Cultural Differences in Mate Preference

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General Abstract

Although there is a large literature on sex differences in human mate preferences, this literature has focused largely on mate preferences in western cultures. In particular, there have been very few studies comparing mate preferences in Eastern and Western cultures. The studies reported in this thesis sought to address this issue. The first empirical chapter (Chapter 2) reports results from a Registered Report that compared sex differences in preferences for physical attractiveness and status in samples of Chinese and UK students. Consistent with previous work, preferences for physical attractiveness were stronger in men than in women and preferences for status were stronger in women than men. This latter sex difference was more pronounced in Chinese than UK participants, however. The second empirical chapter (Chapter 3) reports results from a large-study that attempted to replicate the influential finding that mate-preference sex differences are smaller in countries with greater gender equality. Although robust sex differences in mate preferences were observed, and the magnitude of these sex differences differed among countries, there was little evidence that country-level differences in gender equality predicted the magnitude of mate-preference sex differences. Chapters 2 and 3 used trait-rating and trait-taking tasks to assess mate preferences. By contrast with this approach, the study reported in the final empirical chapter (Chapter 4) compared data-driven models of human face preferences to compare the information Chinese and UK participants used to assess the facial attractiveness of potential mates. This comparison revealed subtle differences in the information used by Chinese and UK participants. Collectively, these findings show evidence for robust sex and cultural differences in human mate preferences. The causes of these cultural differences remain unclear, however.

Table of Contents

List of tables

List of figures

Author's declaration

I, Lingshan Zhang, declare that this thesis is my original work that was carried out under the normal terms of supervision, the work contained herein is my own, except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification.

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Chapter 1: General Introduction

Sexual selection is an important feature of human evolution. People are alive due to successful matching. It is impossible for us to continue to exist if our ancestors failed to mate. Therefore, mate preferences play a special and important role in human evolution. Theoretically, if the goal of sexual reproduction is to keep your offspring safe from harmful gene mutations, picking your sexual partners carefully is one route through which that goal might be achieved.

Mate preferences decide the direction of sexual selection, which influences who will be selected and who will be excluded from the mating pool (Darwin, 1871). Mate preferences allow us to see our own mate value and potential partner's mate value (Buss, 2016). Mate preferences also provide us a chance to explore the evolution of culture (Chang, Wang, Shackelford, & Buss, 2011; Kamble, Shackelford, Pham, & Buss, 2014). Therefore, studying mate preferences can provide key insights into the factors that might drive sexual selection.

1.1 Background to human mating

More than 80% in modern human societies, a mixed system of polygyny and monogamy exists, whereas the majority of marriages are monogamous (Low, 2003; Schacht & Kramer, 2019; Shackelford & Salmon, 2012). Humans are evolved from polygyny to monogamy. As with most monogamous primates, mate abandonment reduces the survival rate of human offspring (Hurtado & Hill, 1996). Some primate data indicate that monogamous mating strategies evolved as a male strategy to increase paternal confidence and father-offspring recognition and that it is an adaptation for the evolution of parental cooperation in raising their children (Chapais, 2011). Other studies suggest that our ancestors evolved from

polygyny to monogamy may because males had less and less resource inequality than they did in the hunting era, causing women attempt to marry monogamously (Kanazawa & Still, 1999). Cartwright (2000) also claimed male preferred mating pattern is “polygyny > monogamy > polyandry”, whereas the preferred female pattern is the opposite: “polyandry > monogamy > polygyny”, and both sexes tend to balance their preference for own fitness and reproductive-maximising strategies, thus, monogamy evolved and retained. Human were then arguably designed for monogamy, so that a long-term mating is indispensable. Consistent with this perspective, humans have neurophysiological systems related to pair bonding and attachment (Hazan & Zeifman, 1999; Young, 2003). Consequently, the monogamous marriage system allowed humans to evolve adaptive strategies for long-term mate selection.

Although most modern society’s mating rule is monogamy, humans easily deviate from perfect monogamous marriage (Puts, 2016) and show evidence of adaptations for limited polygyny. Men in monogamous cultures may have long-term bonds with other women and women may also have long-term affairs (extramarital affair) (Chapais, 2011) or people reproduce with a new spouse after divorce (Puts, 2016). As a result, most studies of human mate preferences have concentrated on mating strategies of monogamous and other “polygyny” or “polyandry” forms.

Physiologically, people’s secondary sexual characteristics are obviously and distinct between males and females, including men’s lower fat hips and buttocks, broader shoulders, bushy eyebrows, hairy body, deep voice, greater upper body musculature (Barber, 1995; Low, Alexander, & Noonan, 1987). Secondary sexual characteristics between the sexes can not only indicate an individual's reproductive ability and immune ability, but also improve their intrasexual competitiveness. For example, the large buttocks and breasts that are attractive to

men possibly demonstrate the low testosterone level and high estrogen level in females, and male's bears, deep voice are more likely to intimidate other men (Barber, 1995; Puts, 2016). Indeed, compared with other species with the canine tooth dimorphism characteristic, humans show moderate secondary sexual characteristics (Mealey, 2000) and moderate sexual dimorphism (Puts, 2016). It indicates males prone to have a modest degree of mating competition. Because the parental care and social monogamy that humans exhibit tend to be found in species with less intense male mating competition. In sum, the different secondary sexual characteristics are the biological fundament of mating psychological mechanisms in evolution.

The evolutionary theories of human mating can be traced back to parental investment theory, and the formation of sexual strategy theory is based on parental investment theory. This thesis will elaborate on these two theories.

1.2 Parental investment theory

Trivers (1972) proposed parental investment is variant across females and males, which means the proportion of energy and time females and males devote to their offspring is notably different. Compared to the sex with more parental devotion, the lesser investing sex is more likely to spend less time on primary partners and, instead, seek to mate with many possible partners to increase their reproductive fitness. The sex difference in parental investment is associated with intrasexual and intersexual competition of sexual selection (Darwin, 1871). Intrasexual competition in terms of human means that individuals compete with members of same sex (Cartwright, 2000). Trivers (1972) assumed that men's reproductive success varies much more than women's, because a woman's reproductive success is relatively invariant and not affected by her desirability as a mate. By contrast, men

cannot reproduce successfully if they are not desirable and fail to attract a mate. Consequently, under this theory, men will compete more among their own sex to mate with women (Intrasexual competition) (Kenrick, Sadalla, Groth, & Trost, 1990).

By contrast with men, women are the sex who invest more in their offspring because they have to experience fertilization, gestation, parturition in order to successfully reproduce. It takes a woman a period of time to breastfeed a child, but a man only needs to contribute one sperm. This difference in investment in offspring is cross-cultural consistent (Low, 1989; Quinn, 1977). Therefore, women are predicted to be choosier for mates than are men. Indeed, as a consequence of having sex, ancestral women risked severe costs (lower reproductive success and lower offspring survive) if they were indiscriminate (Buss, 2016). Intersexual competition is the process whereby individuals attempt to attract the opposite sex as mating partners and maintain those desirable attractive traits even if they has no survival value (Darwin, 1871; Miller, 2000; Symons, 1979). The degree to which men invest in their offspring affects the sexual selection criteria of women, so women's choices play a vital role in evolution of sexual selection (Trivers, 1972).

Parental investment theory is the basic and compelling theory to systematically explain the sex differences in parental investment relating to sex differences in mate preferences. Accordingly, a great deal of evidence had shown sex differences in mate preferences between men and women. For example, consistent with parental investment theory, men are more likely than women to crave short-term, low-cost mating (Schmitt, 2003; Wright & Reise, 1997), have higher pornography consumption (Malamuth, 1996), greater interest in extramarital mating (Wiederman, 1997), prefer to have sex without commitment (Townsend, 1995), greater willingness to have sex with strangers (Clark & Hatfield, 1989), and more

frequent sexual fantasies (Ellis & Symons, 1990) than women do. The discrepancy in parental investment obligation between female and male deeply influences sex difference in mate preference strategies. Thus, women prefer to seek a partner who can provide them with a long-lasting relationship and are willing to provide commitment and investment in offspring. Conversely, because men tend to bear a relatively low cost of parental investment, they prefer multiple short-term partners (Schwarz & Hassebrauck, 2012).

1.3 Sexual Strategies Theory

Buss and Schmitt (1993) proposed sexual strategies theory by extending Trivers' theory. They posited that mating is an inherent drive and hypothesized human mating systems evolved to solve adaptive problem. According to sexual strategies theory, humans have evolved a complex but well-regulated mating strategy. It is typically divided into two contexts, one is long-term mating and the other is short-term mating. Long-term relationships usually reflect the motivation of long-term mating and a great deal of investment of resources in the partner and their offspring. By contrast, short-terms mating is defined as a brief sexual encounter, such as a one-night engagement, casual sex and requires little investment of resources (see also Buss, 2016; Gangestad & Simpson, 2000; Schmitt, 2005).

Crucially, humans adapt with a variety of mating strategies. In other words, humans as a species have a range of mating strategies to choose from (Buss, 2016; Buss & Schmitt, 1993). Based on this reasoning, humans are born with a special ability to adapt to both long-term and short-term mating (Buss & Schmitt, 1993). Not everyone pursues both mating contexts at any one time. In contrast, design characteristics of long-term and short-term mating can be activated differently by external cues (Schmitt, Shackelford, & Buss, 2001). Given the discrepancy in obligated parental investment between men and women, the sexes have

evolved different mating strategies to solve their unique adaptive problems. Hence, sex differences for mate preferences are thought to differ according to short-term and long-term mating contexts (Buss & Schmitt, 1993).

