour (Morse, Gruzen, & Reis, 1976). Another study showed that attractiveness ratings of faces, bodies, and speech are all correlated with each other but found that face judgments contribute the most to overall attractiveness in both men and women (Saxton, Burriss, Murray, Rowland, & Roberts, 2009a). Such evidence suggests that faces are indeed a key determinant when judging someone's attractiveness.

1.7. What makes a face attractive?

1.7.1. Averageness

In 1879, Galton developed a process of extracting typical characteristics from several drawings or photographs in order to create composite portraits. Composites allowed him to "obtain with mechanical precision a generalized picture; one that represents no man in particular, but portrays an imaginary figure possessing the average features of any given group of men" (1879, p. 97). After creating composite portraits, Galton noticed that the composites were more attractive than the individual components he used to create them. He attributed this finding to the composites being free of the irregularities and blemishes found in individual faces.

Galton's (1879) observation was later tested by Langlois and Roggman (1990) by comparing the attractiveness ratings of individual faces with those of computer-generated composite images. They found that both male and female composite faces were rated as more attractive than most of the individual faces that were used to create the composites. Given that some of the individual faces were rated as more attractive than the composites, Alley and Cunningham (1991) argued that some atypical facial characteristics are more attractive than average facial features. In addition, Benson and Perrett (1992) suggested that composites may be rated as more attractive simply because the computer techniques used to generate them lead to the composite faces having a smoother complexion and being more symmetrical than each of the individual faces. This idea was supported by the finding that composite faces are indeed more symmetrical than individual faces (Grammer & Thornhill, 1994).

Rhodes et al. (1999), however, found that both averageness and symmetry independently enhance facial attractiveness. They found that averageness increased attractiveness even when the individual images used to create the composites were made perfectly symmetrical. Similarly, another study found that averageness increases the attractiveness of faces even when they are presented in profile view, where there is no axis for symmetry (Valentine, Darling, & Donnelly, 2004). Little and Hancock (2002) also found that averageness increases attractiveness independent of texture changes. In addition, men with more average faces have been found to have more short-term sexual partners than men with more distinct faces (Rhodes, Simmons, & Peters, 2005). Such studies provide evidence that averageness does indeed independently increase facial attractiveness (for a more detailed review see Penton-Voak & Perrett, 2001). Highly attractive faces, however, have been found to not be average. This suggests that although an average face may be attractive, it may not be the most attractive (Perrett, May, & Yoshikawa, 1994).

Averageness is thought to enhance attractiveness because it signals both health and developmental stability (Rhodes et al., 2001a). One study found that averageness correlates positively with perceived health (Rhodes et al., 2001b). Moreover, the same study found a link between facial distinctiveness (the opposite of averageness) and both poor childhood health in men and poor adolescent health in women.

1.7.2. Symmetry

Initially, symmetry was found to either have no effect (Samuels, Butterworth, Roberts, Graupner, & Hole, 1994) or a negative effect on attractiveness (Kowner, 1996; Swaddle & Cuthill, 1995). These studies created symmetrical faces by dividing the faces along a vertical axis and then mirroring one of the sides (Samuels et al., 1994). This process, however, leads to perfectly symmetrical faces which appear abnormal because their proportions are far from average (Perrett et al., 1999). Studies that have examined symmetry without manipulation have actually found that more symmetrical faces are indeed rated as more attractive (Grammer & Thornhill, 1994). Additionally, studies that have used more advanced techniques to create symmetrical faces have also found that facial symmetry does independently increase attractiveness (Jones, DeBruine, & Little, 2007a; Perrett et al., 1999; Saxton, DeBruine, Jones, Little, & Roberts, 2011).

Symmetry varies greatly across individuals and reflects the ability to cope with environmental stress and parasites during development (Thornhill & Gangestad, 1994). As such, symmetry is thought to be attractive because it signals genetic quality and health (Thornhill & Gangestad, 2006). Indeed, research has found that increasing symmetry in a face increases the face's perceived health (Rhodes et al., 2001b). Although the effect size is small (Perrett, 2010), symmetry has also been linked to actual health since individuals with higher levels of facial symmetry have been found to report fewer incidences of respiratory infections (Thornhill & Gangestad, 2006).

1.7.3 Skin Texture

Skin texture has also been found to influence attractiveness (Fink, Grammer, & Thornhill, 2001; Fink et al., 2006; Jones, Little, Burt, & Perrett, 2004). In women, Fink et al. (2001) found that skin homogeneity increases facial attractiveness. In men, the health ratings of skin patches have been found to correlate positively with facial attractiveness, suggesting that men with attractive faces also have attractive skin (Jones et al., 2004). Moreover, one study found that patches of skin from the cheeks of men with higher genetic quality (i.e. men who were heterozygous at three key loci in the major histocompatibility complex) were rated as healthier and as more attractive than patches of skin from men with lower genetic quality (i.e. men who were homozygous at one or more of the three loci) (Roberts et al., 2005).

1.7.4. Sexual dimorphism in shape

Sexual dimorphism refers to any difference between women and men (Bronstad, Langlois, & Russell, 2008). For instance, the faces of women have full lips, wide eyes, and narrow chins (Johnston & Oliver-Rodriguez, 1997). On the other hand, the faces of men have thin lips, narrow eyes, and broad chins (Thornhill & Gangestad, 2006). Sexually dimorphic facial structures in women and men are termed facial femininity and masculinity, respectively (Thornhill & Gangestad, 2006).

1.7.4.1. Femininity

Research has consistently found a positive relationship between the level of femininity in female faces and corresponding judgements of attractiveness (Law-Smith et al., 2006; Rhodes, Hickford, & Jeffery, 2000). Moreover, femininity is also positively correlated with perceived health (Rhodes, Chan, Zebrowitz, & Simmons, 2003). Thornhill and

Gangestad (2006) found that facial femininity in women correlates negatively with the number of respiratory infections and the duration of these infections. As such, it is suggested that facial femininity is found attractive because it serves as a cue to health.

Studies have also found a positive relationship between facial femininity and levels of oestrogen and progesterone, the two main hormones that influence reproductive health in women (Law-Smith et al., 2006). Levels of both oestrogen and progesterone are higher in menstrual cycles that lead to conception compared to menstrual cycles that do not lead to conception (Baird et al., 1997). This suggests that increased levels of these hormones enhance the chances of successful implantation (Stewart, Overstreet, Nakajima, & Lasley, 1993). Consequently, facial femininity is also suggested to be a cue to fertility (Law-Smith et al., 2006).

Femininity in female faces is therefore considered attractive because it signals both health and fertility (Law-Smith et al., 2006; Puts et al., 2013; Rhodes et al., 2000). As will be discussed in Chapter Two, however, a preference for masculinity in female faces may actually be adaptive in certain environments. For instance, one study found that men in Jamaica prefer more masculine female faces than British men (Penton-Voak, Jacobson, & Trivers, 2004), suggesting cross-cultural variability in face preferences. Another study found that men prefer more masculine women for long-term relationships when they are asked to imagine themselves in harsh circumstances (Little, Cohen, Jones, & Belsky, 2007a). This result is explained by the possibility that a harsh environment may promote a strategy of preferring lower-quality but higher-investing partners since high-quality partners are less likely to invest in their relationships and more likely to abandon their partners (Little et al., 2007a).

1.7.4.2. Masculinity

High levels of testosterone in men lead to more masculine faces, voices, and bodies (Dabbs & Mallinger, 1999; Mazur, Halpern, & Udry, 1994; Penton-Voak & Chen, 2004; Roney, Hanson, Durante, & Maestripieri, 2006; Thornhill & Møller, 1997). In addition to aiding secondary sexual development, testosterone is also argued to suppress the immune system (Folstad & Karter, 1992). The trade-off between developing masculine features and compromising the immune system is known as the immunocompetence-handicap hypothesis (Folstad & Karter, 1992). According to this hypothesis, only men who are in good health can withstand the immunosuppressive costs associated with masculinity. This is consistent with the argument that true indicators of genetic quality are costly to maintain (Zahavi, 1975). Consequently, masculinity can be considered a cue to genetic quality as evidenced by findings that males with higher levels of facial masculinity are perceived to be healthier (Rhodes et al., 2003). More importantly, although the evidence is still debated (Boothroyd et al., 2005; Brooks et al., 2011; Rantala et al., 2013; Roberts, Buchanan, & Evans, 2004; Scott, Clark, Boothroyd, & Penton-Voak, 2012), masculine men might actually be healthier. One study found a negative relationship between masculinity levels and actual health problems (Rhodes et al., 2003). Additionally, men with masculine faces have been found to have fewer respiratory diseases and use antibiotics less than men with feminine faces (Thornhill & Gangestad, 2006). Such findings suggest that masculinity may indeed be an accurate indicator of disease resistance. Recent evidence, however, shows that adiposity, a cue that we will discuss later on (Section 1.7.5), rather than masculinity, mediates the relationship between immune response and attractiveness (Rantala et al., 2013).

In addition to health, masculinity is also related to dominance (Batres, Re, & Perrett, 2015). Faces of men with high levels of masculinity have been found to be perceived as more dominant than faces of men with low levels of masculinity (Batres et al., 2015; DeBruine et al., 2006; Perrett et al., 1998). Perceived dominance in male faces is associated with a variety of social outcomes, such as a positive link between dominance levels and coital opportunities (Mazur et al., 1994). Additionally, there are positive correlations between actual strength in men and their perceived masculinity and dominance levels (Fink, Neave, & Seydel, 2007). It has thus been proposed that dominance cues signal both mate value, as expressed through mate preferences (Perrett et al., 1998), as well as physical formidability in intrasexual competitions (Puts, 2010).

The links between health, dominance, and masculinity initially led researchers to predict that women would be more attracted to men with masculine faces (Thornhill & Gangestad, 1996). Findings regarding women's preferences for masculinity, however, have been mixed. Some studies have indeed found that women prefer men with more masculine faces (Scheib, Gangestad, & Thornhill, 1999) but other studies indicate that women prefer men with average or feminine faces (Penton-Voak et al., 1999; for a review see Scott et al., 2010). Research suggests that women may actually be employing mixed strategies when it comes to masculinity preferences (Little, Burt, Penton-Voak, & Perrett, 2001; Penton-Voak et al., 1999). For instance, masculinity preferences are higher when women are considering engaging in short-term relationships (Little et al., 2001; Little, Connely, Feinberg, Jones, & Roberts, 2011), suggesting that the benefits of choosing a masculine partner are greater under certain conditions. Similarly, there is some evidence that women's preferences for masculinity change throughout their menstrual cycle, with masculinity being preferred the most at peak fertility (Penton-Voak & Perrett, 2000). This suggests that when conception risk is high, women place greater emphasis on the genetic quality of their partners (Penton-Voak et al., 1999; Penton-Voak & Perrett, 2000). It must be noted, however, that the influence of cycle shifts on partner preferences is still under debate (Harris, 2013). One meta-analysis found a robust relationship between cycle shifts and preferences (Gildersleeve, Haselton, & Fales, 2014) while another meta-analysis found no consistent effect of hormonal cycling on mate preferences (Wood, Kressel, Joshi, & Louie, 2014).

In addition to the genetic benefits associated with masculinity, research has also found evidence of costs associated with high levels of testosterone. For example, men with elevated levels of testosterone report lower levels of investment in their relationships (Gray, Kahlenberg, Barrett, Lipson, & Ellison, 2002) and have decreased levels of paternal care (Muller, Marlowe, Bugumba, & Ellison, 2009). One study found that men who are involved in committed relationships have lower levels of testosterone than men who are not in committed relationships (Burnham et al., 2003). Similarly, men with high levels of testosterone are less likely to marry and once married, they are more likely to get divorced (Booth & Dabbs, 1993). There is also some evidence for a link between raised testosterone and raised aggression (Archer, 1991; Olweus, Mattsson, Schalling, & Löw, 1988). For instance, one study found that male inmates with higher levels of testosterone were more likely to have committed a violent crime whereas male inmates with lower levels of testosterone were more likely to have committed a non-violent crime (Dabbs, Frady, Carr, & Besch, 1987).

Such evidence supports the idea that there is a trade-off associated with testosterone and therefore women’s masculinity preferences will vary depending on the costs and the benefits associated with choosing a masculine partner. For instance, DeBruine, Jones, Crawford, Welling, and Little (2010a) found that masculinity preferences were negatively correlated with a computed health index of the country that the women came from. Consequently, they suggested that in countries with poorer health, masculinity is considered more attractive because it is more important to have healthier offspring. As mentioned earlier, however, the evidence linking masculinity and health is still debated (Boothroyd et al., 2005;

Brooks et al., 2011; Rantala et al., 2013; Roberts et al., 2004; Scott et al., 2012). In addition, the cross-cultural study of DeBruine et al. (2010a) was conducted online and, as will be discussed in Chapter Two, online samples may provide a distorted perspective of populations in developing countries. Chapter Two presents empirical evidence that when testing participants from a developing country in person, those exposed to higher health risks actually prefer more feminine men. This result may again be explained by the possibility that a harsh environment may promote a strategy of preferring lower-quality but higher-investing partners (Little et al., 2007a).

Masculinity preferences are also influenced by individual differences. For instance, several studies have found a positive correlation between a woman's age, within fertile years, and preferences for masculinity in male faces (e.g. Little et al., 2001). One individual difference that is influenced by environmental harshness is age of menarche. Chapter Three thus expands on the individual differences literature by providing exploratory evidence that age of menarche also influences masculinity preferences.

1.7.5. Adiposity

Although the literature on facial adiposity is scarce, some studies have found a relationship between facial adiposity and attractiveness (Coetzee et al., 2009; Coetzee, Re, Perrett, Tiddeman, & Xiao, 2011; Henderson, Holzleitner, Talamas, & Perrett, in press). Facial adiposity refers to the perception of weight from the face (Coetzee et al., 2009; Tinlin et al., 2013). People can accurately estimate a person's weight based on their face alone (Coetzee et al., 2009; Coetzee, Chen, Perrett, & Stephen, 2010) and there is a strong relationship between participant's body mass and their perceived facial adiposity (Coetzee et al., 2009; Tinlin et al., 2013).

Research has found that culture influences weight ideals (McCabe, Ricciardelli, Waqa, Goundar, & Fotu, 2009; Swami, 2015). For instance, overweight adolescents in Fiji and Tonga report being more satisfied with their bodies than overweight adolescents from Australia (McCabe at al., 2009). One study, however, found that Samoan observers and British observers both find women with slender body weights more attractive (Swami, Knight, Tovée, Davies, & Furnham, 2007). Although no culture effect was found by Swami et al. (2007), they did find that Samoan participants with low socioeconomic status rated figures with higher weights as more attractive. In Samoa, individuals with low socioeconomic status may be more traditional whereas individuals with high socioeconomic status may be more westernized. Other studies have also provided evidence of a link between socioeconomic status and weight preferences (Swami, 2015). This suggests that in contexts of low status, higher weights are considered more attractive because only high-status individuals have access to food resources and are therefore able to maintain an increased body mass (Swami et al., 2007). Conversely, in contexts of high status, lower weights are considered more attractive because high-status individuals are more able to maintain a decreased body mass (Furnham, & Alibhai, 1983).

Higher socioeconomic status is also associated with elevated levels of media exposure given increased access to mass media products, such as televisions and magazines. This media exposure also leads to lower weights being considered more attractive (Becker, 2004; Dittmar, Halliwell, & Stirling, 2009; Morry & Staska, 2001; Van Vonderen & Kinnally, 2012). For example, Becker (2004) found that when television was introduced in a rural community in Fiji, adolescent girls increased their efforts to be thinner. This influence is also observed in men, with both men and women exhibiting more eating problems when reading magazines that expose them to ideals of slimness in women and physical fitness in men (Morry & Staska, 2001).

In general, there is a trend of preferences for lower weights when judging attractiveness (Kościński, 2013; Swami et al., 2007), however, there is still a curvilinear relationship between facial adiposity and both perceived attractiveness and perceived health (Coetzee et al., 2009; Henderson et al., in press). Moreover, there are links between facial adiposity and cardiovascular health, incidences of infections (Coetzee et al., 2009), psychological problems (e.g. stress and depression), and general health problems (Tinlin et al., 2013). One study even found that facial adiposity may be a better cue to immune response than masculinity (Rantala et al., 2013).

Chapters Two, Four, and Five all examine adiposity preferences. More specifically, Chapter Two compares adiposity preferences between people with internet access and people without internet access in a developing country. We find that people without internet access prefer heavier women than people with internet access. This finding suggests that the level of harshness in the environment may be influencing adiposity preferences. Chapter Four then goes on to compare the preferences of students whose environment was not changing to the preferences of students undergoing intensive training at an army camp. The results from Chapter Four provide further evidence that adiposity preferences are indeed malleable depending on the level of harshness in the environment.

An alternative explanation for the findings of both Chapters Two and Four may be that familiarity is also influencing face preferences since differing levels of harshness in the environment may familiarize individuals with a different visual diet of faces. Consequently, Chapter Five examines the preferences, as well as the faces, of participants in different areas of both El Salvador and Malaysia. The results from Chapter Five suggest that familiarity may indeed be another factor influencing attractiveness perceptions. In conclusion, the following chapters will provide exploratory research regarding what influences masculinity (Chapters

Two and Three) and adiposity (Chapters Two, Four, and Five) preferences in both male and female faces.

Chapter 2: The digital divide and face preferences in El Salvador: people without internet access prefer more feminine men, more masculine women, and women with higher adiposity

This chapter is largely based on the following work accepted for publication in a peer-reviewed journal: Batres, C., & Perrett, D.I. (2014). The influence of the digital divide on face preferences in El Salvador: People without internet access prefer more feminine men, more masculine women, and women with higher adiposity. *PLoS One, 9*(7), e100966.

2. 1. Abstract

Previous studies on face preferences have found that online and laboratory experiments yield similar results with samples from developed countries, where the majority of the population has internet access. No study has yet explored whether the same holds true in developing countries, where the majority of the population does not have internet access. This gap in the literature has become increasingly important given that several online studies are now using cross-country comparisons. We therefore sought to determine if an online sample is representative of the population in the developing country of El Salvador. In studies of Hispanic men and women aged 18-25, we tested facial masculinity and adiposity preferences by collecting data in person as well as online. Our results showed that there were no differences in preferences between people who reported having internet access, whether they were tested online or in person. This provides evidence that testing style does not bias preferences among the same population. On the other hand, our results showed multiple differences in preferences between people who reported having internet access and people who reported not having internet access. More specifically, we found that people without internet access preferred more feminine men, more masculine women, and women with higher adiposity than people with internet access. We also found that people without internet access had fewer resources (e.g. running water) than people with internet access, suggesting that harshness in the environment may be influencing face preferences. These findings suggest that online studies may provide a distorted perspective of the populations in developing countries.

2.2. Introduction

Two traits that have been found to influence level of facial attractiveness are adiposity and sexual dimorphism. Facial adiposity refers to the perception of weight in faces (Coetzee et al., 2009) and has been found to serve as a cue to health (Tinlin et al., 2013). One study found that Ugandan participants preferred heavier female figures than Greek and British participants (Furnham, Moutafi, & Baguma, 2002). Similarly, Swami and Tovée (2005a) found that, in Malaysia, urban participants found women with lower body mass indices to be more attractive than rural participants. Such findings have been suggested to arise due to differing optimal weights in different environments (Swami & Tovée, 2005a). For instance, in environments with food shortages, heavier women may be better equipped to survive and reproduce (Brown & Konner, 1987) and therefore preferences for heavier women could be adaptive.

Sexual dimorphism refers to the differences between males and females. One study found that women in Jamaica preferred men with more masculine faces than women in the United Kingdom (Penton-Voak et al., 2004). This finding has been attributed to the idea that health risks are higher in Jamaica than in the United Kingdom and therefore it would be beneficial for women in Jamaica to be more attracted to masculinity since there is some evidence that masculinity may signal health (e.g. Rhodes et al., 2003; Thornhill & Gangestad, 2006). The evidence for the link between masculinity and health, however, is debatable (Rantala et al., 2013; Roberts et al., 2004).

In order to further examine the relationship between masculinity preferences and health, DeBruine et al. (2010a) collected online data from 30 different countries. They found that masculinity preferences were negatively correlated with a computed health index of the country that the participants came from. This suggests that, in countries with poorer health, masculinity is considered more attractive because it is more important to have healthier offspring. On the other hand, Brooks et al. (2011) proposed that national income inequality was a better predictor for masculinity preferences than the computed national health index. Brooks et al. (2011) suggested that in unequal societies, where women are less empowered and homicide rates are higher, masculinity preferences are stronger because masculinity signals dominance and male dominance is positively correlated with status (Mueller & Mazur, 1996; Puts, 2010). DeBruine, Jones, Little, Crawford, and Welling (2010b) provided evidence that, among women from different states in the USA, health is a better predictor of masculinity preferences than both income inequality and homicide rates. This study thus showed that, even within the same country, sub-sectors of the population may be faced with different challenges and, as a result, exhibit differing levels of partner preferences.

Regardless of the interpretation used to explain masculinity preferences (i.e. Brooks et al., 2011 or DeBruine et al., 2010a), it is important to consider the countries that were included in these online studies. Developed countries tend to have high levels of internet access. For example, 87% of the population in the United Kingdom has internet access (International Telecommunication Union, 2013). Developing countries, in contrast, tend to have much lower levels of internet access. For instance, only 38% of the population in Mexico has internet access (International Telecommunication Union, 2013). With such low levels of internet access in developing countries, it is unclear whether the online samples from these countries are fully representative of each country's population.