1.3.1 Sex Differences in long-term mating

The adaptability problems that men and women have to solve in long-term relationship are different to some extent. Specifically, our male ancestors must solve the problem of identifying our females with good parenting skills, address the problem of paternity uncertainty, and problem of identifying women with high fertility. However, women ancestors had to deal with the problem of identifying men who possessed resources and were active to invest resources in her or her offspring and the problem of seeking men who are agreeable to and capable of protecting them from attack and injuries to ensure survival. Both women and men also had to solve the problem that seeking the potential mates who are able to make commitment and have good parenting skills in a long-term relationship (Buss & Schmitt, 1993).

Women's reproductive capability dramatically declines with age from menarche until fertility ceases altogether (menopause). By age 46, the possibility women can still birth is zero in hunter-gatherer societies (Hill & Hurtado, 1996). Generally, menopausal women's average age worldwide is around 45 years old (Abdelrahman, Abushaikha, & al-Motlaq, 2014; Sukwatana et al., 1991). Kelly (2013) suggested that the average weaning age for 30 hunter-gatherer groups is 30.9 months and the mean age of final childbearing age for women is 34.9 years. In foraging societies, medical conditions are typically very poor, so pregnant women faced a very high risk of death during parturition. In addition, women average typically release only one egg per month. Thus, successful reproduction is always high cost for

women. These costs include nine months gestation, one year lactation, and the risk of physical impairment or death.

In light of above, Symons (1979) argue that men prefer those women who possess high fertility and can produce as many as offspring as possible. He also argued that the characteristics that indicate women's high fertility are associated with physical attractiveness, such as young age, smooth face, and plump breasts and buttocks. Therefore, men are expected to place more value on potential mate's physical attractiveness and youth (Buss, 1989a; Regan & Berscheid, 1997;Singh, 1993; Symons, 1979 ;Williams, 1975). Analyses of the mate preferences of 1913 adolescents aged 13-18 found that boys put more value on attractiveness than girls (Ha, Overbeek, & Engels, 2010). Todd et al., (2007) even found evidence to support evolutionary prediction that men always focus on women's physical attractiveness in actual mate seeking. By contrast, human male fertility can last a long period and declines quite slowly with age, and they can produce tens of thousands of sperm in a minute. They physically mature more slowly and usually reproduce later than women (Hill & Hurtado, 1996). Thus, female choice is not expected to pay attention as much on male youthful characteristics. Rather, women are hypothesized to place great importance on males' gene quality and other features that are conducive to the survival of their offspring and their own (Buss, 1989a), such as social status, resources, and willingness to invest in mates and their offspring (Pérusse, 1994). Therefore, while men are assumed to always focus on women's physical attractiveness in mate selection, women are expected to pay more attention to the resource possession of potential partners (Alterovitz & Mendelsohn, 2011; Buss & Barnes, 1986; Buunk, Dijkstra, Fetchenhauer, & Kenrick, 2002; Kruger, Fisher, & Jobling, 2003). This sex difference for mate preferences has been observed in lab studies, as well as in speed-dating and other interactive contexts (Li et al., 2013).

Some researchers have raised questions about the extent to which sex differences in mate preferences are culturally consistent. For example, Pillsworth (2008) argued that these sex differences were evident in American participants, but not in the Shuar participants of Ecuador. Lippa (2007) cross-cultural investigation found evidence for robust sex differences in mate preferences for physical attractiveness, but not resources, across cultures. Nonetheless, most studies have observed sex differences in mate preferences across substantial age ranges (Schwarz & Hassebrauck, 2012) and cultural contexts (Buss, 1989a).

Kamble et al., (2014) indicated that Indian males prefer more attractive potential partners than women do, whereas women focus more on men with higher social status. Oda (2001) found that both women and men in Japan placed great emphasis on family commitment but males focussed more on physical appearance of potential mates than women do in long-term relstionships. Nonetheless, there was still some cultural differences for Japanese participants, whereby women paid more attention to physical attractiveness of their spouses than men did (Oda, 2001). Sprecher, Sullivan, & Hatfield (1994) found that American men were more willing to marry women who were good-looking, while American women were more willing to marry men with good earning and good education. Furthermore, Khallad (2005) found that male Jordanian college students put greater emphasis on women's physical appearance and youth, while women focused more on males' economic ability and commitment. Data from African American college students showed that men put more value on potential partner's light skin and prefer to date a light-complexioned person, which are indicators of women physical attractiveness, whereas women prefer to marry men who possess more material wealth than themselves (Murty & Roebuck, 2016; Ross, 1997). Together, these results underline the robustness of sex differences in mate preferences.

Other work has investigated whether sex differences in mate preferences change over time. This work has found that Chinese women pay more attention to their partners' good financial prospects, Chinese men prefer to seek attractive and young women, and that this sex difference has changed little over time (Chang et al., 2010). This sex difference also remained relatively invariant over three decades in Brazil, although women's preferences for good financial prospects had become slightly stronger over time (Souza, Conroy-Beam, & Buss, 2016). Buss et al. (2001) investigated the cultural evolution of mate preferences in American people over a half century (1939-1989) and found that women strikingly express higher desire for mates with financial resources than men do no matter what time period was examined, whereas the magnitude of this sex difference varied.

1.3.2 Sex Differences in short-term mating

As stated by the sexual strategy theory (Buss & Schmitt, 1993), people express highly specialized desires when they pursue a short-term sexual encounter (Gangestad & Simpson, 2000; Schmitt et al., 2001), and desires may represent adaptations to the problems encountered with short-term mating (Buss & Schmitt, 1993). For example, when women seek casual sex, they are often thought to express desires for, and agree to have sex with men who are physically attractive and possess high-quality genes. In other words, these men are characterized by low gene mutation load (Gangestad & Thornhill, 1997a; Rikowski & Grammer, 1999). Given women typically do not obtain long-term investments from short-term sexual partners. Thus, the genetic quality of descendance is considered to be one of the main benefits of short-term mating strategies pursued by women (Cashdan, 1996; Greiling & Buss, 2000). By contrast, men prefer short-term partners with a high sex drive (Hatfield, Sprecher, Pillemer, Greenberger, & Wexler, 1989) or who are sexually available and

accessible (Regan & Berscheid, 1997). Some researchers have suggested that men are more inclined to lower their mating standards for short-term sexual partners than women are (Kenrick, Groth, Trost, & Sadalla, 1993; Regan, 1998) and are more likely to have extramarital affairs (Clark & Hatfield, 1989; Li & Kenrick, 2006). Moreover, men have, on average, significantly more short-term sexual partners than women do (Oliver & Hyde, 1993). Geary, Vigil, & Byrd-Craven (2004) believe man can acquire potential benefits from short-term relationships outweigh the potential costs.

1.4 Strategies of human mating and long-term relationships

When choosing a mate, humans have to assess potential partners' mate values, combine these assessments together according to their own circumstance, and weigh their relative importance. How do people make choices for long-term relationship? What is relatively important? Is this weighting a cross-cultural phenomenon?

Buss and Barnes (1986) argued that the 10 personality traits most valued in mating were being a good life-long mate, "considerate, honest, affectionate, dependable, intelligent, kind, understanding, interesting to talk to, and loyal". Regan et al, (2000) indicated that both sexes placed more value on potential partner's internal attributes/personality, a fundamental among interpersonal relationship (Sprecher & Regan, 2002), such as intelligence and warmth, than they did on external traits, such as wealth. This appeared to be the case for both long-term and short- term relationships. Additionally, dimension reduction identified four universal underlying mate preference dimensions from Buss's (1989a) database: "Love vs. Status/Resources; Dependable/Stable vs. Good Looks/Health; Education/Intelligence vs. Desire for Home/Children; and Sociability vs. Similar Religion" (Shackelford, Schmitt, & Buss, 2005).

To conclude, some characteristics, in short, are kept invariant across time, methodologies, and cultures rated as the most important than others in people's final decision that whether choose or reject a particular partner.

1.4.1 The role of social status

DeWall and Maner, (2008) sought to examine whether attention might be captured quickly by both women and men displaying cues to social status in an eye-tracking study. The results showed that men with high social status can easily 'capture the eye of the beholder'. This finding is in line with the theory that social status is one of the most indispensable attributes in human mating, especially for women's mate choices (Kenrick et al., 1990; Li, Kenrick, Bailey, & Linsenmeier, 2002a). For instance, Japanese males tended to show their financial and social status in their mating advertisement and Japanese females also seek these traits (Oda, 2001). Such patterns appear very stable across cultures (Buss, 1989a). Likewise, Amerindian and modern western society, where men with higher social status entitled more sexual accessed to a large number of women (Betzig, 1986; Macleod, Smith, Metcalfe, & Hart, 2005; von Rueden, Gurven, & Kaplan, 2011) and they generally can acquire more mating partners in real-life mating (Pérusse, 1994).

1.4.2 Physical attractiveness

Physical attractiveness was identified as one of the most noteworthy aspects of mate value for both women and men (Buss, 2005). Studying physical attractiveness may then help us better understand human mating. There is no single definition of attraction, because we have different selection mechanisms and evaluation systems for different environmental stimulus. Why do we like muscles, full lips, smooth skin, young body instead of wrinkled face and

obesity? Why do we find some features attractive and others not? The evolution of preferences is closely related to our interaction with environmental conditions and adaptive mechanisms may form to motivate us to avoid harm and increase fitness for survival and reproduction.