The difference between people with internet access and people without internet access is commonly referred to as the digital divide (DiMaggio, Hargittai, Neuman, & Robinson, 2001; Hargittai, 2002). Past research has found that people with internet access tend to be wealthier and more educated than people without internet access (DiMaggio et al., 2001). It is important to understand the potential influence the digital divide has on partner preferences given that many experiments are now administered online (Jones et al., 2007b; Little et al., 2007a). Previous studies on face preferences have found that online and laboratory experiments yield similar results with samples from developed countries (e.g. Jones et al., 2007b). Yet no study has explored whether the samples used in online experiments are representative of the populations being examined in developing countries, where the digital divide is greatest. This gap in the literature has become increasingly important given that several online studies are now using cross-country comparisons (Brooks et al., 2011; DeBruine et al., 2010a; Moore et al., 2013). Therefore, we sought to determine if an online sample is representative of the population in the developing country of El Salvador, where 26% of the population has internet access (International Telecommunication Union, 2013). We also aimed to examine the extent of the digital divide in El Salvador by using questions intended to determine in what ways people with and without internet access differ.

2. 3. Hypotheses

We predicted that participants who reported having internet access would have similar face preferences, regardless of whether they were tested online or in person. We also predicted that participants without internet access would have different face preferences from participants with internet access. More specifically, we predicted that if health risks are a better predictor of masculinity preferences as suggested by Debruine et al. (2010a), then male masculinity would be considered more attractive by people without internet access than by people with internet access, since health risks (Anuario Estadistico, 2009) are higher in areas of El Salvador where internet is less accessible. If, however, homicide rates and income inequality are better predictors of masculinity preferences as suggested by Brooks et al. (2011) then male masculinity would be considered more attractive by people with internet access than by people without internet access, since homicide rates and income inequality (Instituto de Medicina Legal, 2013) are higher in areas of El Salvador where internet is more accessible. We also predicted that adiposity would be considered more attractive by people without internet access than by people with internet access since health risks are higher (Anuario Estadistico, 2009) and reliability of access to food may be lower in areas without internet access. Study 1 was conducted in person in El Salvador with Salvadorian participants and Study 2 was conducted online with Salvadorian participants.

2.4. Methods

2.4.1. Ethics statement

Ethical approval was received from the University of St Andrews Ethics Board. Participants provided written consent after being presented with the information sheet and consent information.

2.4.2. Study 1: In person data collection

2.4.2.1. Participants

69 men (M_{age}=20.71 years, SD=1.90) and 83 women (M_{age}=20.46 years, SD=2.09) aged 18-25 from El Salvador were recruited through word-of-mouth to complete the study in person. 31 men (M_{age}=20.77 years, SD=2.08; M_{BMI}=25.67 kg/m², SD=4.73) and 40 women (M_{age}=20.38 years, SD=1.84; M_{BMI}=23.29 kg/m², SD=4.04) reported having internet access in their home (internet in-person sample) while 38 men (M_{age}=20.66 years, SD=1.76; M_{BMI}=21.15 kg/m², SD=2.07) and 43 women (M_{age}=20.53 years, SD=2.31; M_{BMI}=22.47 kg/m², SD=3.07) reported not having internet access in their home (non-internet in-person

sample). The majority of participants with internet access reported being from the state of San Salvador (83%) and the majority of participants without internet access reported being from the state of Ahuachapán (88%). It is important to note that San Salvador has lower health risks (Anuario Estadistico, 2009) but higher homicide rates (Instituto de Medicina Legal, 2013) than Ahuachapán.

2.4.2.2. Materials

Face images of white men and women photographed facing forward, under constant camera and lighting conditions, with neutral expressions, no adornments, and closed mouths were selected from a commercially available library (3DSK, 2012). These images were delineated with 189 points using custom software (Tiddeman, Burt, & Perrett, 2001) and aligned to a standard inter-pupillary distance (Rowland & Perrett, 1995). Ten composite images (5 male and 5 female) were created (each averaging 3 original faces together) and masked to occlude clothes with a black oval around the head.

The masculinity prototypes were generated by separately averaging female faces (M_{age}=23.04 years, *SD*=3.81) and male faces (M_{age}=25.25 years, *SD*=4.64) (for details see Re, DeBruine, Jones, & Perrett, 2013). The male adiposity prototypes were generated by separately averaging male faces with a low body mass index (BMI) (*M*=22.19 kg/m², *SD*=2.52; M_{age}=25.10 years, *SD*=3.96) and male faces with a high BMI (*M*=26.47 kg/m², *SD*=3.27; M_{age}=24.80 years, *SD*=3.77). The female adiposity prototypes were generated by separately averaging female faces with a low BMI (*M*=17.85 kg/m², *SD*=0.80; M_{age}=22.70 years, *SD*=3.56) and females faces with a high BMI (*M*=24.06 kg/m², *SD*=6.34; M_{age}=23.40 years, *SD*=4.50) (for details see Re & Perrett, 2014). The prototypes were then used to create transforms with ±50% of the shape difference while holding texture and colour constant. This resulted in a total of 20 pairs of faces, where 10 pairs were of women and 10 pairs were of men. Among these 10 pairs, 5 pairs were made up of a feminized and masculinized face shape (see Figure 1A) and 5 pairs were made up of a low-BMI and a high-BMI face shape (see Figure 1B).

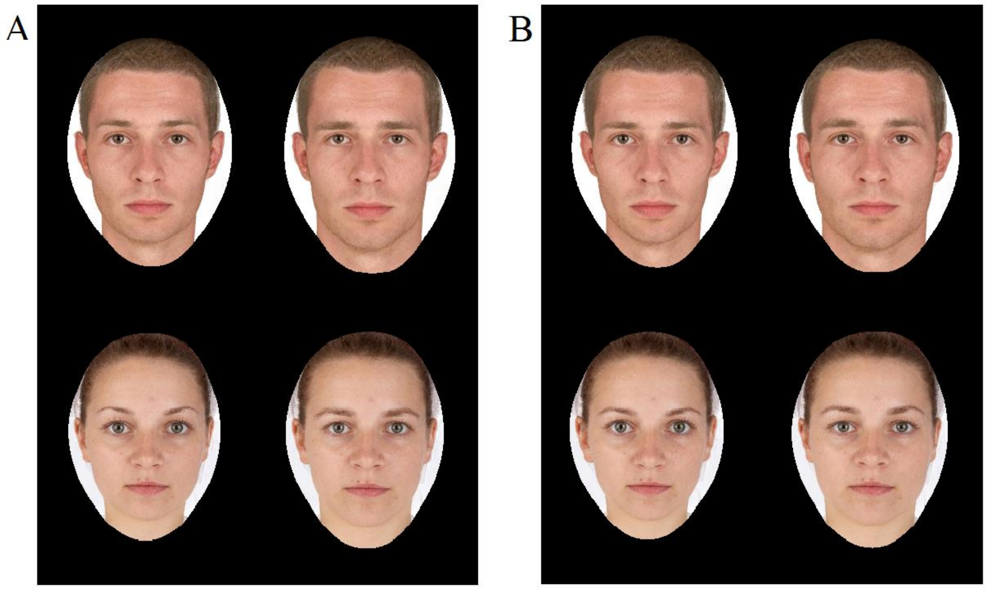

Figure 1. Example of Facial Stimuli. One of the male (top) and female (bottom) masculinity pairs (A), where the left faces are feminized in shape and the right faces are masculinized in shape. One of the male (top) and female (bottom) adiposity pairs (B), where the shapes of the left faces are decreased in BMI and the shapes of the right faces are increased in BMI.

2.4.2.3. Procedure

Participants were tested individually and in person. Participants were tested without the use of computers given that participants without internet access were expected to be less familiar with computers than participants with internet access. Participants were given a stack of laminated sheets that consisted of 30 pairs of faces. The laminated sheets were blocked according to the sex of the face (15 faces were of men and 15 faces were of women). Each laminated sheet consisted of one pair of faces and which face appeared on the left/right was counterbalanced. Participants were asked to select which face from each pair they considered to be the most attractive. There was no time limit. The first 5 faces in each block consisted of faces that differed in perceived height and served to familiarize the participants with the task of selecting which face they considered to be the most attractive. The remaining 10 pairs in each block consisted of the faces that differed in the traits of interest (i.e. masculinity and adiposity).

The participants then completed a questionnaire that was administered verbally in Spanish which requested the participant's sex, age, which state they were from, whether they had internet access in their home, and several other questions intended to determine in what ways people with and without internet access differ: whether they graduated from high school, whether they were attending or had graduated from university, whether they had children, whether they have a television in their home, whether they were born in a hospital, whether they have running water in their home, and how many times they have been to other countries. The questionnaire was administered verbally given that some of the participants were expected to be unable to read and write. Lastly, their height and weight were measured. Each participant was given 5 US dollars upon completion of the experiment.

2.4.3. Study 2: Online data collection

2.4.3.1. Participants

17 men (M_{age}=20.71 years, SD=2.02) and 28 women (M_{age}=20.43 years, SD=1.57) aged 18-25 from El Salvador were recruited online. Everyone in this sample reported having access to the internet in their home (internet online sample). The majority of participants reported being from the state of San Salvador (82%).

2.4.3.2. Procedure

The procedure was identical to that in Study 1 except that it was conducted online and therefore all questions were administered in a written format in Spanish. The pairs of faces were presented in the same manner as they were in Study 1 except that they were presented online and participants clicked on the face they considered the most attractive. Participants were not paid for their participation.

2.5. Results

Masculinity and adiposity preferences were calculated by taking the percentage of faces high on the trait selected across the pairs. One sample t-tests revealed that the faces selected for both traits in both sexes were significantly different to chance in all three samples ($p<0.032$ for all comparisons). Age was not significantly different between the samples ($F(2,194)=0.016$, $p=0.984$). Data were analysed using ANOVAs (fixed factors: sample (3 levels: internet in-person, non-internet in-person, internet online) and sex of participant (2 levels)) (see Table 1 for a summary of the results). The ANOVAs revealed no significant effects of sex of participant ($p>0.201$ for all analyses) as well as no significant interaction between sample and sex ($p>0.383$ for all analyses). The ANOVAs did reveal a significant effect of sample for all the analyses except adiposity preferences in male faces. Post-hoc tests with a Bonferroni correction were conducted for the preferences where sample had a significant effect (see Figure 2).

Table 1. Summary of ANOVA results.

	df	F	Sig	η_p^2
Masculinity in Male Faces				
Internet	2	16.872	<0.001	0.150
Sex	1	0.216	0.642	0.001
Sex*Internet	2	0.470	0.626	0.005
Error	191			
Masculinity in Female Faces				
Internet	2	5.671	0.004	0.056
Sex	1	1.644	0.201	0.009
Sex*Internet	2	0.215	0.806	0.002
Error	191			
Adiposity in Male Faces				
Internet	2	0.503	0.605	0.005
Sex	1	0.007	0.932	<0.001
Sex*Internet	2	0.965	0.383	0.010
Error	191			
Adiposity in Female Faces				
Internet	2	19.553	<0.001	0.170
Sex	1	0.242	0.623	0.001
Sex*Internet	2	0.152	0.859	0.002
Error	191			

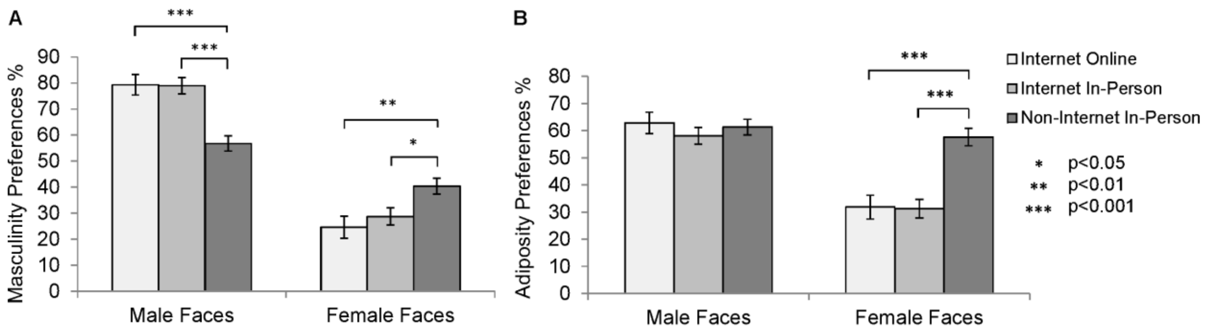

Figure 2. Masculinity and Adiposity Preferences. Comparisons of (A) masculinity preferences and (B) adiposity preferences between the internet online sample (light grey bars), the internet in-person sample (medium grey bars), and the non-internet in-person sample (dark grey bars). Preferences refer to the marginal mean percentage of faces high on the trait selected across the pairs.

The ANOVA for masculinity preferences in male faces revealed a significant effect of sample ($F(2,191)=16.872$, $p<0.001$, $\eta_p^2= 0.150$), where the non-internet in-person sample preferred more feminine male faces than both the internet in-person sample ($p<0.001$) and the internet online sample ($p<0.001$). The ANOVA for masculinity preferences in female faces revealed a significant effect of sample ($F(2,191)=5.671$, $p<0.01$, $\eta_p^2= 0.056$), where the non-internet in-person sample preferred more masculine female faces than the internet in-person sample ($p<0.05$) and the internet online sample ($p<0.01$). The ANOVA for adiposity preferences in male faces revealed no significant effect of sample ($F(2,191)=0.503$, $p=0.605$, $\eta_p^2= 0.005$). The ANOVA for adiposity preferences in female faces revealed a significant effect of sample ($F(2,191)=19.553$, $p<0.001$, $\eta_p^2= 0.170$), where the non-internet in-person sample preferred faces with higher adiposity than both the internet in-person sample ($p<0.001$) and the internet online sample ($p<0.001$). Post-hoc tests revealed no significant differences between the internet in-person sample and the internet online sample ($p>0.900$ for all comparisons).

The non-internet in-person sample reported having been to other countries less than both the internet in-person ($t(150)=17.142$, $p<0.001$) and the internet online samples ($t(124)=14.950$, $p<0.001$). Compared to the internet in-person sample and the internet online sample, the non-internet in-person sample was also less likely to have a television ($\chi^2(1)=17.897$, $p<0.001$; $\chi^2(1)=11.667$, $p<0.01$), more likely to have children ($\chi^2(1)=26.227$, $p<0.001$; $\chi^2(1)=16.975$, $p<0.001$), less likely to have graduated from high school ($\chi^2(1)=84.525$, $p<0.001$; $\chi^2(1)=61.642$, $p<0.001$), less likely to have attended or graduated from university ($\chi^2(1)=144.185$, $p<0.001$; $\chi^2(1)=117.660$, $p<0.001$), less likely to have been born in a hospital ($\chi^2(1)=38.639$, $p<0.001$; $\chi^2(1)=28.441$, $p<0.001$), and less likely to have running water in their home ($\chi^2(1)=24.981$, $p<0.001$; $\chi^2(1)=16.471$, $p<0.001$). The internet in-person and internet online samples did not differ in any of the above (p>0.426 for all comparisons) (see Table 2 for the descriptive statistics for the three samples).

Table 2. Descriptive statistics for the three samples.

	age (M years ± SD)	height (M in ± SD)	weight (M lbs ± SD)	BMI (M ± SD)	% never left the country	% television in home	% have children	% graduated high school	% attend(ed) university	% born in hospital	% running water in home
Internet Online											
Males	20.71 ± 2.02				5.9	100.0	0.0	100.0	100.0	100.0	100.0
Females	20.43 ± 1.57				3.6	100.0	0.0	100.0	100.0	100.0	100.0
Internet In-Person											
Males	20.77 ± 2.08	68.97 ± 2.29	174.07 ± 35.07	25.67 ± 4.73	25.8	100.0	0.0	100.0	100.0	100.0	100.0
Females	20.38 ± 1.84	63.09 ± 1.96	132.32 ± 26.47	23.29 ± 4.04	2.5	100.0	0.0	100.0	100.0	97.5	100.0
Non-Internet In-Person											
Males	20.66 ± 1.76	64.33 ± 2.05	124.43 ± 13.23	21.15 ± 2.07	78.9	78.9	23.7	26.3	2.6	48.6	63.2
Females	20.53 ± 2.31	59.81 ± 2.14	114.27 ± 16.43	22.47 ± 3.07	88.4	76.7	37.2	27.9	2.3	60.5	76.7

All participants in the internet samples (i.e. online and in person) reported not having children, having electricity in their home, having a television in their home, and having access to running water in their home. Participants in the non-internet sample, on the other hand, showed variability in their responses to already having children and having electricity, television, and running water in their home. To examine whether such variability influences preferences, independent samples t-tests were run within the non-internet sample. Participants who already had children and participants who did not have children did not differ in any of their preferences (p>0.432 for all analyses). Participants who had electricity (p>0.349 for all analyses), television (p>0.176 for all analyses), and running water (p>0.078 for all analyses) in their home did not differ in any of their preferences when compared to participants who did not have those resources in their home.

2.6. Discussion

Our results showed that there were no differences in preferences between people from El Salvador who reported having internet access, whether they were tested online or in person. This provides evidence that testing style does not bias preferences among the same population. On the other hand, our results showed multiple differences in preferences between people from El Salvador who reported having internet access and people from El Salvador who reported not having internet access. This suggests that, unlike samples from studies conducted online with participants from developed countries (e.g. DeBruine et al., 2010b), samples from studies conducted online with participants from developing countries may not be fully representative of the populations (e.g. Brooks et al., 2011; DeBruine et al., 2010a; Moore et al., 2013). Future research needs to take this into account when using online samples from countries where a substantial portion of the population does not have internet access. This applies not only to face preference research but to all studies that use online testing in developing countries (e.g. Hoerger, Quirk, & Weed, 2011).

Our data provide evidence that, even within a small country, sub-sectors of the population have different preferences. We found that adiposity preferences in female faces were higher among people without internet access than people with internet access. This finding is consistent with previous literature that has found that heavier figures are considered more attractive in poorer and rural areas (Furnham et al., 2002; Swami & Tovée, 2005a).

We also found that masculinity in male faces was considered more attractive by people with internet access than by people without internet access. Past research has suggested that risks to health from disease (DeBruine et al., 2010a) or violence (Brooks et al., 2011) may be responsible for differing levels of masculinity preferences in male faces. In our sample, participants without internet access face higher health risks (Anuario Estadistico, 2009) but lower homicide rates (Instituto de Medicina Legal, 2013). Our results, thus, support Brooks et al.'s (2011) interpretation that homicides rates and income inequality are better predictors of masculinity preferences than health risks since we found that male masculinity was considered more attractive by people with internet access than by people without internet access.

Another possibility is that media exposure is driving both sexual dimorphism and adiposity preferences. Several studies have found that the media promotes certain beauty ideals, such as masculinity in men, and femininity and low body weight in women (Harris & Clayton, 2002; Voracek & Fisher, 2006). People who have internet access experience greater exposure to the media through online advertisements and websites and are therefore likely to be more exposed to faces with accentuated masculinity and femininity as well as female faces with lower adiposity.

We also found that participants with internet access were more likely to have a television in their home, which exposes them even further to the media through commercials, television shows, and movies. For example, starring movie roles are more likely to be played by women with low body mass indices (Voracek & Fisher, 2006). Exposure to such beauty ideals has been found to impact behaviour and preferences. For instance, one study found that adolescent Fijian girls became more interested in weight loss after television was introduced in their town (Becker, 2004). Thus, media exposure may explain our findings of preferences for higher masculinity in male faces and higher femininity and lower adiposity in female faces among people with internet access in El Salvador. Under the media exposure interpretation, however, it remains unclear why past research has found that online participants from developing countries prefer more masculine male faces than online participants from developed countries (DeBruine et al., 2010a), since people from developing countries tend to have lower levels of media exposure than people from developed countries (Schramm, 1964).

A third explanation for our findings is that the level of harshness in the environment may be influencing face preferences. Our data provide evidence that people without internet access face a harsher environment than people with internet access. For example, we found that people without internet access are less likely to have access to running water in their home than people with internet access. One study found that women prefer less masculine men and men prefer more masculine women for long-term relationships when they are asked to imagine themselves in harsh circumstances (Little et al., 2007a). Therefore, increased levels of environmental harshness could explain our findings of preferences for masculine women and feminine men among people without internet access.

The environmental harshness explanation could also explain our adiposity findings. Past research suggests that BMI preferences may reflect differing optimal weights in different environments (Swami & Tovée, 2005a). For instance, heavier women are better equipped to survive in periods of famine (Brown & Konner, 1987) and therefore may be found more attractive in environments with food shortages. Although BMI and weight were higher among people with internet access, preferences for adiposity were higher among people without internet access. This suggests that, although higher levels of weight are considered more attractive in the non-internet population, it may be harder to achieve high levels of weight in such a harsh environment.