Some evolutionary psychologists have argued that many human body traits advertise a particular aspect of fitness called "developmental stability" (Miller, 2000). Therefore, it was reasonable to suspect that the preference for physical attractiveness was designed to identify individuals with high developmental stability (i.e., the ability to maintain typical development in the face of assaults on the immune system). Consistent with this view, Hönekopp, Rudolph and Beier et al. (2007) found that physical fitness (PF) was positively associated with physical attractiveness and mating success and high levels of adiposity was associated with immunocompetence (Rantala et al., 2013). Some evidence has uncovered some important physical signals associated with health, such as symmetry in faces and bodies (Gangestad & Thornhill, 1997; Jones et al., 2001; Møller & Thornhill, 1998), facial averageness (G. Rhodes, Zebrowitz, et al., 2001) and sexual dimorphism (Anthony C. Little, 2014; G. Rhodes, Chan, Zebrowitz, & Simmons, 2003). Consequently, many researchers have argued that these traits play an important role in physical attractiveness.

In addition, some researchers investigated both sexes participants from Azore Island, Guinea-Bissau, Indobesia and the U.S. found a strong cross-cultural consensus for female body attractiveness that female with low waist-to-hip ratio (WHR) was rated more attractive than high WHR female. They also suggested that women with low WHR reported engaging in more flirting (Singh, 2004). Although, both facial and bodily attractiveness were predictive of overall physical attractiveness, in this thesis, I will concentrate on facial attractiveness,

because the predictive ability of the face is slightly stronger (Mueser, Grau, Sussman, & Rosen, 1984). Meanwhile, face attraction ratings were found to be a better predictor than bodily attractiveness scores for long-term and short-term relationship (Currie & Little, 2009).

1.4.3 Partner age

Buss's (1989a) cross-cultural research showed that men prefer to marry a woman who is much younger than they are, while women prefer their partner to be older than they are (Alterovitz & Mendelsohn, 2011). This is consistent with men's reproductive capacity not decreasing rapidly with age, while women's reproductive capacity declines dramatically with age until menopause when it is zero (Buunk, Dijkstra, Kenrick, & Warntjes, 2001). These age preferences have been shown to be consistent across cultures (Buss, 1989a). For example, they have been observed in Indian (Kamble et al., 2014), Japanese (Oda, 2001), and American (Sprecher et al., 1994) samples. However, adolescent men's ideal dating partner is a few years older than themselves (Kenrick, Keefe, Gabrielidis, & Cornelius, 1996), potentially because copulating with sexually mature women increases the chances of reproducing.

1.4.4 Love and commitment

Evolutionary psychologists often argue that passionate love is innate in humans, based on universal biological processes, and applies to people of all cultures (Karandashev, 2015). Buss et al. (2001) presented evidence that all the samples in their 37 cultures tested rated love as the most important attribute in selecting long-term partners. Therefore, love appears to influence mate choice, long-term romantic relationships, and human survival (Karandashev, 2015). Jin et al. (2015) have examined love is fundamental forms of mate preference, its priming effect was stronger in the both Chinese and Japanese women. Indian and American

samples reported love and loyalty as being more important to them regardless of arrangement or freedom of marriage, whereas American individual place a slightly higher value on love as a precursor to marriage and marriage satisfaction than Indian people did (Myers, Madathil, & Tingle, 2005). However, parental investment theory suggested that men are less choosy than women are and have a stronger desire for sexual activity in relationships. Thus, man may reveal (i.e., confess) their love earlier than women do (Ackerman, Griskevicius, & Li, 2011).

1.4.5 Other personality traits

Russians and Americans rated love, happiness, and kindness as the most important traits in mate choice (Pearce, Chuikova, Ramsey, & Galyautdinova, 2010). Kindness was vital not only in first impressions but also in mating choice (Jonason, Raulston, & Rotolo, 2012; Sutherland et al., 2018) and was more important in long-term relationships than short-term relationships (Li et al., 2002a). Some authors reported that altruism is one 'non-negotiable' (i.e., essential) trait that affects mate choice, with both sexes preferring altruistic partners for long-term relationships (Farrelly, 2013). Wilbur and Campbell (2010) examined women's preference for ambition in terms of different relationship contexts and believed that ambition was an important trait for women seeking a long-term partner. This effect is possibly due to women desiring more traits related to resource acquirement, such as ambition and financial prospects, than men do.

Amador and Charles et al.'s (2005) findings showed that both sexes placed a higher value on dependable and emotionally stable character. Especially for women, dependability was an extremely important attribute in mate choice (Arístegui, Castro Solano, & Buunk, 2018; Lippa, 2007). Buss (2016) found that men and women in all societies preferred people who are reliable, emotionally stable, mature and pleasant. Zhan (2016) investigated cultural and

sex difference for mate preference between two groups, American and Chinese college students. Regardless, American women prioritized emotional stability/maturity and ambitiousness/industriousness more than men did. Chinese people emphasised a desire for a good housekeeper more than American people did, whereas American people placed higher importance on physical attractiveness than Chinese people did. Turkish (White, Pearce, & Khramtsova, 2011), Japanese, Russian, and American (Pearce et al., 2010) students reported that dependability and love were the most important traits when they seek a long-term romantic partner.

Sense of humour was a highly valued trait in many cultures (Buss, 1988; Lippa, 2007) and appeared to be an important characteristic for mate selection and interpersonal attraction. More concretely, individuals with a good sense of humour were rated significantly higher in attractiveness and suitability (McGee & Shevlin, 2009).

1.4.6 Intelligence

Unlike other personality traits, Penke, Denissen and Miller (2007) hypothesized that genetic variation in intelligence results from mutation-selection balance. Consequently, people's preferences for intelligence were more uniform and less variable than preferences for personality traits (Stone, Shackelford, & Buss, 2012). Langlois, Kalakanis and Rubenstein et al. (2000) proposed that attractiveness and intelligence in both sexes can be inherited by their offspring. They reported that attractive women attempt to choose intelligent men because such mates are capable to get more resources.

In addition, a large-scale BBC internet survey of participants from 53 countries found that people ranked intelligence as the most important trait when they choose a partner (Lippa,

2007). Indeed, kindness and intelligence were most important (Buss, 1989a) and necessities to both sexes (Li et al., 2002a). Prokosch and Coss et al. (2009) assessed whether intelligence and creativity predicted men's mating appealing and the result showed that the two traits independently and strongly predicted men's attractiveness in both short-term and long- term relationships. However, they accounted for greater variability in their appeal as a long-term mate than a short-term mate.

Preference for intelligence seems to show a clear sex difference whereby women place more value on intelligence than men do (Furnham, 2009). On the other hand, women's own intelligence may be an important predictor of their own women's mate preferences. Stanik & Ellsworth (2010) reported a negative relationship between women's own SAT verbal test scores (a reliable indicator of intelligence) and their desire for traits in a long-term partner that are associated with that partner's ability of provide financial resources. However, they also reported a positive correlation between women's intelligence and interest in casual sex: as intelligence increased, women's desire for short-term mating also increased.

1.5 The strategies of human mating and short-term relationships

Short-term mating is prevalent and rates of infidelity and extramarital sex remain relatively high in many countries (Wiederman, 1997; Whisman, Gordon, & Chatav, 2007). Serial marriages are also common in numerous cultures (Buss & Schmitt, 1993). Indeed, men in many countries show evidence of adaptations that appear to be designed for short-term mating (Buss & Schmitt, 1993). Such adaptations are consistent with parental investment theory, women would be expected to engage more in long-term relationship because they normally get less return from a casual sexual relationship than men do. However, in modern societies, reliable methods of contraception, such as condoms, morning-after pills, and the

oral contraceptive pill, reduce conception risk and the associated costs for women (Buss, 2003).

Sexual strategies theory emphasises that women also evolved short-term mating strategies. Undeniable, there must be a corresponding that a man has a casual sex with a woman, that woman is having this same behaviour with that man (Buss & Schmitt, 2019). This issue is often overlooked in research working exclusively from parental investment theory. For example, women place more value on physical attractiveness in short-term and extra-pair sex partners than they do in long-term relationships, much like men do (Buss & Schmitt, 1993; Greiling & Buss, 2000; Lucas, Koff, Grossmith, & Migliorini, 2011). This pattern may be more pronounced in countries like the US, where women's mating is unrestricted, than in countries like India, where there are greater restrictions on women's mating (Muggleton & Fincher, 2017).

There are two assumptions that can account for the possible functions of women's short-term mating. These are the good genes and mate switching hypotheses (Buss & Schmitt, 2019; Buss, Goetz, Duntley, Asao, & Conroy-Beam, 2017). The good genes hypothesis suggests that women are inclined to prefer attributes like attractiveness in short-term and extra-pair mates in order to obtain good genes for offspring. By contrast, the mate switching hypothesis suggests that women are more likely to switch men who could offer more benefits than one's current partner through extra-pair mating. Consistent with the mate switching hypothesis, Glass & Wright (1992) investigated married peoples' preferences with anonymous questionnaires, finding that the justifications women give for having affairs are primarily focused on love, rather than sex.

Because the cost of parental investment between men and women is not equal, men are more active in short-term relationship (Buss & Schmitt, 1993). Gray, Garcia, & Gesselman (2019) measured sexuality among 1,522 single American adults and found that men reported more real and ideal frequent sexual behaviour and a more open attitude towards short-term sex, such as one-night stands, than women did. In general, men tend to overestimate women's sexual interests, especially high physical attractive ones (Perilloux, Easton, & Buss, 2012). As a result, men's short-term dating strategies are straightforward, and they tend to look for women who are more physical attractive and sexually open.