Although the environmental harshness explanation is consistent with our findings, further research is needed in order to identify what forms of hardship are most influential on preferences. For instance, Lee and Zietsch (2011) found that when women are primed with pathogen prevalence they prefer good-gene traits, such as “muscularity”, but when they are primed with resource scarcity they prefer good-dad traits, such as “nurturing”. In an environment like El Salvador, where both pathogen prevalence and resource scarcity are real threats, it remains to be determined which form of hardship is more influential on preferences. It may be possible that, among people with internet access in developing countries, pathogen prevalence is more influential since they face less resource scarcity. This would explain why past studies have found that masculinity preferences are negatively correlated with country-level health indices in online samples (DeBruine et al., 2010a). On the other hand, people without internet access face both pathogen prevalence as well as resource scarcity. Using Lee and Zietsch’s (2011) findings, our studies provide some preliminary evidence that resource scarcity may be more influential than pathogen prevalence in environments with both threats since our non-internet sample preferred more feminine men. In order to confirm this preliminary analysis, more sensitive questions that measure resource scarcity would need to be used in future studies.

In addition to the differences in access to television and running water, we also found that people without internet access have been to other countries fewer times, have children earlier, are less educated, and are less likely to have been born in a hospital than people with internet access. These differences suggest that people with internet access have very different lifestyles from people without internet access, which provides further evidence of a digital divide (DiMaggio et al., 2001; Hargittai, 2002). Our findings show that the digital divide does influence face preferences and this relationship needs to be taken into consideration in future experiments in order to accurately measure the preferences of people from developing countries.

One limitation from our experiment is that, unlike our in-person samples, our online sample was neither compensated nor supervised and participants might therefore be less motivated to take the experiment seriously. Past studies, however, have found that participants who are uncompensated and unsupervised yield results that are comparable in quality to participants who are compensated and supervised (Germine et al., 2012). Our study was also limited in that our experiment consisted of only 5 trials per condition, it only used faces of white men and women, and our participants came from only one country. It would be beneficial to examine if any differences in face preferences arise from using faces of another ethnicity versus faces of own ethnicity. Additionally, although all Salvadorians fall under the ethnicity of Hispanic, there are differences within this ethnicity that may reflect cultural and genetic heritage and might influence preferences. It would therefore be beneficial for other studies to examine the influence of the digital divide within other developing countries. While it is clear from past studies that preferences for facial characteristics differ across populations (e.g. DeBruine et al., 2010a), there are a number of factors that can contribute to these differences (e.g. health (DeBruine et al., 2010b), violence (Brooks et al., 2011), societal-level measures of development (Moore et al., 2013), income inequality (Brooks et al., 2011), ecological conditions (Swami & Tovée, 2007), media (Becker, 2004)). In order to gain a better understanding of these influences, more studies that compare sub-sectors of the same geographical population (e.g. De Barra, DeBruine, Jones, Mahmud, & Curtis, 2013; Swami & Tovée, 2007) need to be undertaken.

Chapter 3: Early menarche is associated with preference for masculine male faces and younger preferred age to have a first child

This chapter is largely based on the following work accepted for publication in a peer-reviewed journal: Batres, C., & Perrett, D.I. (in press). Early menarche is associated with preference for masculine male faces and younger preferred age to have a first child. *Evolutionary Psychology*.

3.1. Abstract

One developmental factor that is associated with variation in reproductive strategy is pubertal timing. For instance, women who experience earlier menarche tend to have their first pregnancy earlier and prefer more masculinized male voices. Early menarche may also lead to preferences for masculine faces but no study has shown such a link. We therefore investigated the relationships between pubertal timing, reproductive plans, sexual attitudes and behaviours, and masculinity preferences in nulliparous women aged 18-30 from the United Kingdom (*N*=10,793). We found that women who experienced earlier menarche reported a younger preferred age to have a first child and showed stronger masculinity preferences. This provides evidence that women experiencing early menarche not only have children earlier but, notably, *plan* to have children earlier. Additionally, our findings provide evidence that age of menarche influences partner selection, which is instrumental for the implementation of reproductive strategies.

3.2. Introduction

Life-history theory proposes that individuals face a trade-off between effort spent on survival and effort spent on reproduction (Chisholm et al., 1993; Stearns, 1992). Moreover, within reproductive effort, individuals must also balance mating and parenting effort (Chisholm et al., 1993). Much research on life-history theory has focused on understanding how different reproductive strategies influence an individual's reproductive success. For example, some individuals may pursue a quantitative reproductive strategy of having a greater number of children with a relatively low level of investment in each while other individuals may pursue a qualitative reproductive strategy of having fewer children with a relatively high level of investment in each (Chisholm et al., 1993; Hoier, 2003). In addition to quantity versus quality, speed is also a factor in reproductive strategy. For instance, individuals who choose to have children can exercise a “fast and early” or a “slow and late” reproductive strategy (Draper & Harpending, 1982).

According to life-history theory, reproductive strategies depend on both developmental and environmental factors and can be adaptive (Belsky, Steinberg, & Draper, 1991; Hoier, 2003). One developmental factor that has been identified as influential in life-history trajectory is pubertal timing (Belsky et al., 1991; Hoier, 2003). In women, early pubertal timing is associated with early onset of ovulatory cycles (Vihko & Apter, 1984). Even after menarche, women who experienced early pubertal timing have been found to have higher oestradiol levels as adolescents (Vihko & Apter, 1984) and up until early adulthood (Apter, Reinilä, & Vihko, 1989; Bernstein, Pike, Ross, & Henderson, 1991).

Researchers propose that there is a complex relationship between exposure to adversity and psychosocial stress early in life and biological reactivity (Boyce, & Ellis, 2005; Ellis, 2004). For instance, girls with high psychosocial stress arising from father absence tend to experience earlier menarche than girls whose fathers were present in their home (Doughty, & Rodgers, 2000; Ellis, McFadyen-Ketchum, Dodge, Pettit, & Bates, 1999). Boyce and Ellis (2005) suggest that girls with early father absence develop in a manner that speeds pubertal maturation and accelerates onset of sexual activity since they are exposed to an environment where male parental investment is unreliable. Indeed, research has shown that girls who experience early menarche have romantic relationships at an earlier age, engage in sexual intercourse at an earlier age, and have their first pregnancies earlier (Hoier, 2003; Udry, 1979). It is unknown, however, whether women who experience menarche at an earlier age *plan* to have children earlier or whether they have their first pregnancy earlier as a by-product of having romantic relationships and sexual intercourse at an earlier age. We therefore aimed to investigate if, in addition to their actual reproductive outcomes, age of menarche also influences women's reproductive plans. Given that early puberty is linked to a "fast and early" reproductive strategy, we predicted that women who reported an earlier age of menarche would also report a younger preferred age to have a first child.

It has also been argued that speed of sexual development influences mate preferences because partner selection is instrumental for the implementation of reproductive strategies (Cornwell et al., 2006). One preference that has been suggested to influence reproductive strategies is that for masculinity. There is some evidence that masculinity is a cue to health as indicated by findings that males with higher levels of facial masculinity are perceived to be healthier (Rhodes et al., 2003). More importantly, although the evidence is still debated (Rantala et al., 2013; Roberts et al., 2004), men with masculine faces might actually be healthier, as measured by health histories and medical examinations (Rhodes et al., 2003).

Masculinity is also a cue to dominance (Batres, Re, & Perrett, 2015) and intra-sexual competitiveness (Puts, 2010; Scott et al., 2012) since it signals physical strength and fighting ability. For instance, when individuals are asked to vote for someone to run their country in times of war, they select candidates with masculine faces (Little, Burriss, Jones, & Roberts, 2007b). Masculine men may be healthier or more dominant, enabling them to win in intra-sexual competitions, and as a result of successful competitions, they may have greater access to resources, enabling them to maintain a healthier physique and high status.

Along with the benefits associated with masculinity, there is evidence of certain costs associated with this trait. For instance, increasing facial masculinity results in decreasing perceptions of warmth, cooperation, emotionality, honesty, and perceived quality as a parent (Perrett et al., 1998). Additionally, there is evidence for a link between masculinity and aggression since masculine faces are considered more threatening, coercive, volatile, and controlling (Johnston, Hagel, Franklin, Fink, & Grammer, 2001). Such evidence supports the idea that women face a trade-off, with preferences depending on the costs and the benefits of choosing a masculine partner. For example, masculinity preferences are higher when women are considering engaging in short-term relationships (Little et al., 2001; Little et al., 2011).

Masculinity preferences are also influenced by individual differences. For instance, research has found a positive correlation between a woman's age, within fertile years, and preferences for masculinity in male faces (e.g. Little et al., 2001). Another individual difference that has been suggested to influence masculinity preferences is age of puberty. Cornwell et al. (2006) predicted that women who mature earlier would have learned to associate masculine characteristics with potential mates and would therefore prefer faces with higher levels of masculinity. More specifically, girls who experience earlier menarche are more likely to draw the attention of boys who are older and more physically mature (Gowen, Feldman, Diaz, & Yisrael, 2004; Magnusson, Stattin, & Allen, 1985). This early attention from boys with more sexually mature characteristics may then result in early maturing girls preferring more masculine partners (Cornwell et al., 2006).

Hoier (2003) did indeed find that women who experienced earlier menarche gave higher overall attractiveness ratings to male faces when compared to women who experienced later menarche. Cornwell et al. (2006), however, found no effect of menarche age on facial masculinity preferences but did find that women who had intercourse at an earlier age preferred more masculine faces. The link between pubertal timing and partner preferences might not have been found in Cornwell et al.'s (2006) study since their sample consisted of only 46 women. Furthermore, age of menarche varies depending on country of origin (Pathak & Whittemore, 1992), a variable that was not controlled for in Cornwell et al.'s (2006) study. Physical stress in the environment, such as economic hardship and malnutrition, leads to a delay in puberty since it is necessary for the individual to channel energy towards growth and survival rather than reproduction (Ellis & Garber, 2000; Surbey

1998). Given that physical stress in the environment varies greatly across countries, it is helpful to hold country of origin constant when examining age of menarche. Indeed, some studies have found that average age of menarche does not even overlap between some countries (Bernstein et al., 1991). For example, one study classified participants from the United States as having menarche “before age 12”, “at age 12”, or “at age 13 and older” whereas participants from China were classified as having menarche “before age 15”, “at age 15”, or “at age 16 and older” (Bernstein et al., 1991). Such differences suggest that country of origin should be held constant in order to better examine the influences of pubertal timing.

Although Cornwell et al. (2006) did not find a link between age of menarche and facial masculinity preferences, Jones, Boothroyd, Feinberg, and DeBruine, (2010) did find that women who experience earlier menarche prefer more masculinized male voices. Moreover, research has found that women’s preferences for men’s facial and vocal masculinity are positively correlated (Feinberg, DeBruine, Jones, & Little, 2008). We therefore aimed to investigate if age of menarche influences facial masculinity preferences in a large sample of women from the United Kingdom and predicted that women who reported early menarche would prefer more masculine male faces.

Age of menarche has also been linked with number of partners wanted, with earlier puberty leading to a higher number of partners desired (Hoier, 2003). In addition, Smith et al. (2009) found that women who prefer short-term relationships have stronger preferences for masculine men. These studies (Hoier, 2003; Smith et al., 2009) likely indicate that women who undergo menarche at a younger age may be more interested in short-term sexual relationships. Surprisingly, Hoier (2003) did not find a link between age of menarche and sociosexuality (i.e. willingness to engage in uncommitted sexual relationships). We therefore aimed to further investigate the relationship between age of menarche and women’s sociosexual attitudes in a large sample. We predicted that women who reported an earlier age of menarche would report a higher willingness to engage in uncommitted sexual relationships. Lastly, we also aimed to explore the relationship between age of menarche and sex drive since past studies have found that sex drive is highly correlated with lifetime number of sex partners as well as with sociosexual orientation (Ostovich & Sabini, 2004).

3.3. Methods

3.3.1. Materials

Male and female university students aged 18-22 were photographed facing forward, under constant camera and lighting conditions, with neutral expressions, no adornments, and closed mouths. These images were delineated with 189 points using Psychomorph, a custom face processing software (Tiddeman et al., 2001), and aligned to a standard inter-pupillary distance (Rowland & Perrett, 1995). Seven male composite images were created (each averaging three original male faces together). Masculinity prototypes were then generated by separately averaging the female faces and the male faces (for details see Batres & Perrett, 2014). The seven composites were then transformed to create pairs using ±50% of the shape difference between the male and female prototypes while holding texture and colour constant. This resulted in a total of seven pairs of male faces, where each pair was made up of a 50% feminized and a 50% masculinized face shape.

A questionnaire asked for the participant's sex, age, ethnicity, sexual orientation, whether they already had children ("How many children do you have?"), their preferred age to have a first child ("What age would you like to have (or have had) your first child?"), the age at which they had their first sexual intercourse ("About what age were you when you first had sexual intercourse?"), their age of menarche ("How old were you when you started puberty (when you started your first period)?”), their sex drive (on a scale from 1 “strongly disagree” to 7 “strongly agree”, “I have a strong sex drive”), and the three attitude questions from the revised sociosexual orientation inventory (Penke & Asendorpf, 2008; the average score for these three questions was used in the analyses) since of the three facets of sociosexuality (i.e. behaviour, attitude, and desire), attitude towards sexual relationships is the best predictor of women’s preferences in potential partners (Quist et al., 2012).

3.3.2. Participants and procedures

10,793 Caucasian nulliparous heterosexual women aged 18-30 (M_{age}=23.70 years, *SD*=3.52) from the United Kingdom completed all questions of the study online (see Reimers, 2007 for details). Ethical criteria from the BBC editorial policy and guidelines were followed. Participants were first presented with the questionnaire and instructed to skip any question that did not apply to them (e.g. if they had not had sexual intercourse, then they should skip the question regarding their age at first sexual intercourse) or any question to which they did not recall the answer (e.g. if they did not remember the age at which they started their first period, then they should skip that question). It must be noted that only participants who completed all questions of the study were used in the data analyses, meaning that the sample was restricted to women who were sexually active and wanted to have children at some point. After the questionnaire, participants were then presented with the seven pairs of faces varying in masculinity, where one pair appeared at a time. The order of the pairs and which face was on the left/right were both randomized. Participants were instructed to select which face they considered to be the most attractive.

3.4. Results

Given that less than 5% of the sample reported age of menarche at 10 years or younger and 16 years or older, we winsorized those responses into two categories. Using those categories, 4.9% of women reported their age of menarche as 10 years or younger, 16.8% reported age 11, 25.4% reported age 12, 29.9% reported age 13, 15.2% reported age 14, 5.5% reported age 15, and 2.3% reported age 16 or older. For all the analyses, masculinity preferences were calculated by taking the proportion of masculine faces selected across the seven pairs. Partial correlations controlling for current age were conducted (see Table 3). There were significant positive correlations between age of menarche and both age of first sexual intercourse ($r(10790)=0.081$, $p<0.001$) and preferred age to have a first child ($r(10790)=0.029$, $p<0.01$, see Figure 3). There were significant negative correlations between age of menarche and both masculinity preferences ($r(10790)=-0.024$, $p<0.05$, see Figure 3) and sex drive ($r(10790)=-0.037$, $p<0.001$). There was no significant correlation between age of menarche and sociosexual attitude ($r(10790)=0.007$, $p=0.437$).

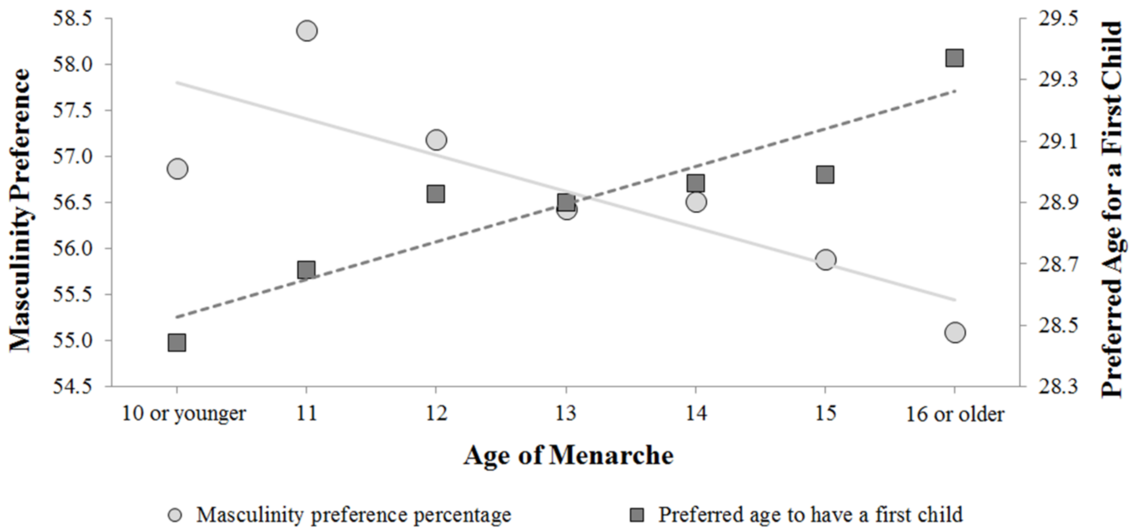

Figure 3. Relationships with Age of Menarche. Scatterplot with linear regression trend lines depicting the negative relationship between age of menarche and masculinity preferences and the positive relationship between age of menarche and preferred age to have a first child.

Table 3. Partial correlations controlling for current age.

	Sociosexual attitude	Sex drive	Masculinity preferences	Preferred age to have a first child	Age of first sexual intercourse	Age of menarche
Sociosexual attitude		0.148***	0.023*	0.088***	-0.174***	0.007
Sex drive			0.035***	-0.005	-0.056***	-0.037***
Masculinity preferences				0.006	0.019*	-0.024*
Preferred age to have a first child					0.078***	0.029**
Age of first sexual intercourse						0.081***
Age of menarche						

Note. Correlation (2-tailed) is significant at the 0.05 level (*), at the 0.01 level (**), or at the 0.001 level (***).

The data were further analysed using a two-step hierarchical regression analysis (dependent variable: masculinity preference; first step independent variable: current age; second step independent variables: age of menarche, preferred age to have a first child, age of first sexual intercourse, sex drive, and sociosexual attitude). Variance inflation factors (all≤1.450) and tolerance values (all≥0.690) indicated that multicollinearity was not an issue. Current age (β=0.010, p=0.319) was not a significant predictor of masculinity preferences in the first model (R^2 change<0.001, $F(1,10792)=0.992$, p=0.319). In the second model, current age (β=0.008, p=0.517) and preferred age to have a first child (β=0.003, p=0.791) were not significant predictors of masculinity preferences but age of first sexual intercourse (β=0.027, $p<0.01$), sex drive (β=0.032, $p<0.01$), sociosexual attitude (β=0.023, $p<0.05$), and menarche age (β=-0.025, $p<0.05$) did significantly predict masculinity preferences (R^2 change=0.003, $F(6,10792)=5.140$, $p<0.001$). A second identical two-step hierarchical regression analysis was conducted with the addition of interaction terms (age of menarche x preferred age to have a first child, age of menarche x age of first sexual intercourse, age of menarche x sex drive, and age of menarche x sociosexual attitude). None of the interaction terms significantly predicted masculinity preferences (β=0.184, p=0.159; β=0.192, p=0.063; β=-0.042, p=0.654; β=0.059, p=0.537).

Given that sociosexuality is not related to age of menarche but appears to be significantly related to masculinity preferences, we also ran a two-step hierarchical regression model that controlled for sociosexual attitude (dependent variable: masculinity preference; first step independent variables: current age and sociosexual attitude; second step independent variables: age of menarche, preferred age to have a first child, age of first sexual intercourse, and sex drive). Variance inflation factors (all≤1.450) and tolerance values (all≥0.690) indicated that multicollinearity was not an issue. Current age (β=0.008, p=0.412) was not a significant predictor of masculinity preferences but sociosexual attitude (β=0.023,

$p<0.05$) was a significant predictor of masculinity preferences in the first model (R^2 change=0.001, $F(2,10792)=3.273$, $p<0.05$). In the second model, current age (β=0.008, $p=0.517$) and preferred age to have a first child (β=0.003, $p=0.791$) were not significant predictors of masculinity preferences but sociosexual attitude (β=0.023, $p<0.05$), age of first sexual intercourse (β=0.027, $p<0.01$), sex drive (β=0.032, $p<0.01$), and menarche age (β=-0.025, $p<0.05$) did significantly predict masculinity preferences (R^2 change=0.002, $F(6,10792)=5.140$, $p<0.001$).

To analyse whether the significant relationship between age of menarche and masculinity preferences was being driven by a specific age group, partial correlations controlling for current age were re-run excluding each menarche age category. The relationship between age of menarche and masculinity preferences remained significant when excluding every menarche category except for that of age 11. When excluding participants who reported menarche as occurring at age 11, there was no significant correlation between age of menarche and masculinity preferences ($r(8975)=-0.014$, $p=0.181$).

A two-step hierarchical regression analysis for preferred age to have a first child was also conducted (dependent variable: preferred age to have a first child; first step independent variable: current age; second step independent variables: sociosexual attitude, age of menarche, masculinity preferences, age of first sexual intercourse, and sex drive). Variance inflation factors (all≤1.059) and tolerance values (all≥0.944) indicated that multicollinearity was not an issue. Current age (β=0.546, $p<0.001$) was a significant predictor of preferred age to have a first child in the first model (R^2 change=0.298, $F(1,10792)=4587.791$, $p<0.001$). In the second model, masculinity preferences (β=0.002, $p=0.791$) and sex drive (β=-0.013, $p=0.116$) were not significant predictors of preferred age to have a first child but current age (β=0.527, $p<0.001$), sociosexual attitude (β=0.089, $p<0.001$), menarche age (β=-0.017,

$p<0.05$), and age of first sexual intercourse ($\beta=0.080$, $p<0.001$) did significantly predict preferred age to have a first child (R^2 change=0.012, $F(6,10792)=809.546$, $p<0.001$).