Buunk et al. (2002) argued that both sexes place greater emphasis on physical attractiveness when relationship involvement decreases. On one hand, women and men were more likely to favour an attractive/active short-term partner over one who had high warmth/ trustworthiness (Fletcher, Tither, O'Loughlin, Friesen, & Overall, 2004). On the other hand, women were more likely to trade-off their preference for physical attractiveness in long-term relationships (Waynforth, 2001).

1.6 Factors that influence variation in mate preferences

1.6.1 Women's own resources

As mentioned above, women are more likely to place great value on a partner's financial resources rather than physical attractiveness than men are. This may at least partly be moderated by their own social status, however. Women's resource control may be an important predictor of sex differences in mate preference (Moore, Cassidy, Smith, & Perrett, 2006), with women who have high social status showing less desire for high-status partners (Moore & Cassidy, 2007). More specifically, some studies have argued that when women can acquire their own resources to help with raising offspring independently (i.e., women have

financial independence), the preference for partners with resources decreases (Cashdan, 1993).

In order to account for the modulating effect of women's own resources, an alternative explanation had been proposed by Eagly & Wood (1999) to challenge evolutionary sexual selection theory. Social structural theory argues that different social divisions of labour, including family roles and professional roles, lead to gender differences in mate selection. The degree of gender equality in a society was considered by Eagly and Wood (1999) to be the primary factor influencing sexual selection. For example, in a society with high gender equality, women participate more in dominating job place and pay relatively less attention to family, meaning that they may place less emphasis on potential partners' financial ability but more on their ability to take care of family (Wood & Eagly, 2002). Previous research found evidence to support this account and suggested that the sex differences in mate preferences might be becoming larger as a consequence of decreasing gender equality (e.g. Kasser & Sharma, 1999; Moore & Cassidy, 2007; Zentner & Mitura, 2012). Lee and Zietsch (2011) found that women's mate preferences shifted towards good-dad traits, such as 'high earning potential', 'commitment', 'emotionally warm', 'kind' and 'nurturing', when primed with resource scarcity, and good-gene traits when primed with pathogen prevalence.

However, the claimed moderating effect of women's status (i.e., financial resource control) on mate preference is controversial, for instance, a converse effect had been reported that positive relationship shown between female status and preferences for financial resources in a potential partner (Buss, 1989b; Gil-Burmann, Peláez, & Sánchez, 2002). Moreover, Gangestad et al, (2006) provide little support to the negative association between gender equality in access to resources and sex differences in mate preference. They suggested that

pathogen prevalence is a more robust predictor to influence the cultural variation of mate preference sex difference instead of gender equality.

1.6.2 Relationship context

As sexual strategies theory (Buss & Schmitt, 1993) argues, the desired type of relationship sought (often referred to as relationship context) is likely to influence mate preferences. People may tend to use different strategies to choose a potential partner for long-term or short-term relationship. For instance, women emphasised physical attractiveness when seeking a casual dating partner (Li and Kenrick, 2006; Wilbur & Campbell, 2010), but emphasised ability and willingness to provide resources when seeking a long-term partner (Fletcher et al., 2004).

1.6.3 Menstrual cycle

Many researchers have supported that women's hormonal changes in the menstrual cycle can influence women's preferences. Indeed, some studies have found associations between women's hormone levels and their attractiveness perception of a range of different male faces (Jones et al., 2008; Johnston, Hagel, Franklin, Fink, & Grammer, 2001; Gildersleeve, Haselton, & Fales, 2014). Penton-Voak et al. (1999) found that women at high risk of pregnancy showed stronger preferences for masculine faces than did women who were not ovulating. Especially, late in the follicular phase (Penton-Voak & Perrett, 2000), the magnitude of women's attraction to masculine men was enlarged when they seek for a potential short-term partner rather than long-term relationship (Jones, Debruine and Perrett et al., 2008; Little & Jones, 2012). Moreover, Jones et al. (2005a) suggested that women's preferences for male facial femininity was strongest during the phase of the menstrual cycle when progesterone level was high and fertility was low. Essentially, these findings are

consistent with a Dual Mating Strategy hypothesis in which women are more likely to date one short-term partner who display cues of reproductive fitness (e.g., masculine characteristics) when fertile (Penton-Voak, Perrett and Castles et al., 1999; Jones et al., 2005b) but otherwise prefer men displaying cues of pro-sociality (e.g., facial femininity) (Jones et al., 2005a). However, the largest-ever longitudinal study to have been conducted on hormonal regulation of women's preferences for facial masculinity found no compelling evidence that women's preferences for facial masculinity were associated to changes in women's hormonal status (Jones et al., 2018). Marcinkowska, Galbarczyk & Jasienska (2016) also found no significant effect of hormonal status or fertility on women's preferences for either body or facial masculinity. Thus, the potential effects of fertility on mate preferences remain highly controversial (see Jones et al., 2019 for a detailed discussion of these controversies).

Studies have more reliably found that women's sexual desire can be regulated by their menstrual cycle phase (Pillsworth, Haselton, & Buss, 2004). For instance, Jones et al., (2018) found that women's changes in general sexual desire, but not their desire for uncommitted sexual relationships, were correlated with changes in their hormonal status. More specifically, women's sexual desire was negatively related to progesterone and positively related to estradiol. Other work has also reported ovulatory increases sex desire in both extra-pair and in-pair mating (Arslan, Schilling, Gerlach, & Penke, 2018; Shimoda, Campbell, & Barton, 2018) or that estradiol positively predicted change in women's sexual desire and progesterone negatively predicted it (Roney & Simmons, 2013; Roney & Simmons, 2016).

1.6.4 Own attractiveness and mate value

Edlund & Sagarin (2010) presented evidence that people with higher mate value (i.e., people who are more desirable as mates) were more demanding in their partner choice. Buss and Shackelford (2008) also argued that more attractive women were more likely to have higher standards in a long-term mating. Likewise, men who rated their mate value as high appear more selective in their partner choices (Arnocky, 2018). In addition, self-rated attractiveness appears to be correlated with mating strategy. Ha et al. (2009) found that 13-18 years-old boys and girls who had higher mate value were also more likely pursue an attractive partner in their short-term mating. Also, more attractive women reported more interest in and openness to casual sex and more sexual experiences (Perilloux, Cloud, & Buss, 2013). Some studies proposed that women used their self-perceived attraction to adjust their partner preferences in speed-dating (Todd et al., 2007). Women with higher self-rated mate value also show stronger preferences for masculinity (Little & Mannion, 2006) and symmetry (Little, Burt, Penton-Voak, & Perrett, 2001) in male face.

Mate value also predicts men's mate preferences and partner choices. More educated and wealthier men tend to be more selective and tend to choose more attractive and slender women as their potential partner (Fales et al., 2016). Perilloux et al. (2012) used a speed-dating methodology to explore misperceptions of sexual interest and found that men who had more desire for short-term mating or who considered themselves as more attractive were more likely to overestimate sexual interest from women. Burriss, Welling, & Puts (2011) investigated whether men's attractiveness predicts their preferences in women's face and found that more attractive men showed stronger desire for facial femininity in both long-term and short-term mating contexts.

1.6.5 Sex ratio of local population

Sex ratio is defined as ratio of men to women of reproductive-age in a given mating pool (Stone, Shackelford, & Buss, 2007) and appears to alter mating dynamics (Griskevicius et al., 2012). For instance, when women are the minority sex are more selective in their choice of romantic partners (Kenrick, Li, & Butner, 2003). Researchers recruited 9809 participants located on 6 continents and 5 islands to further test the idea that sex ratio alters mate preferences and found that, in societies where men are less numerous, men raise their mating standards for a long-term relationship but decrease their mating standards for short-term mating (Stone, Shackelford & Buss, 2007).

1.6.6 Societal and cultural factors

Mate selection is a complex process that may be deeply influenced by social cultural factors, such as gender equality (Eagly & Wood, 1999), socioeconomic development (Stone, Shackelford, & Buss, 2008), cultural homogeny (Kalmijn, 1994), and social learning (Little, Jones, Debruine, & Caldwell, 2011). For instance, Kalmijn (1994) found that Cultural similarity can help couples to form a common way of lifestyle in marriage, thereby generating social identity, confirmation and affective connection. Moreover, a large amount of evidence has emerged indicating that social learning influences mate preferences through mate choice copying (Jones, DeBruine, Little, Burriss, & Feinberg, 2007; Waynforth, 2007). Additionally, Individuals copy the choices of individual with high status (Little, Jone et al., 2011) and this effect of mate choice copying appears for both men and women for both short-term and long-term relationships (Place et al., 2010). Indeed, images of men labeled as married are more attractive to women than are the same images when labeled single (Eva & Wood, 2006).

1.6.7 Religion

Badahdah and Tiemann (2005) revealed that religiosity was one of the most frequently provided and highly demanded traits by Muslim people in USA, especially female Muslims. The importance of religiosity in mate preferences among Chinese people has also increased between 1990 and 2010, indicating the role of religiosity in mate preferences can change over time (Chang et al., 2011). Schmitt and Fuller (2015) also examined the relationship between personal religiosity and permissive sexuality across 10 major geographic regions and found that higher personal religiosity was associated with lower sexual permissiveness.