3.5. Discussion

The results from this study replicate the finding that women who experience menarche at an earlier age have sexual intercourse earlier (Hoier, 2003). This study also replicates the finding that there is no link between age of menarche and sociosexuality (Hoier, 2003). Along with previous literature (Provost, Kormos, Kosakoski, & Quinsey, 2006), this study shows that sociosexuality is related to masculinity preferences and since we found that early menarche is also related to masculinity preferences, we expected for earlier menarche to be related to a less restricted sociosexual attitude. Our study, however, did not find this link and, with such a large sample, it provides strong evidence that there is no relationship between age of menarche and sociosexual attitudes. One possible explanation for this finding is that age of menarche may not relate to sociosexual attitudes but may relate to one or both of the two other dimensions of sociosexuality (i.e. behaviour and desire). As mentioned earlier, girls who experience earlier menarche draw more attention from boys (Gowen et al., 2004; Magnusson et al., 1985). Such increased levels of attention could mean that women who experience menarche earlier may have similar sociosexual attitudes to women who experience menarche later but those with earlier menarche may simply engage in more sociosexual behaviours as a consequence of having more opportunities to do so. This study only examined sociosexual attitudes and therefore future research would be needed in order to investigate the relationships between sociosexual behaviours and desires with pubertal timing.

Although we found no link between age of menarche and sociosexual attitudes, we did find a negative relationship between age of menarche and sex drive. Women who experienced earlier pubertal timing reported having a stronger sex drive. This provides further evidence of the need to investigate the relationship between sociosexual desires (not only sociosexual attitudes) and menarche age. Indeed, research has found that the frequency of sexual intercourse for women in relationships is affected by their levels of sexual desire rather than their sexual attitudes (Simpson & Gangestad, 1991). Thus, it would be interesting to further investigate the relationships between pubertal timing, sex drive, and sociosexual desires. Studies that aim to do so would benefit from using a more comprehensive measure of sex drive (e.g. the Sex Drive Questionnaire; Ostovich & Sabini, 2004).

Our results also showed that even after controlling for other factors known to influence masculinity preferences (e.g. sociosexual attitude), women who experience earlier menarche prefer more masculine male faces. This suggests that developmental factors influence not only reproductive strategies but also partner selection, which is instrumental for the implementation of such strategies. Our findings support one explanation proposed by Cornwell et al. (2006) in which girls who experience early menarche may consider themselves to be of higher-quality given their social success through puberty and therefore, these earlier maturing girls may in turn prefer higher-quality mates (i.e. more masculine). Alternatively, our findings could also support a further explanation proposed by Cornwell et al. (2006) and Jones et al. (2010) in which early maturing girls might have learned to associate masculinity with desirable mates since girls who experience earlier menarche are more likely to draw the attention of boys who are older and more physically mature (Gowen et al., 2004; Magnusson et al., 1985). Additionally, girls who experience early menarche are more likely to have engaged in sexual and romantic activity with older males and also receive more attention and positive feedback from older males (Prokopčakova, 1998). These early positive interactions with older males could lead early maturing girls to develop a preference for masculine-looking partners later on in life since older males look more masculine (Batres et al., 2015). Indeed, research has found that facial attractiveness judgements in adulthood reflect the effects of visual exposure during critical periods of development (Perrett et al., 2002; Saxton, Little, DeBruine, Jones, & Roberts, 2009b).

Upon further inspection, the significant relationship between age of menarche and masculinity preferences seems to be driven by women who experienced menarche at age 11. As evidenced by Figure 3, masculinity preferences peak for those women who reported age of menarche as 11. These findings suggest that there might be something special about experiencing menarche at that age. Indeed, at age 11, most girls in the UK transition from primary school, where they are surrounded by younger boys, to secondary school, where they are surrounded by older boys. Thus, it appears that, in the UK, age 11 is a critical period during development that has long-lasting influences on partner preferences. It would be interesting to examine the relationship between age of menarche and masculinity preferences in countries where the transition between primary and secondary school falls at a different age in order to further test the influence of being exposed to older boys during sexual maturation.

Our results also provide new evidence that women who experience menarche at an earlier age have a younger preferred age to have a first child than women who experience menarche at a later age. This relationship persisted even after controlling for other factors. This suggests that women who experience early menarche are not only having children earlier (Udry, 1979) but they are also planning on having children earlier. This distinction is important as it provides evidence that women experiencing earlier menarche are planning to reproduce earlier, not simply having earlier pregnancies as a by-product of having romantic relationships and sexual intercourse at an earlier age.

It is important to note that, although statistically significant, several effect sizes in our regression analyses, including the effect size of menarche age on preferred age to have a first child, were statistically quite small. That said, our findings are of theoretically importance since they provide evidence that even after many years, age of menarche still relates to our variables of interest (e.g. preferred age to have a first child).

One possible explanation for our findings is that levels of female reproductive hormones may underlie all of our variables of interest (i.e. age of menarche, preferred age to have a first child, and masculinity preferences). Women who experience earlier menarche have higher oestradiol levels as adolescents (Vihko & Apter, 1984) and even up until early adulthood (Apter et al., 1989; Bernstein et al., 1991). Reproductive hormones have been found to influence feminine appearance (Jasieńska, Ellison, & Thune, 2004), partner preferences (Feinberg et al., 2012), and ideal number of children (Law-Smith et al., 2012). For instance, women with higher levels of oestrogen are more likely to have feminine body shapes (Jasieńska et al., 2004) and faces (Smith et al., 2006). Feminine women are rated as more attractive (Rhodes et al., 2003) and consequently, they may be able to choose masculine partners and enforce demands of paternal investment more successfully than less feminine women (Feinberg et al., 2012). Indeed, research has found that women who rate themselves as more attractive are more attracted to masculinity (Feinberg et al., 2012; Little et al., 2001). Oestrogen levels have also been found to correlate positively with maternal tendencies (Law-Smith et al., 2012). Given such findings, it is possible that levels of reproductive hormones may explain the links between early menarche and both desire to have children at a younger age and preferences for more masculine partners.

It would be beneficial for future studies to examine if the links between early menarche, preferred age to have a first child, and masculinity preferences are also present in other countries. As mentioned earlier, physical stress in the environment, such as economic hardship and malnutrition, leads to a delay in puberty since it is necessary for the individual to channel energy towards growth and survival rather than reproduction (Ellis & Garber, 2000; Surbey 1998). The United Kingdom is a developed country with high gross national income per capita and high life expectancy (United Nations Development Programme, 2014), hence it would be interesting to compare the influence of age of menarche in a country that has low gross national income per capita and low life expectancy. Additionally, women from the United Kingdom have access to free public healthcare and contraception, both of which may influence their reproductive strategies. It would therefore be interesting to examine how age of menarche influences reproductive plans as well as sexual attitudes and behaviours in countries where women do not have access to such services. Lastly, even within the same country, women's environments will vary and therefore future research would benefit from delving further into how physical stress in the environment (e.g. socioeconomic status) influences reproductive strategies and mate preferences through pubertal timing.

Chapter 4: When the going gets tough, tough women become attractive: how the harsh environment of an army training camp changes adiposity preferences

This chapter is largely based on the following work submitted for publication in a peer-reviewed journal: Batres, C., & Perrett, D.I. (in submission). When the going gets tough, tough women become attractive: how the harsh environment of an army training camp changes adiposity preferences.

4.1. Abstract

Previous studies suggest that facial preferences may be contingent on an individual's environment, yet no study has traced how the preferences of the same individuals change as their environment changes. We therefore sought to determine if, and to what extent, adiposity preferences are malleable by repeatedly testing students whose environment was not changing as well students undergoing intensive training at an army camp. Our results showed that the students at the training camp reported increases in multiple stressors as well as showing changes in adiposity preferences. More specifically, we found that increases in the harshness of the environment led to an increased male attraction to cues of higher weight in female faces. Such changes in preferences may be adaptive because they allow for more opportunities to mate with partners who are better equipped to survive illnesses or uncertain food availability. These findings thus provide new evidence for the malleability of preferences depending on the environment.

4.2. Introduction

Research suggests that partner preferences are malleable (Swami & Tovée, 2006), being influenced by a myriad of factors, including environmental hardship (Chapter Two). An individual's capacity to change their preferences according to their environment may be adaptive since partnership and alliance choices are crucial for economic, physical, and psychological wellbeing. Additionally, partner choice influences an individual's reproductive outcome and therefore altering partner preferences according to the environment may confer evolutionary benefits.

One preference that has been identified to alter between environments is that for weight. Underweight individuals have iron deficiencies (Brown, Mishra, Kenardy, & Dobson, 2000), compromised immunity (Dirks & Leeuwenburgh, 2006), and are at higher risk of infection (Sullivan, Patch, Walls, & Lipschitz, 1990) when compared to individuals with healthy weights. On the other hand, overweight individuals are more likely to suffer from hypertension (Brown et al., 2000), asthma (Brown et al., 2000), and are also at higher risk of infection (Falagas & Kampoti, 2006) when compared to individuals with healthy weights. Weight has also been linked to reproductive health in women, with underweight individuals experiencing more miscarriages (Brown et al., 2000) and both underweight and overweight individuals reporting menstruation irregularities (Brown et al., 2000) and having an increased risk of ovulatory infertility (Grodstein, Goldman, & Cramer, 1994). Given the health risks associated with being either underweight or overweight (Brown et al., 2000; Dirks & Leeuwenburgh, 2006; Grodstein et al., 1994; Sullivan et al., 1990), it would be adaptive for weight preferences to fall within a healthy range, with some variation of preferences depending on the environment.

Harsh environments have been associated with a preference for cues to higher weight (Chapter Two). For example, Tovée, Swami, Furnham, and Mangalparsad (2006) found that Zulus from South Africa prefer female figures with higher body mass than Caucasians from the United Kingdom. Moreover, they found that Zulus who had recently immigrated to the United Kingdom had preferences intermediate between those of Zulus residing in South Africa and Caucasians residing in the United Kingdom. Additionally, Chapter Two found that harsh environments are also associated with increased preferences for facial cues to weight (i.e. adiposity). They found that, within El Salvador, men and women living in harsher environments (e.g. no access to running water) preferred female faces with higher levels of adiposity.

Preferences for cues to higher weights in bodies (Tovée et al., 2006) and faces (Batres & Perrett, 2014) could be adaptive since heavier people may be better equipped to survive illnesses or uncertain food availability (Brown & Konner, 1987). Even hunger level has been found to influence preferences, with hungrier men preferring heavier female figures than satiated men (Swami & Tovée, 2006). These studies (Batres & Perrett, 2014; Swami & Tovée, 2006; Tovée et al., 2006) suggest that preferences change according to the individual's environment, but they do not track the same participants across environmental changes and therefore such a link cannot be confirmed. We therefore aimed to examine if, and to what extent, adiposity preferences are malleable by repeatedly testing university students undergoing intensive training at an army camp. Based on previous research (Batres & Perrett, 2014; Tovée et al., 2006), we predicted that as these participants underwent their training, they would prefer heavier male and female faces. We also repeatedly tested a control group of university students whose environment was not changing.

4.3. Methods

4.3.1. Stimuli

Face images of Caucasian men and women photographed facing forward, under constant camera and lighting conditions, with neutral expressions, no adornments, and closed mouths were selected from a commercially available library (3DSK, 2012). These images were delineated with 189 points using custom software (Tiddeman et al., 2001) and aligned to a standard inter-pupillary distance (Rowland & Perrett, 1995). Ten composite images (five male and five female) were created (each averaging three original faces together) and masked to occlude clothes with a black oval around the head (for details see Batres et al., 2015).

Male adiposity prototypes were generated by separately averaging male faces with a low body mass index (M_{BMI}=22.19 kg/m², SD=2.52; M_{age}=25.10 years, SD=3.96) and male faces with a high body mass index (M_{BMI}=26.47 kg/m², SD=3.27; M_{age}=24.80 years, SD=3.77). Female adiposity prototypes were generated by separately averaging female faces with a low body mass index (M_{BMI}=17.85 kg/m², SD=0.80; M_{age}=22.70 years, SD=3.56) and females faces with a high body mass index (M_{BMI}=24.06 kg/m², SD=6.34; M_{age}=23.40 years, SD=4.50). The composites were then transformed to create 20-step continua using ±100% of the shape difference between high and low adiposity prototypes while holding texture and colour constant. This resulted in a total of 10 face continua (5 male and 5 female) that reflected changes in adiposity.

4.3.2. Participants and procedures

Ethical approval was received from the University of St Andrews Ethics Board and all participants provided consent. All participants completed the experiment three separate times with time intervals of approximately three days between each testing session. The experimental condition was conducted at a military base in the United Kingdom where university students (cadets in the University Officer Training Corps) were attending a 10-day training camp. Session 1 was conducted on the first day of the camp before the training commenced and Sessions 2 and 3 were conducted at approximately three-day intervals during the remainder of the training camp. Twenty-three men (M_{age}=19.48 years, SD=1.38) and eight women (M_{age}=19.25 years, SD=1.04) completed all three sessions of the training camp condition. The control condition was conducted with students at the University of St Andrews with sessions taking place with intervals of approximately three days. Nine men (M_{age}=26.89

years, *SD*=7.17) and 11 women (M_{age}=22.45 years, *SD*=0.82) completed all three sessions of the control condition.

Participants were presented with the 10 facial continua in male and female blocks, with one continuum appearing at a time. Participants were instructed to change each face by scrolling the computer cursor across the image (which transformed the face in adiposity) and to click when they considered the face to be at its most attractive. The scroll direction to increase adiposity was randomized across trials.

A questionnaire was then presented to participants in which they had to answer questions intended to measure changes in their environment (on a scale from 1 "not at all" to 10 "extremely"): "Currently, how tired are you?"; "Currently, how hungry are you?"; "Currently, how stressed are you?"; "How much physical strain have you been under in the past three days?"; "How much mental pressure have you been under in the past three days?"; "How much pain are you currently in?"; "How much out of your comfort zone have you felt in the past three days?"; "How much have you been shouted at in the past three days?".

4.4. Results

4.4.1. Questionnaire

Independent samples t-tests for each question at each testing session revealed that there were no significant sex differences except for the second session in the control condition on the question of hunger. For all subsequent questionnaire analyses, data from men and women were aggregated. We then analysed the training camp and the control conditions with repeated-measures ANOVAs where time (i.e. first, second, and third testing sessions) was the within-subjects variable and condition (i.e. training camp or control) was the between-subjects factor. Greenhouse-Geisser corrections were used when the assumption of sphericity was violated. There were significant interactions between time and condition for the questions on tiredness, physical strain, mental pressure, pain, being more out of their comfort zone, and being shouted at (see Table 4). Training camp participants reported higher levels of tiredness, physical strain, mental pressure, pain, being more out of their comfort zone, and being shouted at more after the first testing session (see Figure 4).

Table 4. Results from repeated-measures ANOVAs

	Effect of Time	*Interaction Between Time and Condition*
Hunger	F (2,94)=1.053, p =0.353	F (2,94)=1.404, p =0.251
Tiredness	F (2,94)=0.224, p =0.800	F (2,94)=3.270, p <0.05
Stress	F (1.698,79.797)=5.156, p <0.05	F (1.698,79.797)=0.283, p =0.718
Physical Strain	F (2,96)=6.135, p <0.01	F (2,96)=9.154, p <0.001
Mental Pressure	F (2,94)=16.379, p <0.001	F (2,94)=17.835, p <0.001
Pain	F (2,96)=5.394, p <0.01	F (2,96)=6.136, p <0.01
Being Out of Comfort Zone	F (2,92)=5.437, p <0.01	F (2,92)=6.750, p <0.01
Being Shouted At	F (1.750,85.766)=14.727, p <0.001	F (1.750,85.766)=3.578, p <0.001

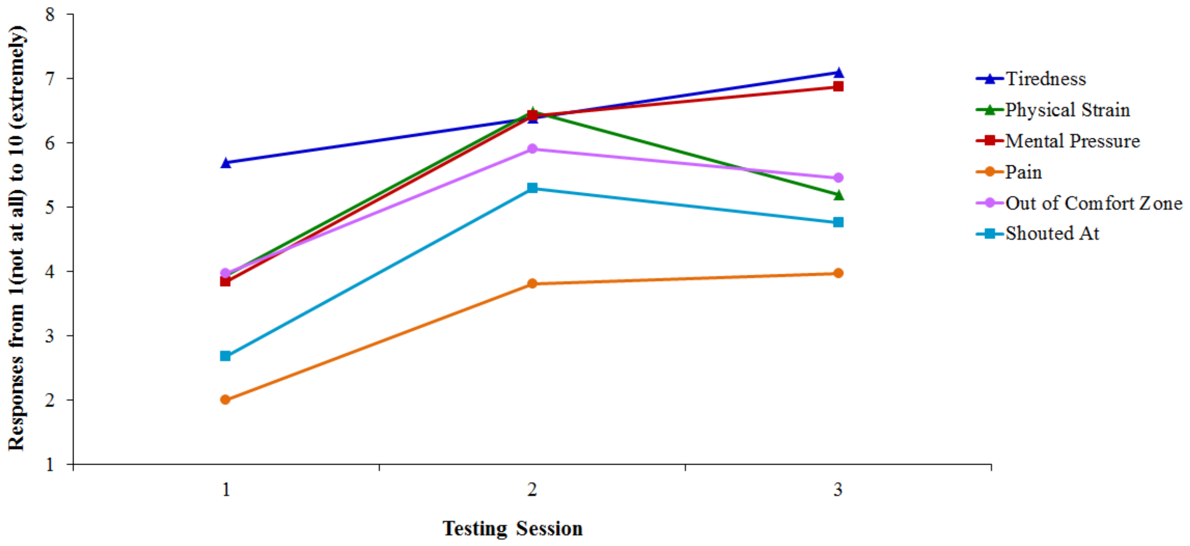

Figure 4. Responses in the training camp condition regarding changes in their environment. Questions that had a significant interaction between time and condition have been plotted out. Participants were asked to answer on a scale from 1 "not at all" to 10 "extremely": "Currently, how tired are you?"; "How much physical strain have you been under in the past three days?"; "How much mental pressure have you been under in the past three days?"; "How much pain are you currently in?"; "How much out of your comfort zone have you felt in the past three days?"; "How much have you been shouted at in the past three days?".

4.4.2. Facial preferences

Preferences were calculated as the average level of adiposity selected across the facial continua for each sex of face. Independent samples t-tests for adiposity preferences at each testing session revealed that there was a significant sex difference for female faces (with males preferring lower levels of adiposity than females). Consequently, we analysed the data for men and women separately. We analysed the data using repeated-measures ANOVAs where time (i.e. first, second, and third testing sessions) was the within-subjects variable and condition (i.e. training camp or control) was the between-subjects factor. Greenhouse-Geisser corrections were used when the assumption of sphericity was violated.

For female participants looking at female faces, there was no effect of time ($F(2,34)=0.404$, $p=0.671$) nor an interaction between time and condition ($F(2,34)=0.186$, $p=0.831$). For male participants looking at female faces, there was a significant effect of time ($F(2,60)=5.266$, $p<0.01$) and a significant interaction between time and condition ($F(2,60)=4.196$, $p<0.05$).

For female participants looking at male faces, there was a significant effect of time ($F(2,34)=6.393$, $p<0.01$) but no interaction between time and condition ($F(2,34)=0.003$, $p=0.997$). For male participants looking at male faces, there was no effect of time ($F(1.603,48.099)=0.405$, $p=0.624$) nor an interaction between time and condition ($F(1.603,48.099)=1.054$, $p=0.343$).

For the significant interaction between time and condition of male participants looking at female faces (see Figure 5), post-hoc tests using a Bonferroni correction were conducted. Preferences significantly increased between Session 1 and Sessions 2 and 3 ($p<0.05$ for each comparison) but were unchanged between Session 2 and Session 3 ($p>0.05$).