1.7 Facial appearance and mate preferences

New born Babies and older show more sustained attention to attractive faces than unattractive ones, suggesting that preferences for attractive faces emerges early in life (Langlois, Ritter, Roggman, & Vaughn, 1991; Langlois et al., 1987; Slater et al., 1998). People with attractive faces also appear to get more social advantages than people with unattractive faces in their daily live (Little, 2014). From an evolutionary perspective, facial attractiveness may be one of the most important traits related to sexual selection (Johnston, 2006; I. Penton-Voak & Perrett, 2000) because it is thought to signal pathogen resistance (Thornhill & Gangestad, 1993; Little, 2014). Human evaluation of facial attractiveness tends to be highly consistent across societies and ethnicities and shows high cross-cultural consistency (Cruz, 2013; Fink & Penton-Voak, 2002; Langlois et al., 2000; Anthony C. Little, 2014). Although Shackelford and Larsen (1999) provided empirical evidence that those who were rated more attractive are physical healthier, Kalick, Zebrowitz, Langlois et al. (1998) found little evidence that this was the case. But what facial characteristics influence attractiveness?

1.7.1 Facial symmetry

Symmetry refers to one half of a face being similar to the other half of the face and has been thought to be an important characteristic of attractive faces (Little, 2014; Little, Jones, & Debruine, 2011; Rhodes, 2006; Thornhill & Gangestad, 1999). Little, Jones and Debruine (2011) argued that fluctuating asymmetry (FA) is one useful measure for developmental stability in that higher FA reflects human who have experienced sub-optimal development and do not possess carry good genes for immunocompetence. Consistent with this perspective, Gangestad, Thornhill and Yeo (1994) found that facial attractiveness was negative related with fluctuating asymmetry and Perrett Burt, Penton-Voak et al., (1999) found that both sexes raters gave higher ratings of attractiveness to faces when symmetry was experimentally increased in face images.

Indeed, symmetry predicts sexual behaviour in many species (Scheib, Gangestad & Thornhill, 1999) with symmetric males often achieving high mating success (Møller & Thornhill, 1998). Men who possess more symmetric bodies attract more potential sexual partners (Gangestad & Thornhill, 1997b; Rhodes, Simmons, & Peters, 2005; Thornhill & Gangestad, 1994) and Shackelford and Larsen (1997) found that facial symmetry was positively correlated with measures of actual health in humans.

Preferences for symmetric faces also show evidence of cross-cultural stability. Apicella, Little, & Marlowe (2007) explored preferences for symmetry in both the Hadza, a hunter-gatherer society in Tanzania, and UK participants. Results suggested that both cultures rated symmetric faces as more attractive than asymmetric faces.

1.7.2 Facial averageness

Facial averageness (i.e., prototypicality or the converse of distinctiveness) refers to how similar a person's face is to that of most other people in the population. Non-average (i.e., highly distinctive) faces have more extreme characteristics than the average face of the population (Little, Jones, Debruine, 2011; Little, 2014). Rubenstein, Kalakanis, & Langlois (1999) found that averageness was correlated with attractiveness (as measured by looking time) even in young infants. 5 year-old children also seem to prefer average faces, although their preferences are weaker than those shown by adults (Rubenstein, Langlois, & Roggman, 2002; Vingilis-Jaremko & Maurer, 2013). People may prefer average individuals due to mechanisms that drive them to mate with individuals who possess high heritable genetic (Gangestad & Simpson, 2000; Lee et al., 2016; Little, Jones, & Debruine, 2011).
Indeed, high-average faces are judged healthier than less average faces (Grammer & Thornhill, 1994; Rhodes et al., 2001; Zebrowitz & Rhodes, 2004).

The majority of works have shown that the preference of averageness occurs across different societies and cultures (Little, 2014; Rhodes, Yoshikawa and Clark et al., 2001). For example, Apicella, Little and Marlowe (2007) investigated the face preferences of the Hadza of Northern Tanzania in Africa and found similar preferences for averageness to those observed in western cultures. Rhodes et al. (2007) also found that averageness was attractive in Chinese and Japanese cultures, supporting the view that averageness preferences may be universal.

1.7.3 Facial sexual dimorphism

Masculinity and femininity are closely related to facial attractiveness (Perrett et al., 1998). During puberty, male and female facial features undergo drastic changes and sexual

dimorphism increases markedly (Fink & Penton-Voak, 2002). These changes in sexual dimorphism are also highly heritable (Lee and Mitchem et al., 2014). Facial masculinity in men is thought to be an indicator of genetic immunity (Folstad & Karter, 1992; Phalane, Tribe, Steel, Cholo, & Coetzee, 2017), although evidence for links between heath and sexual dimorphism is mixed (see Jones et al., 2019).

Some studies have shown that women prefer men with masculine faces (Berry & McArthur, 1985; DeBruine et al., 2006; Johnston et al., 2001; Perrett et al., 1998), while others have shown that femininity is more desirable (Perrett, Lee & Penton-Voak, 1998; Rhodes, Hickford, & Jeffery, 2000; Welling, DeBruine, Little, & Jones, 2009). Marcinkowska et al. (2014) investigated 1979 participants from 28 countries and found that there is no significantly cross-cultural difference in men's preferences for femininity in women's faces.

1.7.4 Beyond sexual dimorphism, symmetry and averageness

Although most research on facial attractiveness has used theory-driven models to investigate the effects of these shape cues on facial attractiveness, work comparing data-driven models highlights the limitations of this approach. For example, both Said and Todorov (2011) and Holzleitner et al. (2019) found that sexual dimorphism, symmetry and averageness explained relatively little of the variance in the attractiveness of faces. By contrast, data-driven models based on component analyses of face shapes were able to explain the majority of the variance in attractiveness. These results suggest that data-driven approaches may have greater utility for understanding the predictors of facial attractiveness than do existing theory-driven models.

1.8 The current studies

As far as we know, the sex difference in mate preference has been found across cultures and times, especially in long-term mating, that women value more resource possessing cues, such as social status and earning capacity, but men prioritize physical attractiveness and youth cues. Thus, physical attractiveness, resource possession, and age have become the measurable objectives of mate preference sex difference in my empirical studies. In sum, the empirical work reported in this thesis explores possible cultural differences and similarities for these key traits in mate preference, with a strong focus on comparisons of East Asian and Western European preferences. In addition, as an important factor to influence mate preference sex difference, the effect of women's own power (i.e., financial resource control) is disputable. My empirical study also aims to address this question.

Specifically, the first empirical chapter (Chapter 2) reports a large-scale study comparing Chinese sample and UK sample's sex differences in preferences for physical attractiveness and social status in long-term and short- term mating. This study also examined cultural differences in age preferences. The second empirical chapter (Chapter 3) reports work investigating the possible role that gender equality plays in cultural differences and in the magnitude of mate-preference sex differences. This study investigated the influential hypothesis that sex differences are smaller in countries that have greater gender equality. These two studies used budget allocation and trait ranking methods to assess mate preferences. By contrast with this approach, the final empirical chapter (Chapter 4) reports the results of a study using a data-driven method to investigate the predictors of Chinese and UK men's and women's judgments of facial attractiveness. Collectively, these studies will provide new insights into the robustness and causes of previously reported cultural agreement

and differences in human mate preferences, with a strong focus on comparisons of East Asian and Western European preferences.

Chapter 2: Chinese and UK participants' preferences for physical attractiveness and social status in potential mates

The following chapter is based on work published in the Royal Society Open Science

Zhang, L., Wang, H., Lee, A. J., DeBruine, L. M., & Jones, B. C. (2019). Chinese and UK participants' preferences for physical attractiveness and social status in potential mates. *Royal Society Open Science*, *6*(11), 181243.

The date of principle acceptance for this work was 16th October 2018. The accepted protocol is archived at https://psyarxiv.com/sybp4/ (version one). Data and analysis code are archived at https://osf.io/rkstx/.

Abstract

Men are hypothesized to show stronger preferences for physical attractiveness in potential mates than women are, particularly when assessing the attractiveness of potential mates for short-term relationships. By contrast, women are thought to show stronger preferences for social status in potential mates than men are, particularly when assessing the attractiveness of potential mates for long-term relationships. These mate-preference sex differences are often claimed to be 'universal' (i.e., stable across cultures). Consequently, we used an established "budget allocation" task to investigate Chinese and UK participants' preferences for physical attractiveness and social status in potential mates. Confirmatory analyses replicated these sex differences in both samples, consistent with the suggestion that they occur in diverse cultures. However, confirmatory analyses also showed that Chinese women had stronger preferences

for social status than UK women did, suggesting cultural differences in the magnitude of mate-preference sex differences can also occur.

2.1 Introduction

Two key factors are thought to drive sex differences in human mate preferences (Buss, 1989a; Symons, 1979; Trivers, 1972). First, because fertility declines faster with age and requires a larger physiological cost for women than men, men are hypothesized to show stronger preferences for physical cues of reproductive capacity (e.g., youth, health, and good nutritional status) in women than women do when assessing the attractiveness of potential mates (Symons, 1979). Second, women bear greater costs of obligatory parental investment (i.e., pregnancy and lactation) than men do, meaning they have both a greater need for resources and reduced ability to obtain resources (Trivers, 1972). Consequently, women are hypothesized to show stronger preferences for cues of capability to invest resources in offspring when assessing men's attractiveness as long-term partners (Buss, 1989a; Symons, 1979; Trivers, 1972). When assessing men's attractiveness as short-term partners, however, resources are thought to be less important and women are hypothesized to prefer men displaying cues that they are in good physical condition and will father healthy children (Gangestad & Simpson, 2000). Consistent with these hypotheses (Buss & Schmitt, 1993) for additional theoretical perspectives, studies have reported that women place greater emphasis on social status (i.e., resources) and men place greater emphasis on physical attractiveness when assessing potential long-term partners, while both men and women place great emphasis on physical attractiveness when assessing potential short-term partners (Li, Valentine, & Patel, 2011).