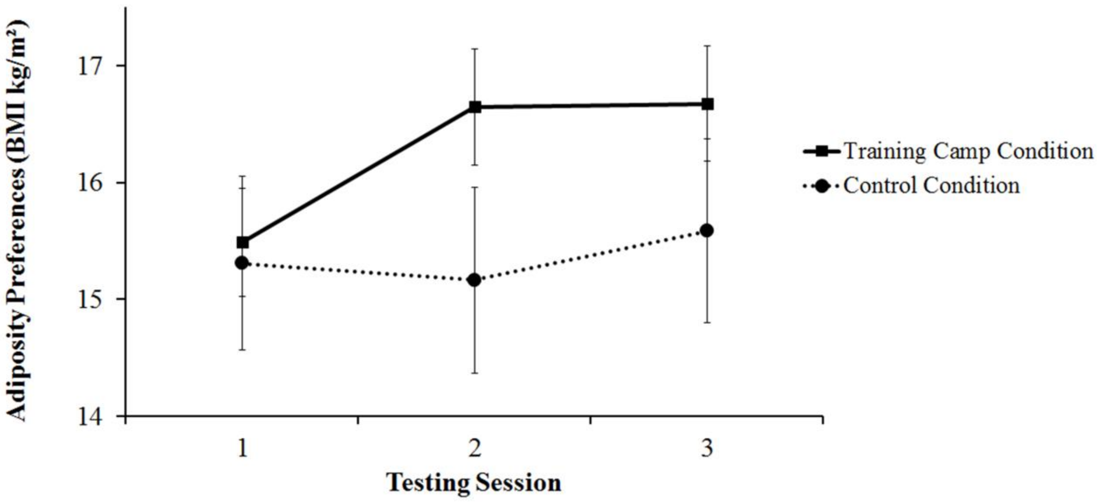

Figure 5. Adiposity preferences for the male participants looking at female faces. Comparison of marginal mean adiposity preferences in female faces for the male participants across time in the training camp and control conditions. Standard error bars are displayed. For the training camp condition, testing session 1 was conducted on the first day of the camp before the training commenced and Sessions 2 and 3 were conducted during the remainder of the training camp with time intervals of approximately three days between each testing session. For the control condition, testing sessions were conducted with time intervals of approximately three days between each testing session.

In order to further examine how changes in harshness perceptions relate to changes in adiposity preferences, we computed adiposity preference changes as well as changes in the answers to the harshness questions that had a significant interaction between time and condition (i.e. tiredness, physical strain, mental pressure, pain, being more out of their comfort zone, and being shouted at). We then ran bivariate correlations between the changes in both male and female adiposity preferences and the changes in the harshness answers and found no significant correlations (p>0.441 for all analyses).

4.5. Discussion

Our questionnaire results show that the participants in the training camp condition, but not in the control condition, experienced an increase in the harshness of their environment as evidenced by their reports of higher physical strain, mental pressure, pain, feeling out of their comfort zone, and being shouted at more during the training camp than in their "normal" life at baseline. Our results also showed a significant interaction between time and condition for male participants looking at female faces. This suggests that the increased level of harshness in the training camp increased the male cadets' preferences for adiposity in female faces. Past research has found that hunger level influences weight preferences, with hungrier men preferring heavier female figures than satiated men (Swami & Tovée, 2006). In our study, however, hunger was not reported to be significantly different in the training camp, suggesting that the observed changes in adiposity preferences are not being driven by hunger level.

Adiposity preferences for male participants looking at female faces increased between the first day of the camp before the training commenced (Session 1) and day three of training (Session 2) and then plateaued for the remainder of the training camp (Session 3). This suggests that the adiposity preferences of the male participants changed in response to the harsher environment and then remained at the new level while the environment remained harsh. It is interesting to note that the increased harshness of the training camp was enough to elicit a change in preferences. This environmental harshness change is minor when compared to real-world changes in the environment (e.g. poverty), which may therefore produce even stronger changes in preferences. Additionally, the change in preferences manifested itself within three days of being exposed to the harsher environment, suggesting that preferences shift rather quickly.

There was a significant main effect of time for male participants looking at female faces and for female participants looking at male faces. This suggests that simply re-exposing participants to the same stimuli influences opposite-sex preferences. Indeed, research has shown that simply exposing participants to a certain population of faces increases their preferences for similar faces (Cooper & Maurer, 2008).

The only significant interaction between time and condition, however, was that of male participants looking at female faces. More specifically, the male cadets shifted their preferences from underweight women to slightly heavier (but still underweight) women. This finding is consistent with previous research which has found that men prefer underweight women (Kościński, 2013).

One possible explanation for there only being a significant interaction for male participants looking at female faces is that weight has been found to significantly influence reproductive health in women (Brown et al., 2000; Grodstein et al., 1994), but less so in men (Sallmén, Sandler, Hoppin, Blair, & Baird, 2006). This suggests that malleability in adiposity preferences may confer stronger evolutionary benefits for men. Female participants showed no change in preference for men depending on condition, although some but not all cross-cultural studies have reported changes in women's preferences depending on their environment (Batres & Perrett, 2014; Swami & Tovée, 2005b). Studies with larger sample sizes than that here are needed to determine if adiposity preferences in women are malleable depending on the environment.

4.6. Conclusions

Several studies (Batres & Perrett, 2014; Tovée et al., 2006) have found that preferences differ between environments, yet to our knowledge, this is the first study to test the same individuals while their environment is changing. Our study supports the case for the malleability of preferences depending on the environment since we found that, during the training camp, participants reported increases in multiple stressors as well as showed changes in facial preferences. More specifically, we found that increases in the harshness of the environment were accompanied by an attraction to facial cues of increased weight in male participants looking at female faces. These changes may be adaptive because they allow for increased opportunities to mate with people who are better equipped to survive illnesses or uncertain food availability. Our sample size was sufficient to establish these changes in men's adiposity preferences, yet it will require more extensive samples and more specific environmental challenges to distinguish which variables (e.g. physical strain, mental pressure) are responsible for such changes.

Chapter 5: Familiarity with own population appearance and face preferences

This chapter is largely based on the following work submitted for publication in a peer-reviewed journal: Batres, C., Kannan, M., & Perrett, D.I. (in submission). Familiarity with own population appearance influences face preferences.

5.1. Abstract

Previous studies have found that, in Malaysia and in El Salvador, individuals from rural areas prefer heavier women than individuals from urban areas. Several explanations have been proposed to explain these differences in weight preferences but no study has tested familiarity as a possible explanation. We therefore sought to investigate participants' face preferences while also examining the facial characteristics of the actual participants. Our results showed that, in both Malaysia and El Salvador, participants from rural areas preferred female faces with higher levels of adiposity than participants from urban areas. Additionally, we found that the female faces from the rural areas were rated as looking heavier than the female faces from the urban areas. Our findings provide preliminary evidence that familiarity may be contributing to the differences found in face preferences between rural and urban areas, given that people from rural and urban areas are exposed to different faces.

5.2. Introduction

Previous studies have found that individuals from rural areas prefer heavier women than individuals from urban areas (Batres & Perrett, 2014; Swami & Tovée, 2005a). For example, Swami & Tovée (2005a) found that, in Malaysia, male and female participants from a rural area preferred female bodies with higher body mass indices (BMIs) when compared to participants from urban areas. Similarly, in El Salvador, Chapter Two found that male and female participants from a rural area found faces of heavier women more attractive than participants from an urban area.

Several explanations have been proposed to explain these differences in weight preferences observed between people from rural and urban areas. One explanation is that there are differing optimal weights for different environments given that BMI is closely related to health (Lake, Power, & Cole, 1997) and fertility (Frisch, 1988). In rural environments with less certain food availability, women with higher BMIs may be better equipped to survive and reproduce (Brown & Konner, 1987) and therefore preferences for such women could be adaptive.

A second explanation for the differences in weight preferences between people from rural and urban areas is that of media exposure. Research has shown that the media promotes beauty ideals of low body weight in women (Katzmarzyk & Davis, 2001; Voracek & Fisher, 2006). For instance, Voracek and Fisher (2006) found that starring movie roles in an established leading European adult media company were more likely to be played by actresses with low BMIs. Given that exposure to media is often greater in urban areas than rural areas (Chan & McNeal, 2006), higher weight preferences among rural participants may be due to their lower levels of exposure to such beauty ideals.

In this study, we set out to investigate the possibility of a third explanation: people from rural and urban areas may have a different visual diet of faces and, if so, familiarity could be contributing to their weight preferences. Indeed, research has found that exposure to a certain population of faces increases the attractiveness of similar faces (Cooper & Maurer, 2008; Saxton et al., 2009b). For instance, girls who attend single-sex schools prefer more feminized male and female faces than girls who attend mixed-sex schools (Saxton et al., 2009b). Familiarity can also be manipulated experimentally, with exposure to certain facial features leading to a preference for faces with similar facial features later on (Cooper & Maurer, 2008). The after-effects of such exposure can last for minutes (Cooper & Maurer, 2008), days (Carbon et al., 2007), or weeks (Carbon & Ditye, 2011).

We thus aimed to examine if familiarity could be responsible for the findings that individuals from rural areas prefer heavier women than individuals from urban areas in the countries of Malaysia (Swami & Tovée, 2005a) and El Salvador (Batres & Perrett, 2014). We tested participants from rural and urban areas of both Malaysia and El Salvador on their preferences for facial adiposity (i.e. the perception of weight in faces; Coetzee et al., 2009) (Study 1). We then took facial images of those same participants and had another set of participants rate their faces on apparent weight (Study 2). Based on previous research (Batres & Perrett, 2014; Swami & Tovée, 2005a), we predicted that the rural participants would find female faces with higher levels of adiposity more attractive than the urban participants in both Malaysia and El Salvador. We also predicted that the faces of the women from the rural areas would be rated as heavier than the faces of the women from the urban areas. Previous research has not consistently found a preference for male faces with higher levels of adiposity in rural areas (Batres & Perrett, 2014) and therefore we predicted that there would be no difference in adiposity preferences for male faces between rural and urban participants. Lastly, we also predicted that there would be no difference in weight ratings between the faces of the men from the rural areas and the faces of the men from the urban areas in both Malaysia and El Salvador.

5.3. Methods

5.3.1. Study 1

5.3.1.1. Materials

Face images of Caucasian men and women photographed facing forward, under constant camera and lighting conditions, with neutral expressions, no adornments, and closed mouths were selected from an online database (3DSK, 2012). These images were delineated with 189 points using Psychomorph, a custom software (Tiddeman et al., 2001), and aligned to a standard inter-pupillary distance (Rowland & Perrett, 1995). Ten composite images (5 male and 5 female) were created (each averaging 3 original faces together) and masked to occlude clothes with a black oval around the head.

Face prototypes were then created to use for transforming the composites in adiposity. The male adiposity prototypes were generated by separately averaging male faces with a low BMI (M=22.19 kg/m², SD=2.52; M_{age}=25.10 years, SD=3.96) and male faces with a high BMI (M=26.47 kg/m², SD=3.27; M_{age}=24.80 years, SD=3.77). The female adiposity prototypes were generated by separately averaging female faces with a low BMI (M=17.85 kg/m², SD=0.80; M_{age}=22.70 years, SD=3.56) and females faces with a high BMI (M=24.06 kg/m², SD=6.34; M_{age}=23.40 years, SD=4.50) (for details see Chapter Two). The prototypes were then used to create transforms of the 10 composite faces with ±50% of the shape difference while holding texture and colour constant. This resulted in a total of 10 pairs of faces, where 5 pairs were of women made up of a low-BMI and a high-BMI face shape and 5 pairs were of men made up of a low-BMI and a high-BMI face shape (see Figure 6).

Figure 6. Example of facial stimuli. One of the female adiposity pairs (top) and one of the male adiposity pairs (bottom). The faces on the left correspond to a low-BMI face shape and the faces on the right correspond to a high-BMI face shape.

5.3.1.2. Procedures and participants

Ethical approval was received from the University of St Andrews Ethics Board. Participants provided written consent after being read the consent information. Participants were tested by Mallini Kannan in Malay in Malaysia and by Carlota Batres in Spanish in El Salvador. They were first given a stack of laminated sheets that consisted of 5 pairs of male faces and 5 pairs of female faces. Each laminated sheet consisted of 1 pair of faces and which face appeared on the left/right was counterbalanced. Participants pointed at the face from each pair they considered to be the most attractive. There was no time limit. The participants then completed a short questionnaire that requested demographic information, such as their sex, age, and where they were living. Lastly, a photograph of their face was taken and their weight was measured. Each participant was paid in local currency (15 Ringgit in Malaysia and 5 US dollars in El Salvador) upon completion of the experiment. Forty-three men (M_{age}=20.44 years, *SD*=1.75) and 65 women (M_{age}=19.95 years, *SD*=1.59) aged 18-24 from Malaysia completed the study and 69 men (M_{age}=20.71 years, *SD*=1.90) and 83 women (M_{age}=20.46 years, *SD*=2.09) aged 18-25 from El Salvador completed the study (see Table 5 for participant information).

Table 5. Participant Information

	Rural	*Urban*
Malaysia	18 men (M_{age}=20.83 years, SD=1.79) 24 women (M_{age}=20.13 years, SD=1.92)	25 men (M_{age}=20.16 years, SD=1.70) 41 women (M_{age}=19.85 years, SD=1.37)
El Salvador	38 men (M_{age}=20.66 years, SD=1.76) 43 women (M_{age}=20.53 years, SD=2.31)	31 men (M_{age}=20.77 years, SD=2.08) 40 women (M_{age}=20.38 years, SD=1.84)

5.3.2. Study 2

5.3.2.1. Procedures and participants

Ethical approval was received from the University of St Andrews Ethics Board. Participants provided consent online after being presented with the consent information. Participants rated the face images collected in Study 1, individually and in random order. Participants rated either the face images from Malaysia or the face images from El Salvador. The faces from the rural and urban populations were intermixed and each face was masked to occlude clothes with a black oval around the head. The images were blocked according to sex of the face and participants were instructed to rate how heavy they thought each man/woman was on a 10 point Likert-scale (1= very underweight, 10= very overweight). The participants then completed a short questionnaire that requested demographic information, such as their sex and age. Each participant was paid 2 US dollars upon completion of the experiment through MTurk. Twenty men (M_{age}=29.80 years, *SD*=5.36) and 20 women living in the United States (M_{age}=32.90 years, *SD*=9.70) successfully rated (i.e. responded "yes" to the question "Were you able to see and rate all images successfully?") the faces from Malaysia on weight. Twenty men (M_{age}=36.30 years, *SD*=10.10) and 19 women (M_{age}=33.58 years, *SD*=9.61) living in the United States successfully rated the faces from El Salvador on weight.

5.4. Results

5.4.1. Study 1

5.4.1.1. Malaysia

Adiposity preferences were calculated by taking the percentage of faces high on the trait selected across the 5 pairs of male faces and the 5 pairs of female faces. Independent samples t-tests revealed no significant effect of sex of participant on preferences (p>0.882 for all analyses) and therefore, for all subsequent analyses, data from male and female participants was aggregated. Independent samples t-tests revealed no significant effect of population (i.e. rural versus urban) on weight preferences in male faces ($t(106)=-0.75$, $p=0.454$) but a significant effect of population on weight preferences in female faces ($t(106)=3.56$, $p<0.01$), with the rural participants preferring heavier female faces.

Weight was higher among male participants from the urban area (M= 71.29 kg., SD=20.65) than male participants from the rural area (M=54.78 kg., SD=9.77) and this difference was statistically significant ($t(36.29)=-3.49$, $p<0.01$). Weight was higher among female participants from the urban area (M=57.07 kg., SD=11.67) than female participants from the rural area (M=51.58 kg., SD=10.39) but this difference was not statistically significant ($t(62)=-1.90$, $p=0.063$).

5.4.1.2. El Salvador

Adiposity preferences were calculated as above. Independent samples t-tests revealed no significant effect of sex of participant on preferences (p>0.212 for all analyses) and therefore, for all subsequent analyses, data from male and female participants was aggregated. Independent samples t-tests revealed no significant effect of population on weight preferences in male faces ($t(150)=0.77$, $p=0.445$) but a significant effect of population on weight preferences in female faces ($t(150)=5.91$, $p<0.001$), with the rural participants preferring heavier female faces.

Weight was higher among male participants from the urban area ($M=78.96$ kg., $SD=15.91$) than male participants from the rural area ($M=56.44$ kg., $SD=6.00$) and this difference was statistically significant ($t(36.97)=-7.46$, $p<0.001$). Weight was higher among female participants from the urban area ($M=60.02$ kg., $SD=12.01$) than female participants from the rural area ($M=51.83$ kg., $SD=7.45$) and this difference was also statistically significant ($t(64.30)=-3.70$, $p<0.001$).

5.4.2. Study 2

Participants showed high levels of inter-rater reliability for all judgments of male and female faces (all Cronbach's $\alpha>0.97$) and we therefore averaged participants' ratings to produce a mean rating of apparent weight. We then analysed the data with independent samples t-tests where population (i.e. rural versus urban) was the grouping variable. A Levene's correction was used when equal variances could not be assumed.

5.4.2.1. Malaysia

Perceived weight ratings were not significantly different between the rural and the urban populations for the male faces ($t(40.07)=0.32$, $p=0.754$) but they were significantly different for the female faces ($t(62)=3.13$, $p<0.01$). The female faces from the rural area were rated as looking heavier than the female faces from the urban area.

5.4.2.2. El Salvador

Perceived weight ratings were not significantly different between the rural and the urban populations for the male faces ($t(67)=-0.56$, $p=0.579$) but they were significantly different for the female faces ($t(81)=3.67$, $p<0.001$). The female faces from the rural area were rated as looking heavier than the female faces from the urban area.

5.5. Discussion

Our results showed that there were no differences in adiposity preferences in male faces between the participants from the rural and urban areas in either Malaysia or El Salvador. In addition, we found no differences in the perceived weight ratings between the male faces from the rural and urban areas in both Malaysia and El Salvador.

On the other hand, our results showed that the participants from the rural areas preferred female faces with higher levels of adiposity than the participants from the urban areas in both Malaysia and El Salvador. Additionally, even though the women from the urban areas were actually heavier than the women from the rural areas, we found that the female faces from the rural areas were rated as looking heavier than the female faces from the urban areas in both Malaysia and El Salvador.

One possible explanation for such findings is that people from urban areas may store fat differently than people from rural areas. Indeed, individuals vary in the way fat is distributed (Santosa & Jensen, 2008). For example, “apple-” and “pear-shaped” bodies are frequently distinguished (Wingard, 1990). Individuals with a more apple-shaped body have a higher proportion of visceral body fat and a higher waist girth for any given body mass index. Conversely, a more pear-shaped body is associated with greater fat deposition below the waist. Fat deposition in the cheeks and neck is related to visceral adiposity (Levine, Ray, & Jensen, 1998; Onat et al., 2009). Individuals with faces higher in adiposity are more likely to have apple-shaped bodies and to be predisposed to insulin resistance. Adverse environments with attendant stresses can predispose visceral adiposity (Chrousos, 2009). Hence, it is quite possible that different populations within the same country may vary in facial morphology as a result of environmental influences including stress and/or dietary composition.

Our findings suggest that familiarity can contribute to the differences found in face preferences between rural and urban populations. It appears that people from rural areas have a different visual diet of faces than people from urban areas in both Malaysia and El Salvador. More specifically, the faces of the women from the rural areas are rated as looking heavier than the faces of the women from the urban areas. Even without the impact of modern media exposure, people in an urban setting may thus be exposed to faces with lower adiposity. This exposure to faces with lower adiposity may therefore contribute to the observed differences in facial preferences. Future research that examines differences between rural and urban populations should thus also examine the facial characteristics that make up such populations. In addition, further research is needed in order to understand how conflicting weight cues (e.g. high facial adiposity but low body weight) influence overall attractiveness.

One limitation from our study is that we cannot tease apart the influence of familiarity from other factors that influence face preferences between rural and urban populations. For instance, exposure to the media is greater in urban areas than rural areas (Chan & McNeal, 2006) and therefore it is difficult to disentangle the everyday familiarity effect from the media familiarity effect. It would be interesting to examine how face preferences change as people migrate between areas that differ in the visual appearance of the population but do not differ in other factors known to influence face preferences (e.g. media (Becker, 2004), health

(Tovée et al., 2006), violence (Brooks et al., 2011)). Such distinctions would help us further understand the role that familiarity plays in what it is that we find attractive. Regardless, this study provides new evidence that familiarity may contribute to the differences observed in face preferences across populations.

Chapter 6: General discussion

6.1. Summary of findings

In this thesis, I provided exploratory research regarding factors affecting mate choice. More specifically, I examined the influences of internet access, pubertal timing, environmental harshness, and population familiarity on masculinity and adiposity preferences. This discussion will now summarize the findings from Chapters Two-Five, address the strengths and weaknesses of each chapter, and suggest future research that could further enhance our understanding of what we find attractive.

In Chapter Three, we investigated the relationships between pubertal timing, reproductive plans, sexual attitudes and behaviours, and masculinity preferences in nulliparous women from the United Kingdom. We found that women who experienced earlier menarche reported a younger preferred age to have a first child and showed stronger masculinity preferences. This provides evidence that women experiencing early pubertal timing not only have children earlier (Udry, 1979) but, notably, they *plan* to have children earlier. Additionally, our findings provide evidence that age of menarche influences partner selection, which is instrumental for the implementation of reproductive strategies.

We believe that the strength of this study comes from its large sample size. The effect of menarche age on masculinity preferences is small, but our large sample size allowed us to detect it. That age of menarche is related (even minimally) to masculinity preferences many years later is of theoretical importance. Another strength of this study is that we examined women's reproductive plans, not only their actual reproductive outcomes. This allowed us to determine that women experiencing earlier menarche are planning to reproduce earlier, not simply having earlier pregnancies as a by-product of having romantic relationships and sexual intercourse at an earlier age.