Because biological universals (i.e., sex differences in age-related decline in fertility and costs of pregnancy and lactation) are thought to underpin the sex differences in mate preferences described above, researchers have hypothesized that they should occur across cultures (Buss, 1989a; Li et al., 2011; Symons, 1979). Indeed, there is good evidence that these mate-preference sex differences do occur in diverse cultures, at least when people express preferences for long-term relationships, such as marriage (Chang, Wang, Shackelford, & Buss, 2011). While evidence for cross-cultural similarity in mate-preference sex differences for long-term relationships is well established, fewer studies have investigated mate-preference sex differences for short-term relationships. Moreover, studies investigating cross-cultural similarity in mate-preference sex differences have typically done so using either trait-rating or -ranking paradigms. These paradigms can be problematic because trait ratings do not require participants to trade off traits against each other and because trait rankings do not contain information about the relative strength of preference for traits (Li, Kenrick, Bailey, & Linsenmeier, 2002b; Li et al., 2011).

Li et al. (2002) developed the budget-allocation task to address the methodological limitations of trait-rating and -ranking paradigms. In the budget-allocation task, participants allocate a sum from a maximum total budget of 100 mate dollars to each of the following traits in a potential partner; physical attractiveness, social status, creativity, kindness, and liveliness. Each participant performs this task twice; once when choosing for a long-term (marriage) partner and once-when choosing for a short-term (casual sex) partner. Importantly, the budget-allocation task directly addresses the limitations of the trait-rating and trait-ranking tasks described above. Note that allocations represent participants' trait priorities, as well as their trait preferences.

To test for the hypothesized cross-cultural similarities in mate-preference sex differences, Li et al. (2011) administered their budget-allocation task to US and Singaporean participants. Men allocated significantly more mate dollars to physical attractiveness than women did in both the US and Singaporean samples. Contrary to theory (Buss, 1989a; Buss & Schmitt, 1993), this sex difference in preference for physical attractiveness was particularly pronounced when participants were choosing for potential short-term partners. By contrast, women allocated significantly more mate dollars to social status than men did in both the US and Singaporean samples. This sex difference in preference for social status was particularly pronounced when participants were choosing for potential long-term partners. Intriguingly, when choosing for potential long-term partners, Singaporean women allocated significantly more mate dollars to social status than US women did. Li et al. (2011) suggested this latter result was consistent with social status being more important for social interactions generally in Eastern than Western cultures (Ting-Toomey, 1994). It is unclear, however, why this cultural difference in preference for social status was only evident in women's preferences.

We tested for further evidence of these cross-cultural similarities and differences in mate-preference sex differences. We used Li et al's (2011) budget allocation task to compare UK and Chinese participants' preferences for physical attractiveness and social status in hypothetical short-term (casual sex) and long-term (marriage) partners.

In the current study, we replicated three key results from Li et al (2011). By contrast with Li et al (2011), who reported these results for US and Singaporean participants, we replicated their key results in UK and Chinese participants.

Prediction 1. Men will allocate significantly more mate dollars to physical attractiveness than women in both the UK and Chinese samples (Prediction 1a) and this sex difference will be significantly more pronounced when choosing for potential short-term partners than long-term partners (Prediction 1b). Note that, although Prediction 1b is what was reported in Li et al. (2011), it is arguably inconsistent with theory (Buss, 1989a; Buss & Schmitt, 1993).

Prediction 2. Women will allocate significantly more mate dollars to social status than men in both the UK and Chinese samples (Prediction 2a) and this sex difference will be significantly more pronounced when choosing for potential long-term partners than short-term partners (Prediction 2b).

Prediction 3. When choosing for potential long-term partners, Chinese women will allocate significantly more mate dollars to social status than UK women will. Note that, although Prediction 3 is what was reported in Li et al. (2011), it is unclear why this cultural difference was not also observed for men.

2.2 Methods

2.2.1 Participants

According to Li et al's (2011) study, we planned to test 125 heterosexual UK men and 125 heterosexual UK women at University of Glasgow and 125 heterosexual Chinese men and 125 heterosexual Chinese women at East China Normal University (Shanghai). Only participants between the ages of 16 and 30 years of age born in either China (Chinese participants) or the UK (UK participants) were recruited. All procedures have been approved by the University of Glasgow, School of Psychology, Ethics Committee. All participants provided informed consent. Other than age, we collected no further demographic information

from participants. Due to miscommunication among the researchers collecting data, we actually tested 132 heterosexual UK men and 127 heterosexual UK women at University of Glasgow and 172 heterosexual Chinese men and 153 heterosexual Chinese women at East China Normal University (Shanghai).

2.2.2 Procedure

Each participant completed Li et al's (2011) budget-allocation task. In this task, participants are instructed to distribute a total budget of 100 mate dollars across each of the following traits to choose a hypothetical partner; physical attractiveness, social status (i.e., good financial resources), creativity, kindness, and liveliness. Each participant performed this task twice; once when choosing for a long-term (marriage) partner and once-when choosing for a short-term (casual sex) partner. The order in which participants chose for long- and short-term partners was fully randomized and trait order was also fully randomized. On-screen instructions informed participants that each dollar corresponds to a percentile point on that trait. Instructions were presented in English for UK participants and Mandarin for Chinese participants. Data for traits other than attractiveness and social status are reported in an exploratory analyses section. These traits were only included in the study because they were included in Li et al. (2011). Figure 2.1 shows a screen grab of the interface that was used for the English-language version of the budget allocation task.

To ensure Mandarin translations accurately capture the nuance of the English terms used in the budget allocation task, we followed the Psychological Science Accelerator's translation procedure (see Translation procedures section, below).

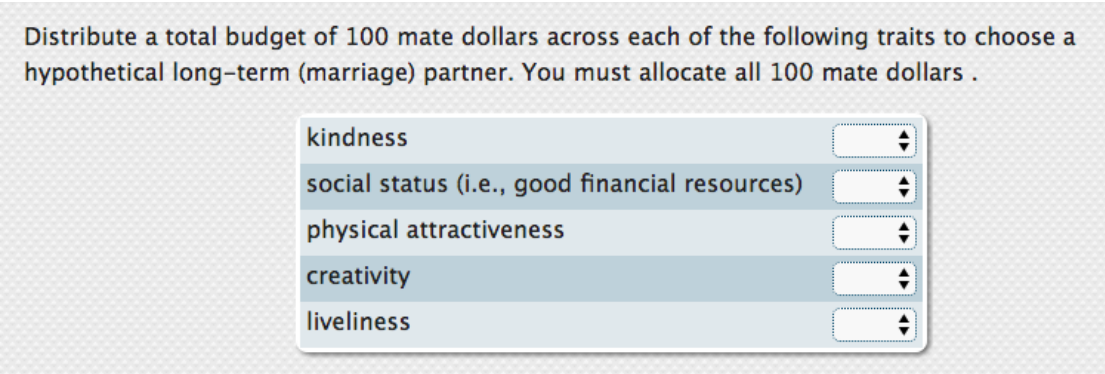

Figure 2.1 Screen grab of interface used for the English-language version of the budget allocation task.

After completing the budget-allocation task, participants were asked to complete a manipulation-check task to ensure they understood what each trait represented (see Data exclusions section, below) and to report the age of their ideal long-term and short-term partner. These age-preference data are used in exploratory analyses testing for cultural and sex differences in age preferences.

2.2.3 Translation procedures

The Psychological Science Accelerator (Chartier, McCarthy, & Urry, 2018; Moshontz et al., 2018) has developed formal procedures for ensuring that instructions translated from one language to another accurately capture the nuance of the terms used in the original instructions (Jones, DeBruine, et al., 2018). This process reflects and extends best practice in translating for cross-cultural research, as described in Brislin (Brislin, 1970).

2.2.3.1 Translation Personnel

Language Coordinator: Coordinated translation process and discussed final version with translators.

"A" Translators: Translated from English to Mandarin and discussed final version with coordinator and B Translators (N=2, both bilingual).

"B" Translators: Translated from Mandarin to English and discussed final version with coordinator and A Translators (N=2, both bilingual).

External Readers: Read materials for final clarity check (N=10, all non-academics).

2.2.3.2 Translation Process

Step 1 (Translation). Original document translated from English to Mandarin by A Translators resulting in document Version A.

Step 2 (Back-translation). Version A translated back from Mandarin to English by B Translators independently resulting in Version B.

Step 3 (Discussion). Version A and B discussed among translators and the language coordinator, discrepancies in Version A and B detected and solutions discussed. Version C created.

Step 4 (External readings). Version C tested on ten non-academics fluent in the target language. Members of the fluent group asked how they perceived and understood the translation and agreed on three synonyms for each trait tested. Possible misunderstandings noted and again discussed as in Step 3. A group of ten native English speakers also asked to agree on three synonyms for each trait to be tested. Note that the Psychological Science Accelerator's procedures for translation use two, rather than ten, bilingual speakers in Step 4.

This process produced the Final Translated Document, containing the instructions used in the study.

2.3 Confirmatory analyses plan

Analysis code (in R) for each analysis is available at https://osf.io/rkstx/ and in our supplemental materials. Only data for physical attractiveness and social status were used in our confirmatory analyses.

Analysis plan for Prediction 1. The amount of mate dollars allocated to physical attractiveness was the dependent variable in these analyses, which included data from both male and female participants. Prediction 1 was tested using separate ANOVAs for Chinese and UK participants' responses. Both ANOVAs had the between-subject factor participant sex (male, female) and the within-subject factor relationship type (marriage, casual sex). Prediction 1a will be supported if there is a significant main effect of participant sex, whereby men allocated significantly more mate dollars to physical attractiveness than did women in both the Chinese and UK participants' data. Prediction 1b will be supported by an interaction between participant sex and relationship type, whereby the effect of participant sex is significant in both the casual sex and marriage conditions, but significantly greater in the casual sex condition than in the marriage condition, in both the Chinese and UK participants' data.

Power analyses (using G*Power 3.1) indicated we would have 90% power to detect effect sizes (f) of 0.15 for the main effect of participant sex (Prediction 1a) and 0.15 for the

interaction between participant sex and relationship type (Prediction 1b), given 125 participants per group and a correlation between the repeated measures of 0.1.

Analysis plan for Prediction 2. The amount of mate dollars allocated to social status was the dependent variable in these analyses, which included data from both male and female participants. Prediction 2 was tested using separate ANOVAs for Chinese and UK participants' responses. Both ANOVAs had the between-subject factor participant sex (male, female) and the within-subject factor relationship type (marriage, casual sex). Prediction 2a will be supported if there is a significant main effect of participant sex, whereby women allocated significantly more mate dollars to social status than did men in both the Chinese and UK participants' data. Prediction 2b will be supported by an interaction between participant sex and relationship type, whereby the effect of participant sex is significant in both the casual sex and marriage conditions, but significantly greater in the marriage condition than in the casual sex condition in both the Chinese and UK participants' data.

Power analyses (using G*Power 3.1) indicated we would have 90% power to detect effect sizes (f) of 0.15 for the main effect of participant sex (Prediction 2a) and 0.15 for the interaction between participant sex and relationship type (Prediction 2b), given 125 participants per group and a correlation between the repeated measures of 0.1.

Analysis plan for Prediction 3. The amount of mate dollars allocated to social status for long-term relationships was the dependent variable in this analysis. This analysis included data from women only. Prediction 3 was tested using an ANOVA with the between-subject factor geographic region (China, UK) and the within-subject factor relationship type (marriage, casual sex). Prediction 3 will be supported if there is a significant main effect of

geographic region, whereby Chinese women allocated significantly more mate dollars to social status than did UK women.

Power analysis (using G*Power 3.1) indicated we had 90% power to detect an effect size (f) of 0.15 for the main effect of geographic region (Prediction 3), given 125 participants per group and a correlation between the repeated measures of 0.1.

2.4 Data exclusions

Responses more than three standard deviations from the mean for that sex and dependent variable were excluded from the dataset prior to analyses. Specifically, we calculated the means and standard deviations for attractiveness and status allocations separately for men and women, then excluded from all analyses any participant who had at least one value more than three standard deviations above or below the sex-specific mean for attractiveness or status allocation. At Step 4 of the translation process, the external speakers were asked to agree on synonyms for each of the traits tested. Participants were asked to match these synonyms to the traits at the end of the study. Participants who failed this manipulation-check task for any trait was excluded from the analyses. No other exclusion criteria were applied.

2.5 Exploratory analyses plan

Data for traits other than attractiveness and social status are reported in an exploratory analyses section. These traits were only included in the study because they were included in Li et al. (2011). Exploratory analyses testing whether women value physical attractiveness more than other traits for short-term, but not long-term, relationships, while men value physical attractiveness more than other traits for both short- and long-term relationships are

also reported in this section, along with exploratory analyses testing for cultural and sex differences in age preferences (Buss & Schmitt, 1993).

2.6 Results of confirmatory analyses

Distributions of the scores used in our confirmatory analyses are shown in Figure 2.2.

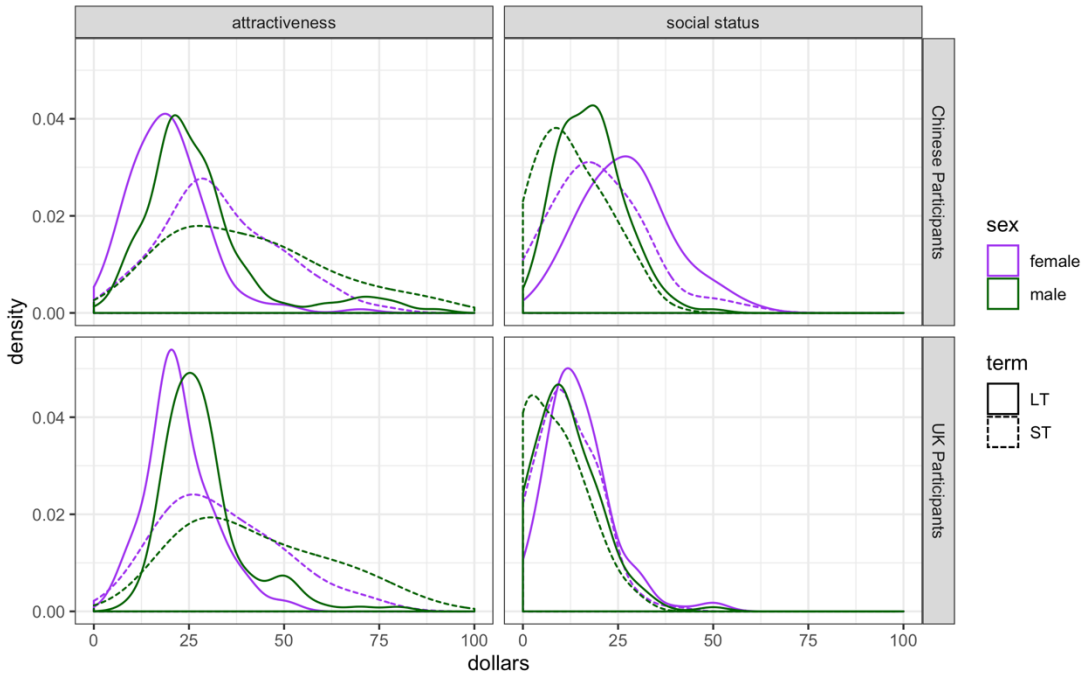

Figure 2.2 Distributions of scores used in our confirmatory analyses.

Results of tests of prediction 1. After data exclusions, 120 Chinese women, 142 Chinese men, 99 UK women, and 113 UK men could be included in the final analyses of physical attractiveness.

Table 2.1 Mean mate dollars allocated to physical attractiveness by group (and SD).

Sample	Long-term		Short-term	
	Male	Female	Male	Female
Chinese	27.63 (15.83)	19.52 (10.23)	40.45 (20.86)	33.26 (15.29)
UK	28.90 (11.21)	22.78 (8.56)	42.50 (18.74)	33.64 (15.17)

In both samples, the main effects of participant sex (Chinese: $F(1,260)=20.28$, $p<.001$; UK: $F(1,210)=21.09$, $p<.001$) and relationship context (Chinese: $F(1,260)=151.54$, $p<.001$; UK: $F(1,210)=137.80$, $p<.001$) were significant. Men allocated more mate dollars to physical attractiveness than women did and people allocated more mate dollars to physical attractiveness for short-term relationships than they did for long-term relationships (see Table 2.1). The interaction was not significant in either sample (Chinese: $F(1,260)=0.18$, $p=.671$; UK: $F(1,210)=1.73$, $p=.189$). These data support Prediction 1a, but not Prediction 1b.

Results of tests of prediction 2. After data exclusions, 144 Chinese women, 151 Chinese men, 118 UK women, and 120 UK men could be included in the final analyses of social status.

Table 2.2 Mean mate dollars allocated to social status by group (and SD).

	Long-term		Short-term	
Sample	Male	Female	Male	Female
Chinese	17.71 (8.49)	27.19 (11.64)	12.85 (9.28)	19.85 (12.16)
UK	11.51 (8.66)	14.65 (8.77)	8.37 (7.90)	11.62 (7.83)

In both samples, the main effects of participant sex (Chinese: $F(1,293)=68.63$, $p<.001$; UK: $F(1,236)=12.01$, $p<.001$) and relationship context (Chinese: $F(1,293)=74.98$, $p<.001$; UK: $F(1,236)=31.11$, $p<.001$) were significant. Women allocated more mate dollars to social status than men did and people allocated more mate dollars to social status for long-term relationships than they did for short-term relationships (see Table 2.2). The interaction was not significant in either sample (Chinese: $F(1,293)=3.10$, $p=.080$; UK: $F(1,236)=0.01$, $p=.923$). These data support Prediction 2a, but not Prediction 2b.

Results of tests of prediction 3. Consistent with Prediction 3, Chinese women allocated significantly more mate dollars to social status for long-term relationships than did UK women ($F(1,260) = 93.52$, $p<.001$).

2.7 Results of exploratory analyses

The same exclusion criteria detailed in the Data Exclusions section were also applied to these exploratory analyses.

First, mate dollars allocated to creativity (Table 2.3), kindness (Table 2.4), and liveliness (Table 5) were analyzed in the same way as the tests for Predictions 1 and 2.

Analyses of creativity (Table 2.3) showed significant effects of relationship context in both samples (Chinese: $F(1,289)=34.73$, $p<.001$; UK: $F(1,235)=42.55$, $p<.001$) and a significant effect of participant sex in the Chinese sample ($F(1,289)=5.08$, $p=.025$), but not the UK sample ($F(1,235)=0.12$, $p=.730$). The interaction was not significant in either sample (Chinese: $F(1,289)=0.00$, $p=.968$; UK: $F(1,235)=0.03$, $p=.852$). People showed stronger preferences for creativity in long-term than short-term partners. Chinese women showed stronger preferences for creativity than did Chinese men.

Table 2.3 Mean mate dollars allocated to creativity by group (and SD).