One of the weaknesses of this study is that we do not know which factors led to experiencing menarche earlier. Even within the same country, women's environments will vary and therefore future research would be needed in order to delve further into how physical stress in the environment influences mate preferences. Chapter Four aimed to do just that by examining how changes in physical stress in the environment influence partner preferences. More specifically, we sought to determine if, and to what extent, adiposity preferences are malleable by repeatedly testing students whose environment was not changing as well students undergoing intensive training at an army camp. Our results showed that the students at the training camp reported increases in multiple stressors as well as showed changes in adiposity preferences. In particular, we found that increases in the harshness of the environment led to an increased male attraction to cues of higher weight in female faces. Such changes in preferences may be adaptive because they allow for more opportunities to mate with heavier partners who are better equipped to survive illnesses or uncertain food availability (Brown & Konner, 1987).

We believe that the strength of this study comes from our ability to provide evidence for the flexibility of preferences depending on the environment. Previous studies suggest that facial preferences may be contingent on an individual's environment (e.g. Swami & Tovée, 2006; Tovée et al., 2006), yet no study had traced how the preferences of the same individuals change as their environment changes. To our knowledge, this is the first study to have tested the same individuals while their environment is changing, thus providing evidence that preferences are indeed malleable.

One of the weaknesses of this study is that we had a very small female sample. Our sample was sufficient to establish changes in men's adiposity preferences but not enough to be conclusive about the apparent lack of malleability in female preferences. Future work should therefore aim to examine the malleability of female attraction to cues of weight in male faces. Another weakness of this study is that we were not able to distinguish which variables (e.g. physical strain, mental pressure) were responsible for the observed changes in preferences given that the students at the training camp reported increases in multiple stressors. It will require more specific environmental challenges to distinguish which variables are responsible for such changes.

The training camp consisted of a transitory change in environmental harshness and Chapter Two aimed to further investigate the flexibility of partner preferences by examining participants whose long-term environments differed in harshness. More specifically, we sought to determine if an online sample is representative of the population in the developing country of El Salvador. We tested facial masculinity and adiposity preferences by collecting data in person as well as online. Our results showed that there were no differences in preferences between people who reported having internet access, whether they were tested online or in person. On the other hand, our results showed multiple differences in preferences between people who reported having internet access and people who reported not having internet access. In particular, we found that people without internet access preferred more feminine men, more masculine women, and women with higher adiposity than people with internet access. We also found that people without internet access had fewer resources (e.g. running water) than people with internet access, suggesting that harshness in the environment may be influencing face preferences.

We believe that the strength of this study comes from its methodology. By testing people through different channels (i.e. online and in person), we were able to show that testing style does not bias preferences among the same population. In other words, people with internet access showed similar face preferences regardless of whether they were tested online or in person. In addition, by testing people with internet access and people without internet access, we were able to provide evidence that online studies may provide a distorted perspective of the populations in developing countries (see Section 6.2 for a discussion on testing non-WEIRD participants). This finding is increasingly important given that several online studies are now using cross-country comparisons (e.g. Brooks et al., 2011; DeBruine et al., 2010a; Moore et al., 2013). Future research needs to take this into account when using online samples from countries where a substantial portion of the population does not have internet access. This applies not only to face preference research but to all studies that use online testing in developing countries (e.g. Hoerger et al., 2011).

One of the weaknesses of this study is that we were not able to analyse differences within the groups (i.e. people with internet access and people without internet access) because our questionnaire was not granular enough. We presented all participants with questions intended to measure differences in their environments (e.g. "Do you have a television in your home?"). In addition to comparing people with internet access to people without internet access, we also planned to examine within group variability (e.g. examining the role of having a television on preferences). The unforeseen problem was that there was almost no variability within the groups (e.g. people with internet access tended to have a television and people without internet access tended not to have a television). For future work, it would be beneficial to have a more granular questionnaire (e.g. "How many hours of television do you watch per day?"). This would allow for the examination of differences within groups as well as between them. Additionally, we were not able to resolve which aspects of harshness were influential on face preferences since many of our variables were conflated (e.g. people without internet access tended to not have a television, not have running water in their home, not have easy access to a hospital, and not have graduated from high school). Future studies would thus benefit from testing larger samples with varied locations where the influences of individual aspects of harshness can be further examined.

In Chapter Five, we aimed to further our understanding of environmental influences on partner preferences by shifting our attention from environmental harshness to environmental familiarity. More specifically, we sought to investigate participants' face preferences while also examining the facial characteristics of such participants. Our results showed that, in both Malaysia and El Salvador, participants from rural areas preferred female faces with higher levels of adiposity than participants from urban areas. Additionally, even though the women from the urban areas were actually heavier than the women from the rural areas, we found that the female faces from the rural areas were rated as looking heavier than the female faces from the urban areas (see Section 6.2 for a discussion on how harsh environments may predispose people to store fat differently). Our findings provide preliminary evidence that familiarity may be contributing to the differences found in face preferences between rural and urban areas, given that people from rural and urban areas are exposed to different faces.

We believe that the strength of this study comes from testing participants' face preferences alongside investigating the participants' facial characteristics. Previous studies have found that, in Malaysia (Swami & Tovée, 2005a) and in El Salvador (Batres & Perrett, 2014), individuals from rural areas prefer heavier women than individuals from urban areas. Several explanations have been proposed to explain these differences in weight preferences but no study had tested familiarity as a possible explanation. To our knowledge, this is the first study to have investigated facial preferences while also examining the visual diet of the examined populations, thus providing evidence that familiarity with own population appearance may be influencing facial preferences.

One of the weaknesses of this study is that we cannot tease apart the influence of familiarity from other factors that influence face preferences between rural and urban populations. For instance, exposure to the media is greater in urban areas than rural areas

(Chan & McNeal, 2006) and therefore it is difficult to disentangle the everyday familiarity effect from the media familiarity effect. Future studies should examine how face preferences change as people migrate between areas that differ in the visual appearance of the population but do not differ in other factors known to influence face preferences (e.g. media (Becker, 2004), health (Tovée et al., 2006), violence (Brooks et al., 2011)). Such distinctions would help us further understand the role that familiarity plays in what it is that we find attractive.

6.2. Conclusions, limitations, and future research

This thesis has provided evidence that the environment does indeed influence what it is that we find attractive. In Chapter Three, we investigated how pubertal timing, a factor known to be influenced by the environment, affects face preferences as well as reproductive plans. In order to further examine the relationship between masculinity preferences and reproductive plans, we conducted a study in El Salvador (i.e. Chapter Two) which initially included several questions intended to measure reproductive strategies (e.g. "At what age would you like to have your first child?", "What is your preferred number of children?", "Do you have any preference for the sex of your children?"). Surprisingly, numerous participants refused to answer such questions or responded that they could not provide answers to such questions since it was in God's hands (e.g. "I will have my first child when God wants me to", "God will decide how many children I will have", "It is up to God whether I have boys or girls"). These answers meant that the questions could not be used in the analyses since participants either did not have preferences or thought that having preferences was inappropriate.

A second unexpected issue that arose from testing in El Salvador was our control question of sexual orientation. Many participants did not understand the terms “heterosexual”, “bisexual” and “homosexual”. After further explanation of the terms, (e.g. “heterosexual refers to being sexually attracted only to people of the opposite sex, bisexual refers to being sexually attracted equally to people of the opposite sex and people of the same sex, and homosexual refers to being sexually attracted only to people of the same sex”), many participants still did not comprehend the sexual nature of the terms. For example, they would answer that they had about an equal number of male and female friends. For those participants who did understand the sexual nature of the terms after the explanation, they remained very confused about the idea that sexual relationships could exist between people of the same sex. As a result, we were not able to control for sexual orientation since so many participants did not understand the question. A default was assumed that the majority were indeed heterosexual and variation in sexual orientation was treated as noise within the data.

Another issue that arose with testing in a developing country is that participants were not familiar with Likert scales. We had a disgust questionnaire where the possible answers were numbers on a Likert scale. It became apparent quite quickly that the participants struggled with being able to produce their answers as part of a number scale since they had never been exposed to such measures. Participants tended to only answer with the anchor numbers (minimum and maximum) rather than using the full range of the scale. Issues like these illustrate the need to adjust our methodology to be able to accurately capture the information we are after when testing non-WEIRD (Western, Educated, Industrialized, Rich and Democratic; Henrich, Heine, & Norenzayan, 2010) participants.

In Chapter Five, we again used participants from El Salvador but also added participants from Malaysia. In this chapter, we provided evidence that the female participants from our rural samples weighed less than the female participants from our urban samples. Counterintuitively though, the female participants from the rural samples were rated as looking heavier than the female participants from our urban samples. Past research has found that there is a strong relationship between body mass and perceived facial adiposity (Coetzee et al., 2009; Tinlin et al., 2013) and that people can accurately estimate a person's weight based on their face alone (Coetzee et al., 2009; Coetzee, Chen, Perrett, & Stephen, 2010). Our results, however, provide evidence that this finding cannot be generalized between sub populations. In both El Salvador and Malaysia, we found differences between two sub populations (i.e. rural and urban). When comparing these two sub populations in both El Salvador and Malaysia, there was a negative relationship between actual weight and perceived adiposity in females (i.e. participants in the rural areas were rated as looking heavier even though they had lower weights than participants in the urban areas). This finding has important implications for future research aiming to investigate weight preferences through the use of faces.

One possible explanation for this finding is that a harsh environment may predispose people to store fat differently. Indeed, research has found that harsh environments lead to an increased production of cortisol (Evans & English, 2002; Flinn & England, 1997), a hormone produced in response to stressors (Flinn & England, 1997). For example, one study found a positive link between the number of years lived in poverty and nocturnal urinary cortisol levels (Evans & English, 2002). Another study found that children who lived with nonrelatives (e.g. step parents) had higher levels of cortisol than children who lived with relatives (Flinn & England, 1997). Within those households that contained half siblings, step children living in the same household had higher levels of cortisol than the children born to both parents.

Prolonged exposure to cortisol leads to higher fat deposition on the side of the face (commonly referred to as "moon face"; Manenschijn et al, 2012). For instance, moon face is a common symptom of individuals diagnosed with Cushing's syndrome, an illness resulting from cortisol excess (Carlson, 2007). There are various causes for Cushing's syndrome, one being having an adrenocortical adenoma, a tumor located in the adrenal cortex which mediates stress responses (Fegan et al., 2007). Once this tumor is removed, patients no longer exhibit Cushing's syndrome symptoms, notably the fat deposition on the side of their faces decreases and they are no longer identified as having moon face (see Figure 7). Although we did not test our participants for Cushing's syndrome, it did not appear that any of them suffered from extreme moon face. Nonetheless, the participants from the rural areas in both Malaysia and El Salvador were rated higher in perceived facial adiposity, suggesting that living in a harsh environment may indeed lead individuals to store higher levels of fat in the face (probably due to raised cortisol levels). Having raised cortisol levels in a harsh environment may be an adaptive response (e.g. faster development and earlier puberty as discussed in Chapter Three), even when adiposity gain has long-term negative health consequences. Storing fat in the face may also be an adaptive response for mating since higher weights are considered more attractive in harsh environments and, as discussed in Chapter One, the face is the most important factor when judging attractiveness (Morse, Gruzen, & Reis, 1976). Further research, however, is needed in order to understand how conflicting weight cues (e.g. high facial adiposity but low body weight) influence overall attractiveness.

Figure 7. Moon face example. The same patient shown one month before (A) and six months after (B) removal of an adrenocortical adenoma (Fegan et al., 2007).

In both the rural areas of Malaysia and El Salvador (Chapter Five) and in the army training camp (Chapter Four), higher levels of adiposity are considered more attractive. Although both these environments are considered "harsh", the duration of such harshness differs. In the rural areas of Malaysia and El Salvador the harshness in the environment is constant, with individuals being exposed to a continuous lack of access to resources. On the other hand, the harshness in the army training camp is temporary, with individuals being exposed to what they know to be only a transient increase in discomfort. The difference between what is deemed a long-term harsh environment versus a short-term harsh environment would be interesting to further examine. It would be adaptive to respond differently to harshness depending on the probable duration of the additional stress and future studies would benefit from including duration of harshness as a variable of interest.

In conclusion, our findings provide evidence that face preferences are indeed flexible, being influenced by a myriad of factors, including internet access, pubertal timing, environmental harshness, and population familiarity. The ability to change preferences according to the environment may be adaptive since partnership and alliance choices are crucial for economic, physical, and psychological wellbeing. Additionally, partner choice influences reproductive outcomes and therefore altering partner preferences according to the environment may confer evolutionary benefits.

References

3D.SK. (2012). Human photo references and textures for artists. Retrieved from http://www.3d.sk/.

Alaluf, S., Heinrich, U., Stahl, W., Tronnier, H., & Wiseman, S. (2002). Dietary carotenoids contribute to normal human skin colour and UV photosensitivity. *The Journal of nutrition, 132*(3), 399-403.

Alexander, M., Newmark, H., & Miller, R. G. (1985). Oral beta-carotene can increase the number of OKT4+ cells in human blood. *Immunology Letters, 9*(4), 221-224.

Alley, T. R., & Cunningham, M. R. (1991). Averaged faces are attractive, but very attractive faces are not average. *Psychological Science, 2*(2), 123-125.

Anuario Estadistico. (2009). Ministerio de Economia. Gobierno de El Salvador.

Apter, D., Reinilä, M., & Vihko, R. (1989). Some endocrine characteristics of early menarche, a risk factor for breast cancer, are preserved into adulthood. *International Journal of Cancer*, *44*(5), 783-787.

Archer, J. (1991). The influence of testosterone on human aggression. *British Journal of Psychology*, *82*(1), 1-28.

Ashwin, C., Wheelwright, S., & Baron-Cohen, S. (2006). Finding a face in the crowd: testing the anger superiority effect in Asperger syndrome. *Brain and Cognition, 61*(1), 78-95.

Baird, D. D., Wilcox, A. J., Weinberg, C. R., Kamel, F., McConnaughey, D. R., Musey, P. I., & Collins, D. C. (1997). Preimplantation hormonal differences between the conception and non-conception menstrual cycles of 32 normal women. *Human Reproduction, 12*(12), 2607-2613.

Batres, C., & Perrett, D.I. (2014). The influence of the digital divide on face preferences in El Salvador: People without internet access prefer more feminine men, more masculine women, and women with higher adiposity. *PLoS One, 9*(7), e100966.

Batres, C., Re, D. E., & Perrett, D. I. (2015). Influence of perceived height, masculinity, and age on each other and on perceptions of dominance in male faces. *Perception, 44*(11), 1293-1309.

Becker, A. E. (2004). Television, disordered eating, and young women in Fiji: Negotiating body image and identity during rapid social change. *Culture, Medicine and Psychiatry, 28*(4), 533-559.

Belsky, J., Steinberg, L., & Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of socialization. *Child Development, 62*(4), 647-670.

Benson, P., & Perrett, D. (1992). Face to face with the perfect image. *New Scientist, 133*(1809), 32.

Bernstein, L., Pike, M. C., Ross, R. K., & Henderson, B. E. (1991). Age at menarche and oestrogen concentrations of adult women. *Cancer Causes & Control, 2*(4), 221-225.

Booth, A., & Dabbs, J. M. (1993). Testosterone and men's marriages. *Social Forces, 72*(2), 463-477.

Boothroyd, L. G., Jones, B. C., Burt, D. M., Cornwell, R. E., Little, A. C., Tiddeman, B. P., & Perrett, D. I. (2005). Facial masculinity is related to perceived age but not perceived health. *Evolution and Human Behavior, 26*(5), 417-431.

Boyce, W. T., & Ellis, B. J. (2005). Biological sensitivity to context: I. An evolutionary–developmental theory of the origins and functions of stress reactivity. *Development and Psychopathology, 17*(02), 271-301.

Braun, M. F., & Bryan, A. (2006). Female waist-to-hip and male waist-to-shoulder ratios as determinants of romantic partner desirability. *Journal of Social and Personal Relationships, 23*(5), 805-819.

Bronstad, P. M., Langlois, J. H., & Russell, R. (2008). Computational models of facial attractiveness judgments. *Perception, 37*(1), 126-142.

Brooks, R., Scott, I. M., Maklakov, A. A., Kasumovic, M. M., Clark, A. P., & Penton-Voak, I. S. (2011). National income inequality predicts women's preferences for masculinized faces better than health does. *Proceedings of the Royal Society of London B: Biological Sciences, 278*(1707), 810-812.

Brown, P. J., & Konner, M. (1987). An anthropological perspective on obesity. *Annals of the New York Academy of Sciences, 499*(1), 29-46.

Brown, W.J., Mishra, G., Kenardy, J., & Dobson, A. (2000). Relationships between body mass index and well-being in young Australian women. *International Journal of Obesity, 24,* 1360-1368.

Bruce, V., & Young, A. (1986). Understanding face recognition. *British Journal of Psychology, 77*(3), 305.

Burnham, T. C., Chapman, J. F., Gray, P. B., McIntyre, M. H., Lipson, S. F., & Ellison, P. T. (2003). Men in committed, romantic relationships have lower testosterone. *Hormones and Behavior, 44*(2), 119-122.

Buss, D. M. (1998). Sexual strategies theory: Historical origins and current status. *Journal of Sex Research, 35*(1), 19-31.

Carbon, C. C., Strobach, T., Langton, S. R. H., Harsanyi, G., Leder, H., & Kovacs, G. (2007). Adaptation effects of highly familiar faces: Immediate and long lasting. M*emory & Cognition, 35*(8), 1966-1976.

Carbon, C. C., & Ditye, T. (2011). Sustained effects of adaptation on the perception of familiar faces. *Journal of Experimental Psychology: Human Perception and Performance, 37*(3), 615-625.

Carlson, H. E. (2007). Human adrenal cortex hyperfunction due to LH/hCG. *Molecular and Cellular Endocrinology*, *269*(1), 46-50.

Chan, K., & McNeal, J. U. (2006). Children and media in China: An urban-rural comparison study. *Journal of Consumer Marketing, 23*(2), 79-88.

Chisholm, J.S., Ellison, P.T., Evans, J., Lee, P.C., Lieberman, L.S., Pavlik, Z., Ryan, A.S., Salter, E.M., Stini, W.A., & Worthman, C.M. (1993). Death, hope, and sex, life-history theory and the development of reproductive strategies. *Current Anthropology, 34*(1), 1-24.

Chrousos, G. P. (2009). Stress and disorders of the stress system. N*ature Reviews Endocrinology, 5*(7), 374-381.

Coetzee, V., Perrett, D. I., & Stephen, I. D. (2009). Facial adiposity: A cue to health? *Perception*, *38*(11), 1700-1711.

Coetzee, V., Chen, J., Perrett, D. I., & Stephen, I. D. (2010). Deciphering faces: quantifiable visual cues to weight. *Perception, 39*(1), 51-61.

Coetzee, V., Re, D., Perrett, D. I., Tiddeman, B. P., & Xiao, D. (2011). Judging the health and attractiveness of female faces: Is the most attractive level of facial adiposity also considered the healthiest? *Body Image*, *8*(2), 190-193.

Cooper, P. A., & Maurer, D. (2008). The influence of recent experience on perceptions of attractiveness. *Perception, 37*(8), 1216-1226.

Cornwell, R.E., Smith, M.J.L., Boothroyd, L.G., Moore, F.R., Davis, H.P., Stirrat, M., Tiddeman, B., & Perrett, D.I. (2006). Reproductive strategy, sexual development and attraction to facial characteristics. *Philosophical Transactions of the Royal Society B, Biological Sciences*, *361*(1476), 2143-2154.

Cronin, H. (1991). *The ant and the peacock : altruism and sexual selection from Darwin to today / Helena Cronin*: Cambridge : Cambridge University Press, 1991.

Dabbs Jr, J. M., Frady, R. L., Carr, T. S., & Besch, N. F. (1987). Saliva testosterone and criminal violence in young adult prison inmates. *Psychosomatic Medicine, 49*(2), 174-182.

Dabbs, J., M. Jr., & Mallinger, A. (1999). High testosterone levels predict low voice pitch among men. *Personality and Individual Differences, 27*(4), 801-804.

Darwin, C. (1859). *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*: London: Murray, 1859.

Darwin, C. (1871). *The descent of man, and selection in relation to sex / by Charles Darwin*: London: John Murray, 1871.

De Barra, M., DeBruine, L. M., Jones, B. C., Mahmud, Z. H., & Curtis, V. A. (2013). Illness in childhood predicts face preferences in adulthood. *Evolution and Human Behavior, 34*(6), 384-389.

DeBruine, L. M., Jones, B. C., Little, A. C., Boothroyd, L. G., Perrett, D. I., Penton-Voak, I. S., Cooper, P. A., Penke, L., Feinberg, D. R., & Tiddeman, B. P. (2006). Correlated preferences for facial masculinity and ideal or actual partner's masculinity. *Proceedings of the Royal Society of London B: Biological Sciences*, *273*(1592), 1355-1360.

DeBruine LM, Jones BC, Crawford JR, Welling LLM, Little AC (2010a). The health of a nation predicts their mate preferences: cross-cultural variation in women's preferences for masculinized male faces. *Proceedings of the Royal Society of London B: Biological Sciences, 277*(1692), 2405–10.

DeBruine, L. M., Jones, B. C., Little, A. C., Crawford, J. R., & Welling, L. L. (2010b). Further evidence for regional variation in women's masculinity preferences. *Proceedings of the Royal Society of London B: Biological Sciences*, *278*(1707), 813-4.

DiMaggio, P., Hargittai, E., Neuman, W. R., & Robinson, J. P. (2001). Social implications of the Internet. *Annual Review of Sociology*, *27*, 307-336.

Dirks, A.J., & Leeuwenburgh, C. (2006). Caloric restriction in humans: Potential pitfalls and health concerns. *Mechanisms of Ageing and Development*, *127*, 1-7.

Dittmar, H., Halliwell, E., & Stirling, E. (2009). Understanding the impact of thin media models on women's body-focused affect: The roles of thin-ideal internalization and weight-related self-discrepancy activation in experimental exposure effects. *Journal of Social and Clinical Psychology*, *28*(1), 43-72.

Doughty, D., & Rodgers, J. L. (2000). Behavior genetic modeling of menarche in US females. In *Genetic influences on human fertility and sexuality* (pp. 169-181). Springer US.

Draper, P., & Harpending, H. (1982). Father absence and reproductive strategy, an evolutionary perspective. *Journal of Anthropological Research*, *38*(3), 255-273.

Ekman, P., Friesen, W. V., O'Sullivan, M., Chan, A., Diacoyanni-Tarlatzis, I., Heider, K., Krause, R., LeCompte, W. A., Pitcairn, T., Ricci-Bitti, P. E., Scherer, K., Tomita, M., Tzavaras, A. (1987). Universals and cultural differences in the judgments of facial expressions of emotion. *Journal of Personality and Social Psychology*, *53*(4), 712-717.

Ellis, B. J., McFadyen-Ketchum, S., Dodge, K. A., Pettit, G. S., & Bates, J. E. (1999). Quality of early family relationships and individual differences in the timing of pubertal maturation in girls: a longitudinal test of an evolutionary model. *Journal of Personality and Social Psychology*, *77*(2), 387.

Ellis, B.J., & Garber, J. (2000). Psychosocial antecedents of variation in girls' pubertal timing: maternal depression, stepfather presence, and marital and family stress. *Child Development*, *71*(2), 485.

Ellis, C. (2004). *The ethnographic I: A methodological novel about autoethnography*. Rowman Altamira.

Emlen, D. J., Marangelo, J., Ball, B., & Cunningham, C. W. (2005). Diversity in the weapons of sexual selection: horn evolution in the beetle genus Onthophagus (*Coleoptera: Scarabaeidae*). *Evolution*, *59*(5), 1060-1084.

Evans, G. W., & English, K. (2002). The environment of poverty: Multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child development, 73*(4), 1238-1248.

Falagas, M.E., & Kampoti, M. (2006). Obesity and infection. *Lancet Infectious Diseases,6*, 438-446.

Fegan, P. G., Sandeman, D. D., Krone, N., Bosman, D., Wood, P. J., Stewart, P. M., & Hanley, N. A. (2007). Cushing's syndrome in women with polycystic ovaries and hyperandrogenism. *Nature Clinical Practice Endocrinology & Metabolism, 3*(11), 778-783.

Feinberg, D. R., DeBruine, L. M., Jones, B. C., & Little, A. C. (2008). Correlated preferences for men's facial and vocal masculinity. *Evolution and Human Behavior, 29*(4), 233-241.

Feinberg, D.R., DeBruine, L.M., Jones, B.C., Little, A.C., O'Connor, J.J.M., & Tigue, C.C. (2012). Women's self-perceived health and attractiveness predict their male vocal masculinity preferences in different directions across short- and long-term relationship contexts. *Behavioral Ecology and Sociobiology, 66*, 413-418.

Fink, B., Grammer, K., & Matts, P. J. (2006). Visible skin colour distribution plays a role in the perception of age, attractiveness, and health in female faces. *Evolution and Human Behavior, 27*(6), 433-442.

Fink, B., Grammer, K., & Thornhill, R. (2001). Human (Homo sapiens) facial attractiveness in relation to skin texture and colour. *Journal of Comparative Psychology, 115*(1), 92-99.

Fink, B., Neave, N., & Seydel, H. (2007). Male facial appearance signals physical strength to women. *American Journal of Human Biology, 19*(1), 82-87.

Flinn, M. V., & England, B. G. (1997). Social economics of childhood glucocorticoid stress response and health. *American Journal of Physical Anthropology, 102*(1), 33-53.

Folstad, I., & Karter, A. J. (1992). Parasites, bright males, and the immunocompetence handicap. *American Naturalist, 139*(3), 603-622.

Fox, E., Lester, V., Russo, R., Bowles, R. J., Pichler, A., & Dutton, K. (2000). Facial expressions of emotion: Are angry faces detected more efficiently? *Cognition and Emotion, 14*(1), 61-92.

Frisch, R. E. (1988). Fatness and Fertility. *Scientific American, 258*(3), 88.

Furnham, A., & Alibhai, N. (1983). Cross-cultural differences in the perception of female body shapes. *Psychological medicine*, *13*(04), 829-837.

Furnham, A., Moutafi, J., & Baguma, P. (2002). A cross-cultural study on the role of weight and waist-to-hip ratio on female attractiveness. *Personality and Individual Differences, 32*(4), 729-745.

Furnham, A., Lavanchy, M., & McClelland, A. (2006). Waist to hip ratio and facial attractiveness: A pilot study. *Personality and Individual Differences, 40*(1).

Galton, F. (1879). Composite portraits, made by combining those of many different persons into a single resultant figure. *The Journal of the Anthropological Institute of Great Britain and Ireland*, 132-144.

Germine, L., Nakayama, K., Duchaine, B. C., Chabris, C. F., Chatterjee, G., & Wilmer, J. B. (2012). Is the Web as good as the lab? Comparable performance from Web and lab in cognitive/perceptual experiments. *Psychonomic Bulletin & Review, 19*(5), 847-857.

Gildersleeve, K., Haselton, M. G., & Fales, M. R. (2014). Do women's mate preferences change across the ovulatory cycle? A meta-analytic review. *Psychological Bulletin, 140*(5), 1205.

Goren, C. C., Sarty, M., & Wu, P. Y. K. (1975). Visual following and pattern discrimination of face-like stimuli by newborn infants. *Pediatrics, 56*(4), 544.

Gowen, L. K., Feldman, S. S., Diaz, R., & Yisrael, D. S. (2004). A comparison of the sexual behaviours and attitudes of adolescent girls with older vs. similar-aged boyfriends. *Journal of Youth and Adolescence, 33*(2), 167-175.

Grammer, K., & Thornhill, R. (1994). Human (Homo sapiens) facial attractiveness and sexual selection: The role of symmetry and averageness. *Journal of Comparative Psychology, 108*(3), 233-242.

Grant, B. S., & Owen, D. F. (1996). Parallel rise and fall of melanic peppered moths in America and Britain. *Journal of Heredity, 87*(5), 351.

Gray, P. B., Kahlenberg, S. M., Barrett, E. S., Lipson, S. F., & Ellison, P. T. (2002). Marriage and fatherhood are associated with lower testosterone in males. *Evolution and Human Behavior, 23*(3), 193-201.

Grodstein, F., Goldman, M.B., Cramer, D.W. (1994). Body mass index and ovulatory infertility. *Epidemiology,* 247-250.

Hargittai, E. (2002). Second-level digital divide: mapping differences in people's online skills. *First Monday, 7*(4).

Harris, J., & Clayton, B. (2002). Femininity, masculinity, physicality and the english tabloid press the case of Anna Kournikova. *International Review for the Sociology of Sport, 37*(3-4), 397-413.

Harris, C. R. (2013). Shifts in masculinity preferences across the menstrual cycle: Still not there. *Sex Roles, 69*(9-10), 507-515.

Henderson, A. J., Holzleitner, I. J., Talamas, S. N., & Perrett, D. I. (in press). Perception of health from facial cues. *Philosophical Transactions B.*

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences, 33*(2-3), 61-83.

Hill, G. E. (1990). Female house finches prefer colourful males: sexual selection for a condition-dependent trait. *Animal Behaviour, 40*(3), 563.

Hoerger, M., Quirk, S. W., & Weed, N. C. (2011). Development and validation of the delaying gratification inventory. *Psychological Assessment*, *23*(3), 725-738.

Hoier, S. (2003). Father absence and age at menarche. *Human Nature*, *14*(3), 209-233.

Instituto de Medicina Legal. (2013). *Defunciones reconocidas en El Salvador según medicos(as) forenses instituto de medicina legal año 2013, período enero-marzo.* Gobierno de El Salvador.

International Telecommunication Union. (2013). *Percentage of individuals using the Internet*. Retrieved from: http://www.itu.int/ITU-D/ict/statistics/.

Jack, R. E., Blais, C., Scheepers, C., Schyns, P. G., & Caldara, R. (2009). Cultural confusions show that facial expressions are not universal. *Current Biology, 19*(18), 1543-1548.

Jasieńska, G., Ellison, P.T., & Thune, I. (2004). Large breasts and narrow waists indicate high reproductive potential in women. *Proceedings of the Royal Society of London B: Biological Sciences, 271*, 1213-1217.

Johnston, V. S., & Oliver-Rodriguez, J. C. (1997). Facial beauty and the late positive component of event-related potentials. *Journal of Sex Research, 34*(2), 188-198.

Johnston, V.S., Hagel, R., Franklin, M., Fink, B., & Grammer, K. (2001). Male facial attractiveness: Evidence for hormone-mediated adaptive design. *Evolution and Human Behavior, 22*, 251-267.

Jones, B. C., Little, A. C., Burt, D. M., & Perrett, D. I. (2004). When facial attractiveness is only skin deep. *Perception, 33*(5), 569-576.

Jones, B. C., DeBruine, L. M., & Little, A. C. (2007a). The role of symmetry in attraction to average faces. *Perception & Psychophysics, 69*(8), 1273-1277.

Jones, B. C., DeBruine, L. M., Little, A. C., Conway, C. A., Welling, L. L., & Smith, F. (2007b). Sensation seeking and men's face preferences. *Evolution and Human Behavior, 28*(6), 439-446.

Jones, B.C., Boothroyd, L., Feinberg, D.R., & DeBruine, L.M. (2010). Age at menarche predicts individual differences in women's preferences for masculinized male voices in adulthood. *Personality and Individual Differences*, *48*(7), 860-863.

Katzmarzyk, P. T., & Davis, C. (2001). Thinness and body shape of Playboy centerfolds from 1978 to 1998. I*nternational Journal of Obesity*, *25*(4), 590-592.

Kościński, K. (2013). Attractiveness of women’s body: body mass index, waist–hip ratio, and their relative importance. *Behavioral Ecology*, *24*(4), 914-925.

Kowner, R. (1996). Facial asymmetry and attractiveness judgement in developmental perspective. *Journal of Experimental Psychology: Human Perception and Performance, 22*(3), 662-675.

Lake, J. K., Power, C., & Cole, T. J. (1997). Women's reproductive health: the role of body mass index in early and adult life. *International Journal of Obesity & Related Metabolic Disorders, 21*(6), 432-438.

Langlois, J. H., & Roggman, L. A. (1990). Attractive faces are only average. *Psychological Science, 1*(2), 115-121.

Law-Smith, M. J., Perrett, D. I., Jones, B. C., Cornwell, R. E., Moore, F. R., Feinberg, D. R., Boothroyd, L. G., Durrani, S. J., Stirrat, M. R., Whitem S., Pitman, R. M., Hillier, S. G. (2006). Facial appearance is a cue to oestrogen levels in women. *Proceedings of the Royal Society of London B: Biological Sciences, 273*(1583), 135-140.

Law-Smith, M.J., Deady, D.K., Moore, F.R., Jones, B.C., Cornwell, R.E., Stirrat, M., Lawson, J.F., Feinberg, D.R., & Perrett, D.I. (2012). Maternal tendencies in women are associated with oestrogen levels and facial femininity. *Hormones and Behavior*, *61*, 12-16.

Lee, A. J., & Zietsch, B. P. (2011). Experimental evidence that women's mate preferences are directly influenced by cues of pathogen prevalence and resource scarcity. *Biology Letters, 7*(6), 892-5.

Levine, J. A., Ray, A., & Jensen, M. D. (1998). Relation between chubby cheeks and visceral fat. *The New England Journal of Medicine, 339*(26), 1946-1947.

Little, A. C., Burt, D. M., Penton-Voak, I. S., & Perrett, D. I. (2001). Self-perceived attractiveness influences human female preferences for sexual dimorphism and symmetry in male faces. *Proceedings of the Royal Society of London B: Biological Sciences, 268(1462)*, 39-44.

Little, A. C., & Hancock, P. J. B. (2002). The role of masculinity and distinctiveness in judgments of human male facial attractiveness. *British Journal of Psychology, 93*(4), 451-464.

Little, A. C., Cohen, D. L., Jones, B. C., & Belsky, J. (2007a). Human preferences for facial masculinity change with relationship type and environmental harshness. *Behavioral Ecology and Sociobiology, 61*(6), 967–973.

Little, A.C., Burriss, R.P., Jones, B.C., & Roberts, S.C. (2007b). Facial appearance affects voting decisions. *Evolution & Human Behavior, 28*, 18-27.

Little, A. C., Connely, J., Feinberg, D. R., Jones, B. C., & Roberts, S. C. (2011). Human preference for masculinity differs according to context in faces, bodies, voices, and smell. *Behavioral Ecology, 22*, 862–868.

Luxen, M. F., & Buunk, B. P. (2006). Human intelligence, fluctuating asymmetry and the peacock's tail: General intelligence (g) as an honest signal of fitness. *Personality and Individual Differences, 41*(5), 897-902.

Macchi, C. V., Turati, C., & Simion, F. (2004). Can a nonspecific bias toward top-heavy patterns explain newborns' face preference? *Psychological Science, 15*(6), 379-383.

Magnusson, D., Stattin, H., & Allen, V. L. (1985). Biological maturation and social development: A longitudinal study of some adjustment processes from mid-adolescence to adulthood. *Journal of Youth and Adolescence, 14*(4), 267-283.

Manenschijn, L., Koper, J. W., van den Akker, E. L. T., De Heide, L. J. M., Geerdink, E. A. M., De Jong, F. H., Feelders, R. A., & van Rossum, E. F. C. (2012). A novel tool in the diagnosis and follow-up of (cyclic) Cushing's syndrome: measurement of long-term cortisol in scalp hair. *The Journal of Clinical Endocrinology & Metabolism, 97*(10), E1836-E1843.

Matts, P. J., Fink, B., Grammer, K., & Burquest, M. (2007). Color homogeneity and visual perception of age, health, and attractiveness of female facial skin. *Journal of the American Academy of Dermatology, 57*(6), 977-984.

Mazur, A., Halpern, C., & Udry, J. R. (1994). Dominant looking male teenagers copulate earlier. *Ethology & Sociobiology, 15*(2), 87-94.

McCabe, M. P., Ricciardelli, L., Waqa, G., Goundar, R., & Fotu, K. (2009). Body image and body change strategies among adolescent males and females from Fiji, Tonga and Australia. *Body Image, 6*(4), 299-303.

Moore, A. J. (1990). The Evolution of Sexual Dimorphism by Sexual Selection: The Separate Effects of Intrasexual Selection and Intersexual Selection. *Evolution, 2,* 315-331.

Moore, F. R., Coetzee, V., Contreras-Garduño, J., Debruine, L. M., Kleisner, K., Krams, I., Marcinkowska, U., Nord, A., Perrett, D. I., Rantala, M. J., & Schaum, N. (2013). Cross-cultural variation in women's preferences for cues to sex-and stress-hormones in the male face. *Biology Letters, 9*(3), 20130050.

Morry, M. M., & Staska, S. L. (2001). Magazine exposure: Internalization, self-objectification, eating attitudes, and body satisfaction in male and female university students. *Canadian Journal of Behavioural Science, 33*(4), 269.

Morse, S. J., Gruzen, J., & Reis, H. (1976). The 'eye of the beholder': A neglected variable in the study of physical attractiveness? *Journal of Personality, 44*(2), 209.

Mueller, U., & Mazur, A. (1996). Facial dominance of West Point cadets as a predictor of later military rank. *Social Forces, 74*(3), 823-850.

Muller, M. N., Marlowe, F. W., Bugumba, R., & Ellison, P. T. (2009). Testosterone and paternal care in East African foragers and pastoralists. *Proceedings of the Royal Society of London B: Biological Sciences, 276*(1655), 347-354.

Murray, F. G. (1934). Pigmentation, sunlight, and nutritional disease. *American Anthropologist*, *36*(3), 438-445.

Olweus, D., Mattsson, A., Schalling, D., & Löw, H. (1988). Circulating testosterone levels and aggression in adolescent males: a causal analysis. *Psychosomatic medicine, 50*(3), 261-272.

Onat, A., Hergenç, G., Yüksel, H., Can, G., Ayhan, E., Kaya, Z., & Dursunoğlu, D. (2009). Neck circumference as a measure of central obesity: Associations with metabolic syndrome and obstructive sleep apnea syndrome beyond waist circumference. *Clinical Nutrition, 28*, 46-51.

Ostovich, J. M., & Sabini, J. (2004). How are sociosexuality, sex drive, and lifetime number of sexual partners related? *Personality and Social Psychology Bulletin, 30*(10), 1255-1266.

Pathak, D.R., & Whittemore, A.S. (1992). Combined effects of body size, parity, and menstrual events on breast cancer incidence in seven countries. *American Journal of Epidemiology, 135*(2), 153-168.

Penke, L., & Asendorpf, J.B. (2008). Beyond global sociosexual orientations, a more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology*, *95*(5), 1113-1135.

Penton-Voak, I. S., Perrett, D. I., Castles, D. L., Kobayashi, T., Burt, D. M., Murray, L. K., & Minamisawa, R. (1999). Menstrual cycle alters face preference. *Nature, 399*(6738), 741-742.

Penton-Voak, I. S., & Perrett, D. I. (2000). Female preference for male faces changes cyclically: Further evidence. *Evolution and Human Behavior, 21*(1), 39-48.

Penton-Voak, I. S., & Perrett, D. I. (2001). Male facial attractiveness: perceived personality and shifting female preferences for male traits across the menstrual cycle. *Advances in the Study of Behavior, 30*, 219-259.

Penton-Voak, I. S., & Chen, J. Y. (2004). High salivary testosterone is linked to masculine male facial appearance in humans. *Evolution and Human Behavior, 25*(4), 229-241.

Penton-Voak, I. S., Jacobson, A., & Trivers, R. (2004). Populational differences in attractiveness judgements of male and female faces: Comparing British and Jamaican samples. *Evolution and Human Behavior, 25*(6), 355-370.

Perrett, D. I., May, K. A., & Yoshikawa, S. (1994). Facial shape and judgements of female attractiveness. *Nature, 368*(6468), 239-242.

Perrett, D. I., Lee, K. J., Penton-Voak, I., Rowland, D., Yoshikawa, S., Burt, D. M., Henzi, S.P., Castles, D.L., & Akamatsu, S. (1998). Effects of sexual dimorphism on facial attractiveness. *Nature, 394*(6696), 884-887.

Perrett, D. I., Burt, D. M., Penton-Voak, I. S., Lee, K. J., Rowland, D. A., & Edwards, R. (1999). Symmetry and Human Facial Attractiveness. *Evolution and Human Behavior, 20*(5), 295-307.

Perrett, D., Penton-Voak, I.S., Little, A.C., Tiddeman, B.P., Burt, D.M., Schmidt, N., Oxley, R., Kinloch, N. & Barrett, L. (2002). Facial attractiveness judgements reflect learning of parental age characteristics. *Proceedings of the Royal Society of London B: Biological Sciences, 269*(1494), 873-880.

Perrett, D. (2010). *In your face: The new science of human attraction*. Palgrave Macmillan.

Prokopčakova, A. (1998). Drug experimenting and pubertal maturation in girls. *Studia Psychologica, 40*(4), 287-290.

Provost, M. P., Kormos, C., Kosakoski, G., & Quinsey, V. L. (2006). Sociosexuality in women and preference for facial masculinization and somatotype in men. *Archives of Sexual Behavior, 35*(3), 305-312.

Puts, D. A. (2010). Beauty and the beast: Mechanisms of sexual selection in humans. *Evolution and Human Behavior, 31*(3), 157-175.

Puts, D. A., Bailey, D. H., Cárdenas, R. A., Burriss, R. P., Welling, L. L., Wheatley, J. R., & Dawood, K. (2013). Women's attractiveness changes with estradiol and progesterone across the ovulatory cycle. *Hormones and Behavior, 63*(1), 13-19.

Quist, M.C., Watkins, C.D., Smith, F.G., Little, A.C., DeBruine, L.M., & Jones, B.C. (2012). Sociosexuality predicts women's preferences for symmetry in men's faces. *Archives of Sexual Behavior, 41*(6), 1415-1421.

Rantala, M. J., Coetzee, V., Moore, F. R., Skrinda, I., Kecko, S., Krama, T., Kivleniece, I., Krams, I. (2013). Adiposity, compared with masculinity, serves as a more valid cue to immunocompetence in human mate choice. *Proceedings of the Royal Society of London B: Biological Sciences, 280*(1751), 20122495.

Re, D. E., DeBruine, L. M., Jones, B. C., & Perrett, D. I. (2013). Facial cues to perceived height influence leadership choices in simulated war and peace contexts. *Evolutionary Psychology, 11*(1), 89-103.

Re, D. E., & Perrett, D. I. (2014). The effects of facial adiposity on attractiveness and perceived leadership ability. *The Quarterly Journal of Experimental Psychology, 67*(4), 676-686.

Reimers, S. (2007). The BBC internet study, general methodology. *Archives of Sexual Behavior*, *36*(2), 147-161.

Rhodes, G., Sumich, A., & Byatt, G. (1999). Are average facial configurations attractive only because of their symmetry? *Psychological Science, 10*(1), 52-58.

Rhodes, G., Hickford, C., & Jeffery, L. (2000). Sex-typicality and attractiveness: Are supermale and superfemale faces super-attractive? *British Journal of Psychology*, *91*(1), 125.

Rhodes, G., Yoshikawa, S., Clark, A., Lee, K., McKay, R., & Akamatsu, S. (2001a). Attractiveness of facial averageness and symmetry in non-Western cultures: In search of biologically based standards of beauty. *Perception, 30*(5), 611-625.

Rhodes, G., Zebrowitz, L., A., Clark, A., Kalick, S. M., Hightower, A., & McKay, R. (2001b). Do facial averageness and symmetry signal health? *Evolution and Human Behavior, 22*(1), 31-46.

Rhodes, G., Chan, J., Zebrowitz, L. A., & Simmons, L. W. (2003). Does sexual dimorphism in human faces signal health? *Proceedings of the Royal Society of London B: Biological Sciences, 270,* S93-S95.

Rhodes, G., Simmons, L. W., & Peters, M. (2005). Attractiveness and sexual behaviour: Does attractiveness enhance mating success? *Evolution and Human Behavior, 26*, 186-201.

Roberts, M. L., Buchanan, K. L., & Evans, M. R. (2004). Testing the immunocompetence handicap hypothesis: a review of the evidence. *Animal Behaviour, 68*(2), 227-239.

Roberts, S. C., Little, A. C., Gosling, L. M., Perrett, D. I., Carter, V., Jones, B. C., Penton-Voak, I., Petrie, M. (2005). MHC-heterozygosity and human facial attractiveness. *Evolution and Human Behavior, 26*(3), 213-226.

Robins, A. H. (1991). *Biological perspectives on human pigmentation / Ashley H. Robins*: Cambridge, England; New York: Cambridge University Press, 1991.

Roney, J. R., Hanson, K. N., Durante, K. M., & Maestripieri, D. (2006). Reading men's faces: women's mate attractiveness judgments track men's testosterone and interest in infants. *Proceedings of the Royal Society of London B: Biological Sciences, 273*(1598), 2169-2175.

Rowland, D. A., & Perrett, D. I. (1995). Manipulating facial appearance through shape and colour. *Computer Graphics and Applications, IEEE, 15*(5), 70-76.

Sallmén, M., Sandler, D.P., Hoppin, J.A., Blair, A., & Baird, D.D. (2006). Reduced fertility among overweight and obese men. *Epidemiology, 17(5),* 520-523.

Samuels, C. A., Butterworth, G., Roberts, T., Graupner, L., & Hole, G. (1994). Facial aesthetics: Babies prefer attractiveness to symmetry. *Perception, 23*(7), 823-831.

Santosa, S., & Jensen, M. D. (2008). Why are we shaped differently, and why does it matter? A*merican Journal of Physiology-endocrinology and Metabolism, 295*(3), E531-E535.

Saxton, T., Burriss, R., Murray, A., Rowland, H., & Roberts, S. C. (2009a). Face, body and speech cues independently predict judgments of attractiveness. *Journal of Evolutionary Psychology, 7*(1), 23-35.

Saxton, T.K., Little, A.C., DeBruine, L.M., Jones, B.C., & Roberts, S.C. (2009b). Adolescents' preferences for sexual dimorphism are influenced by relative exposure to male and female faces. *Personality and Individual Differences, 47*(8), 864-868.

Saxton, T., DeBruine, L., Jones, B., Little, A., & Roberts, S. C. (2011). A longitudinal study of adolescents' judgments of the attractiveness of facial symmetry, averageness and sexual dimorphism. *Journal of Evolutionary Psychology, 9*(1), 43-55.

Scheib, J. E., Gangestad, S. W., & Thornhill, R. (1999). Facial attractiveness, symmetry and cues of good genes. *Proceedings of the Royal Society of London B: Biological Sciences, 266*(1431), 1913-1917.

Schramm, W. (1964). *Mass media and national development: The role of information in the developing countries* (No. 25). Stanford University Press.

Scott, I. M., Pound, N., Stephen, I. D., Clark, A. P., & Penton-Voak, I. S. (2010). Does masculinity matter? The contribution of masculine face shape to male attractiveness in humans. *PLoS One, 5*(10), e13585.

Scott, I. M., Clark, A. P., Boothroyd, L. G., & Penton-Voak, I. S. (2012). Do men's faces really signal heritable immunocompetence? *Behavioral Ecology, 92*.

Serrano, J. M., Iglesias, J., & Loeches, A. (1992). Visual discrimination and recognition of facial expressions of anger, fear, and surprise in 4- to 6-month-old infants. *Developmental Psychobiology, 25*(6), 411-425.

Simpson, J. A., & Gangestad, S. W. (1991). Individual differences in sociosexuality: evidence for convergent and discriminant validity. *Journal of personality and social psychology, 60*(6), 870.

Simpson, J. A., Gangestad, S. W., Christensen, P. N., & Leck, K. (1999). Fluctuating asymmetry, sociosexuality, and intrasexual competitive tactics. *Journal of personality and social psychology, 76*(1), 159.

Smith, M. L., Perrett, D. I., Jones, B. C., Cornwell, R. E., Moore, F. R., Feinberg, D. R., Boothroyd, L.G., Durrani, S.J., Stirrat, M.R., Whiten, S. and Pitman, R.M. (2006). Facial appearance is a cue to oestrogen levels in women. *Proceedings of the Royal Society of London B: Biological Sciences, 273*(1583), 135-140.

Smith, F., Jones, B., Little, A., DeBruine, L., Welling, L., Vukovic, J., & Conway, C. (2009). Hormonal contraceptive use and perceptions of trust modulate the effect of relationship context on women's preferences for sexual dimorphism in male face shape. *Journal of Evolutionary Psychology, 7*(3), 195-210.

Stahl, W., Heinrich, U., Jungmann, H., von Laar, J., Schietzel, M., Sies, H., & Tronnier, H. (1998). Increased dermal carotenoid levels assessed by noninvasive reflection spectrophotometry correlate with serum levels in women ingesting Betatene. *The Journal of Nutrition, 128*(5), 903-907.

Stearns, S.C. (1992). *The evolution of life histories* (Vol 249). Oxford: Oxford University Press.

Stephen, I. D., Smith, M. J. L., Stirrat, M. R., & Perrett, D. I. (2009a). Facial skin colouration affects perceived health of human faces. *International Journal of Primatology, 30*(6), 845-857.

Stephen, I. D., Coetzee, V., Law-Smith, M., & Perrett, D. I. (2009b). Skin blood perfusion and oxygenation colour affect perceived human health. *PLoS One, 4*(4), e5083-e5083.

Stewart, D. R., Overstreet, J. W., Nakajima, S. T., & Lasley, B. L. (1993). Enhanced ovarian steroid secretion before implantation in early human pregnancy. *The Journal Of Clinical Endocrinology And Metabolism, 76*(6), 1470-1476.

Sullivan, D.H., Patch, G.A., Walls, R.C., & Lipschitz, D.A. (1990). Impact of nutrition status on morbidity and mortality in a select population of geriatric rehabilitation patients. *The American Journal Of Clinical Nutrition, 51,* 749-758.

Sundie, J. M., Kenrick, D. T., Griskevicius, V., Tybur, J. M., Vohs, K. D., & Beal, D. J. (2011). Peacocks, Porsches, and Thorstein Veblen: Conspicuous consumption as a sexual signaling system. *Journal of Personality and Social Psychology, 100*(4), 664-680.

Surbey, M.K. (1998). Parent and offspring strategies in the transition at adolescence. *Human Nature*, *9*(1), 67-94.

Swaddle, J. P., & Cuthill, I. C. (1995). Asymmetry and human facial attractiveness: symmetry may not always be beautiful. *Proceedings of the Royal Society of London B: Biological Sciences, 261*(1360), 111-116.

Swami, V., & Tovée, M. J. (2005a). Female physical attractiveness in Britain and Malaysia: A cross-cultural study. *Body Image, 2*(2), 115-128.

Swami, V., & Tovée, M. J. (2005b). Male physical attractiveness in Britain and Malaysia: A cross-cultural study. *Body Image*, *2*(4), 383-393.

Swami, V., & Tovée, M.J. (2006). Does hunger influence judgments of female physical attractiveness? *British Journal of Psychology, 97(3),* 353-63.

Swami, V., & Tovée, M. J. (2007). Differences in attractiveness preferences between observers in low-and high-resource environments in Thailand. *Journal of Evolutionary Psychology, 5*(1), 149-160.

Swami, V., Knight, D., Tovée, M. J., Davies, P., & Furnham, A. (2007). Preferences for female body size in Britain and the South Pacific. *Body Image, 4*(2), 219-223.

Swami, V. (2015). Cultural Influences on Body Size Ideals. *European Psychologist*, *20,* 44-51.

Thornhill, R., & Gangestad, S. W. (1994). Human fluctuating asymmetry and sexual behaviour. *Psychological Science, 5*(5), 297-302.

Thornhill, R., & Gangestad, S. W. (1996). The evolution of human sexuality. *Trends in Ecology & Evolution, 11*(2), 98-102.

Thornhill, R., & Møller, A. P. (1997). Developmental stability, disease and medicine. *Biological Reviews of the Cambridge Philosophical Society, 72*(4), 497-548.

Thornhill, R., & Gangestad, S. W. (2006). Facial sexual dimorphism, developmental stability, and susceptibility to disease in men and women. *Evolution and Human Behavior, 27*(2), 131-144.

Tiddeman, B., Burt, M., & Perrett, D. (2001). Prototyping and transforming facial textures for perception research. *Computer Graphics and Applications, IEEE, 21*(5), 42-50.

Tinlin, R. M., Watkins, C. D., Welling, L. L., DeBruine, L. M., Al-Dujaili, E. A., & Jones, B. C. (2013). Perceived facial adiposity conveys information about women's health. *British Journal of Psychology, 104*(2), 235-248.

Tovée, M.J., Swami, V., Furnham, A., Mangalparsad, R. (2006). Changing perceptions of attractiveness as observers are exposed to a different culture. *Evolution and Human Behavior, 27(6),* 443-56.

Udry, J.R. (1979). Age at menarche, at first intercourse, and at first pregnancy. *Journal Of Biosocial Science, 11*(4), 433-441.

United Nations Development Programme. (2014). *2014 Human development statistical tables*. Retrieved from http, //hdr.undp.org/en/data.

Valentine, T., Darling, S., & Donnelly, M. (2004). Why are average faces attractive? The effect of view and averageness on the attractiveness of female faces. *Psychonomic Bulletin & Review, 11*(3), 482-487.

Van Vonderen, K. E., & Kinnally, W. (2012). Media effects on body image: Examining media exposure in the broader context of internal and other social factors. *American Communication Journal*, *14*(2), 41-57.

Vihko, R., & Apter, D. (1984). Endocrine characteristics of adolescent menstrual cycles: impact of early menarche. *Journal of Steroid Biochemistry, 20*(1), 231-236.

Voracek, M., & Fisher, M. L. (2006). Success is all in the measures: androgenousness, curvaceousness, and starring frequencies in adult media actresses. *Archives of Sexual Behavior, 35*(3), 297-304.

Wingard, D. L. (1990). Sex differences and coronary heart disease. A case of comparing apples and pears? *Circulation, 81*(5), 1710-1712.

Wood, W., Kressel, L., Joshi, P. D., & Louie, B. (2014). Meta-analysis of menstrual cycle effects on women's mate preferences. *Emotion Review, 6*, 229–249.

Zahavi, A. (1975). Mate selection-a selection for a handicap. *Journal of Theoretical Biology, 53*(1), 205-214.

Appendix: Ethics forms

University of St Andrews

University Teaching and Research Ethics Committee

1 May 2013

Ethics Reference No: *Please quote this ref on all correspondence*	PS9807
Project Title:	Preferences for Facial Characteristics in El Salvador
Researcher's Name:	Carlota Batres
Supervisor:	Professor David Perrett

Thank you for submitting your application which was considered at the Psychology & Neuroscience School Ethics Committee meeting on the 24th April 2013. The following documents were reviewed:

1.	Ethical Application Form	29/04/2013
2.	Participant Information Sheets (Online and In Person)	29/04/2013
3.	Consent Forms (Online and In Person)	29/04/2013
4.	Debriefing Forms (Online and In Person)	29/04/2013
5.	Questionnaire	29/04/2013

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years. Projects which have not commenced within two years of original approval must be re-submitted to your School Ethics Committee.

You must inform your School Ethics Committee when the research has been completed. If you are unable to complete your research within the three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply.

Any serious adverse events or significant changes which occur in connection with this study, and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' (http://www.st-andrews.ac.uk/media/UTRECguidelines%20Feb%2008.pdf) are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

Ccs Prof. D. Perrett (Supervisor)
School Ethics Committee

University of St Andrews
from first to foremost

600 YEARS
1413 – 2013

Project Title	Preferences for Facial Characteristics in Different Countries
Researchers' Names	Julia Carlota Batres and Mallini Kannan
Supervisor	Professor David Perrett
Department/Unit	School of Psychology & Neuroscience
Ethical Approval Code (Approval allocated to Original Application)	PS9807
Original Application Approval Date	01 May 2013
Amendment Application Approval	20 June 2014

Ethical Amendment Approval

Thank you for submitting your amendment application which was considered at the Psychology & Neuroscience School Ethics Committee meeting on the 18th June 2014. The following documents were reviewed:

1. Ethical Amendment Application Form 20/06/2014
2. Participant Information Sheet (Online and In Person) 20/06/2014
3. Consent Form (Online and In Person) 20/06/2014
4. Debriefing Form (Online and In Person) 20/06/2014
5. Questionnaire 20/06/2014

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years from the original application only. Ethical Amendments do not extend this period but give permission to an amendment to the original approval research proposal only. If you are unable to complete your research within the original 3 three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply. You must inform your School Ethics Committee when the research has been completed.

Any serious adverse events or significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee, and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' (http://www.st-andrews.ac.uk/media/UTRECguidelines%20Feb%2008.pdf) are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

Ccs Prof D Perrett (Supervisor)
School Ethics Committee

University of St Andrews

University Teaching and Research Ethics Committee
Sub-committee

01 November 2013

Ethics Reference No: *Please quote this ref on all correspondence*	PS10512
Project Title:	Perceived traits in faces
Researchers' Names:	Julia Carlota Batres and Karoline Frydenlund
Supervisor:	Professor David Perrett

Thank you for submitting your application which was considered at the Psychology & Neuroscience School Ethics Committee meeting on the 23rd October 2013. The following documents were reviewed:

1. Ethical Application Form 31/10/2013
2. Participant Information Sheet 31/10/2013
3. Consent Form 31/10/2013
4. Debriefing Form 31/10/2013
5. Questionnaire 31/10/2013
6. Data Management Plan 31/10/2013

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years. Projects, which have not commenced within two years of original approval, must be re-submitted to your School Ethics Committee.

You must inform your School Ethics Committee when the research has been completed. If you are unable to complete your research within the 3 three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply.

Any serious adverse events or significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee, and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' https://www.st-andrews.ac.uk/utrec/guidelines/ are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

Ccs Professor D. Perrett (Supervisor)
School Ethics Committee

School of Psychology & Neuroscience, St Mary's Quad, South Street, St Andrews, Fife KY16 9JP
Email: psyethics@st-andrews.ac.uk Tel: 01334 462071

University of St Andrews
from first to foremost

600 YEARS
1413 – 2013

Project Title	Perceived traits in faces
Researchers' Names	Julia Carlota Batres and Karoline Frydenlund
Supervisor	Professor David Perrett
Department/Unit	School of Psychology & Neuroscience
Ethical Approval Code	PS10512
Original Application Approval Date	31 October 2013
Amendment Application Approval	06 December 2013

Ethical Amendment Approval

Thank you for submitting your amendment application which was considered at the Psychology & Neuroscience School Ethics Committee meeting on the 4th December 2013. The following documents were reviewed:

1. Ethical Amendment Application Form 06/12/2013
2. Participant Information Sheet 06/12/2013

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years from the original application only. Ethical Amendments do not extend this period but give permission to an amendment to the original approval research proposal only. If you are unable to complete your research within the original 3 three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply. You must inform your School Ethics Committee when the research has been completed.

Any serious adverse events or significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee, and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' (http://www.st-andrews.ac.uk/media/UTRECguidelines%20Feb%2008.pdf) are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

Ccs Prof D. Perrett (Supervisor)
School Ethics Committee

School of Psychology & Neuroscience, St Mary's Quad, South Street, St Andrews, Fife KY16 9JP
Email: psyethics@st-andrews.ac.uk Tel: 01334 462071

University of St Andrews
from first to foremost

600 YEARS
1413 – 2013

Project Title	Perceived traits in faces
Researcher's Name	Carlota Batres
Supervisor	Professor David Perrett
Department/Unit	School of Psychology & Neuroscience
Ethical Approval Code (Approval allocated to Original Application)	PS10512
Original Application Approval Date	31 October 2013
Amendment Application Approval	19 May 2015

Ethical Amendment Approval

Thank you for submitting your amendment application which was considered at the Psychology & Neuroscience School Ethics Committee meeting on the 19th May 2015. The following documents were reviewed:

1. Ethical Amendment Application Form 19/05/2015
2. Participant Information Sheet 19/05/2015

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years from the original application only. Ethical Amendments do not extend this period but give permission to an amendment to the original approval research proposal only. If you are unable to complete your research within the original 3 three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply. You must inform your School Ethics Committee when the research has been completed.

Any serious adverse events or significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee, and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' (http://www.st-andrews.ac.uk/media/UTRECguidelines%20Feb%2008.pdf) are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

Ccs Professor D Perrett (Supervisor)
School Ethics Committee

School of Psychology & Neuroscience, St Mary's Quad, South Street, St Andrews, Fife KY16 9JP
Email: psyethics@st-andrews.ac.uk Tel: 01334 462071

University of St Andrews

University Teaching and Research Ethics Committee Sub-committee

5 June 2014

Ethics Reference No: *Please quote this ref on all correspondence*	PS11032
Project Title:	Preferences in Different Environments
Researcher's Name:	Julia Carlota Batres
Supervisor:	Professor David Perrett

Thank you for submitting your application which was considered at the Psychology & Neuroscience School Ethics Committee meeting on the 21st May 2014. The following documents were reviewed:

1. Ethical Application Form 30/05/2014
2. Participant Information Sheet 30/05/2014
3. Consent Form 30/05/2014
4. Debriefing Form 30/05/2014
5. Questionnaires 30/05/2014
6. Data Management Plan 30/05/2014

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years. Projects, which have not commenced within two years of original approval, must be re-submitted to your School Ethics Committee.

You must inform your School Ethics Committee when the research has been completed. If you are unable to complete your research within the 3 three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply.

Any serious adverse events or significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee, and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' https://www.st-andrews.ac.uk/utrec/guidelines/ are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

Ccs Professor D. Perrett (Supervisor)
School Ethics Committee

School of Psychology & Neuroscience, St Mary's Quad, South Street, St Andrews, Fife KY16 9JP
Email: psyethics@st-andrews.ac.uk Tel: 01334 462071

University of St Andrews
from first to foremost

600 YEARS
1413 – 2013

Project Title	Preferences in Different Environments
Researcher's Name	Julia Carlota Batres
Supervisor	Professor David Perrett
Department/Unit	School of Psychology & Neuroscience
Ethical Approval Code (Approval allocated to Original Application)	PS11032
Original Application Approval Date	30 May 2014
Amendment Application Approval	15 December 2014

Ethical Amendment Approval

Thank you for submitting your amendment application which was considered at the Psychology & Neuroscience School Ethics Committee meeting on the 18th November 2014. The following documents were reviewed:

1. Ethical Amendment Application Form 15/12/2014
2. External Permissions 15/12/2014
3. Questionnaire 15/12/2014

The University Teaching and Research Ethics Committee (UTREC) approves this study from an ethical point of view. Please note that where approval is given by a School Ethics Committee that committee is part of UTREC and is delegated to act for UTREC.

Approval is given for three years from the original application only. Ethical Amendments do not extend this period but give permission to an amendment to the original approval research proposal only. If you are unable to complete your research within the original 3 three year validation period, you will be required to write to your School Ethics Committee and to UTREC (where approval was given by UTREC) to request an extension or you will need to re-apply. You must inform your School Ethics Committee when the research has been completed.

Any serious adverse events or significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the School Ethics Committee, and an Ethical Amendment Form submitted where appropriate.

Approval is given on the understanding that the 'Guidelines for Ethical Research Practice' (http://www.st-andrews.ac.uk/media/UTRECguidelines%20Feb%2008.pdf) are adhered to.

Yours sincerely

Convenor of the School Ethics Committee

Ccs Prof D. Perrett (Supervisor)
School Ethics Committee

School of Psychology & Neuroscience, St Mary's Quad, South Street, St Andrews, Fife KY16 9JP
Email: psyethics@st-andrews.ac.uk Tel: 01334 462071