	Long-term		Short-term	
Sample	Male	Female	Male	Female
Chinese	12.73 (6.59)	14.44 (7.48)	9.83 (7.97)	11.50 (8.52)
UK	14.74 (7.21)	14.97 (8.57)	11.34 (8.05)	11.75 (8.38)

Analyses of kindness (Table 2.4) showed significant effects of relationship context in both samples (Chinese: $F(1,307)=88.48$, $p<.001$; UK: $F(1,229)=90.63$, $p<.001$) and a significant

effect of participant sex in the UK sample ($F(1,229)=19.87$, $p<.001$), but not the Chinese sample ($F(1,307)=1.95$, $p=.164$). The interaction was significant in the UK sample ($F(1,229)=4.36$, $p=.038$), but not the Chinese sample ($F(1,307)=0.04$, $p=.837$). People showed stronger preferences for kindness in long-term than short-term partners. UK women showed stronger preferences for kindness than did UK men.

Table 2.4 Mean mate dollars allocated to kindness by group (and SD).

	Long-term		Short-term	
Sample	Male	Female	Male	Female
Chinese	27.03 (10.90)	25.37 (11.22)	20.35 (11.92)	18.98 (11.23)
UK	27.55 (9.74)	31.46 (10.22)	18.78 (12.29)	25.84 (11.45)

Analyses of liveliness (Table 2.5) showed significant effects of participant sex in both samples (Chinese: $F(1,292)=14.27$, $p<.001$; UK: $F(1,175)=8.62$, $p=.004$) and no significant effect of relationship context in either sample (Chinese: $F(1,292)=1.42$, $p=.234$; UK: $F(1,175)=0.49$, $p=.484$). The interaction was not significant in either sample (Chinese: $F(1,292)=3.79$, $p=.053$; UK: $F(1,175)=0.03$, $p=.858$). Men showed stronger preferences for liveliness than did women.

Table 2.5 Mean mate dollars allocated to liveliness by group (and SD).

	Long-term		Short-term	
Sample	Male	Female	Male	Female
Chinese	17.12 (7.60)	13.08 (7.64)	16.76 (8.23)	14.55 (9.08)
UK	19.53 (6.50)	16.77 (7.11)	20.08 (9.25)	17.09 (7.69)

Next, ideal partner age (adjusted for participant age by subtracting participant age from ideal age, i.e., larger values indicate a stronger preference for older partners) were analyzed using ANOVA. In both samples, the main effects of participant sex (Chinese: $F(1,310)=83.94$,

p<.001; UK: F(1,245)=104.99, p<.001) and relationship context (Chinese: F(1,310)=165.14, p<.001; UK: F(1,245)=27.86, p<.001) were significant. The interaction was significant in the Chinese sample (F(1,310)=5.09, p=.020), but not the UK sample (F(1,245)=0.20, p=.660). These results are summarized in Table 2.6.

Table 2.6 Mean ideal partner age (adjusted for participant age).

	Long-term		Short-term	
Sample	Male	Female	Male	Female
Chinese	1.63	4.57	-0.28	1.84
UK	0.46	2.29	-0.30	1.64

Finally, we tested how men and women valued attractiveness relative to the other traits on the mate dollars task. Data from UK and Chinese samples were combined for these analyses and the results are reported in full in the supplemental materials. ANOVAs suggested that women valued physical attractiveness more than all other traits for short-term, but not long-term, relationships. This pattern occurred because women did not value physical attractiveness more than social status for long-term relationships. Men also valued physical attractiveness more than all other traits for short-term, but not long-term, relationships. This pattern occurred because men did not value physical attractiveness more than kindness for long-term relationships.

2.8 Discussion

We investigated the generality of previously reported effects of participant sex and relationship context on Chinese and UK participants' preferences for physical attractiveness and social status in potential mates. Confirmatory analyses supported our prediction (Prediction 1a) that men in both samples would show stronger preferences for physical attractiveness than women did and our prediction that women in both samples would show

stronger preferences for social status than men did (Prediction 2a). These findings replicate sex differences in preferences for these traits that have been reported in previous research (e.g. Buss, 1989a; Chang et al., 2011; Li et al., 2011). By contrast, we found little evidence for the predictions (Predictions 1b and 2b) that the magnitude of these sex differences are moderated by the relationship context for which partner preferences were expressed. These null results for the interactions between effects of participant sex and relationship context cannot easily be explained by a general failure of our relationship context manipulation, since our confirmatory analyses generally showed the same relatively strong effects of relationship context on preferences for physical attractiveness and social status that have been reported in previous research (Buss, 1989a; Gangestad & Simpson, 2000). On the basis of these findings, we speculate that the interactions between participant sex and relationship context reported in some studies (Li et al., 2011) are potentially not robust. Indeed, prominent theoretical perspectives do not straightforwardly predict such interactions (Buss, 1989a; Buss & Schmitt, 1993).

Li et al. (2011) previously reported that Singaporean women showed stronger preferences for social status in long-term partners than US women did. A confirmatory analysis of women's preferences for social status replicated this pattern in a comparison of Chinese and UK women's partner preferences, supporting the suggestion that this pattern represents a general difference in the extent to which women in Eastern and Western countries value social status in long-term partners (Li et al., 2011).

Exploratory analyses suggested that, for both the Chinese and UK samples, women had stronger preferences for older partners than men did and that people had stronger preferences for older partners for long-term relationships than short-term relationships. These replicate

results of previous studies (Buss & Schmitt, 1993; Gangestad & Simpson, 2000). In other exploratory analyses, we examined how men and women prioritised attractiveness relative to other traits for long- and short-term relationships. Both men and women valued physical attractiveness more than the other traits on the mate dollars task for short-term relationships, but not long-term relationships. Women did not differ significantly in their preferences for social status and physical attractiveness for long-term relationships and men did not differ significantly in their preferences for kindness and physical attractiveness for long-term relationships. The results of these exploratory analyses should be treated cautiously, however, since many of the effects would not survive correction for multiple comparisons and may then be false positives.

Our exploratory analyses of age preferences showed that women had stronger preferences for older mates than did men. This replicates a well-established pattern of results in the mate preferences literature (Buss, 1989a; Buss & Schmitt, 1993). However, the men in our study did (on average) express a preference for mates older than themselves, particularly for long-term relationships. This is a surprising result, since men typically prefer mates younger than themselves (Buss, 1989a; Buss & Schmitt, 1993). Whether or not this is a pattern that replicates in similar samples (e.g., university students) is a question for future research.

In conclusion, our confirmatory analyses present further evidence that sex differences in preferences for physical attractiveness and social status in potential mates occur in a wide range of cultures. This is consistent with the suggestion that they at least partly reflect biological universals, such as sex differences in age-related decline in fertility and costs of pregnancy and lactation (Buss, 1989a; Jonason, Valentine, Li, & Harbeson, 2011; Symons, 1979). However, the difference in the extent to which Chinese and UK women valued social

status in potential mates suggests that factors other than biological universals also influence mate preferences.

Chapter 3: Are sex differences in preferences for physical attractiveness and good earning capacity in potential mates smaller in countries with greater gender equality?

The following chapter is based on work published in Evolutionary Psychology

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All data and code available at https://osf.io/4sr5f/

Abstract

On average, women show stronger preferences for mates with good earning capacity than men do, while men show stronger preferences for physically attractive mates than women do. Studies reporting that sex differences in mate preferences are smaller in countries with greater gender equality have been interpreted as evidence that these sex differences in mate preferences are caused by the different roles society imposes on men and women. Here we attempted to replicate previously reported links between sex differences in mate preferences and country-level measures of gender inequality in a sample of 3073 participants from 36 countries. Although women preferred mates with good earning capacity more than men did and men preferred physically attractive mates more than women did, we found little evidence that these sex differences were smaller in countries with greater gender equality. Although one analysis suggested that the sex difference in preferences for good earning capacity was smaller in countries with greater gender equality, this effect was not significant when controlling for Galton's problem or when correcting for multiple comparisons. Collectively,

these results provide little support for the social roles account of sex differences in mate preferences.

3.1 Introduction

Sex differences in human mate preferences have been widely reported in the literature on human mating strategies. That women tend to show stronger preferences for long-term mates with good earning capacity than men do, while men tend to show stronger preferences for physically attractive mates than women do, is a particularly robust finding (Buss & Schmitt, 2019). Indeed, similar sex-asymmetric trade-offs between physical and socioeconomic characteristics have been reported in actual partner choices. For example, women, but not men, are more likely to tolerate unattractive physical characteristics in a wealthier partner (Chiappori, Oreffice, & Quintana-Domeque, 2012; Oreffice & Quintana-Domeque, 2010). Since sex differences in these aspects of mate preferences have been reported for many different cultures (Buss et al., 1990; Buss & Schmitt, 2019), some researchers have suggested they most likely reflect evolved preferences for the types of mates that will maximize an individual's reproductive fitness (Buss et al., 1990; Buss & Schmitt, 2018; Lippa, 2007).

Social role theory presents an alternative to this evolved preferences explanation for sex differences in preferences for good earning capacity and physical attractiveness (Eagly & Wood, 1999). Under social role theory, these sex differences are hypothesized to reflect the effects of the different social roles imposed on men and women (Eagly & Wood, 1999). Support for this account comes from reanalyses of early work on sex differences in mate preferences (Buss et al., 1990) that suggested sex differences in preferences for good earning capacity and domestic skills (housekeeping and cooking), but not physical attractiveness, were smaller in countries that scored higher on United Nations' measures of gender equality

(Eagly & Wood, 1999). Although these results were partially replicated by Zentner & Mitura, (2012) and Kasser & Sharma (1999), Gangestad et al. (2006) suggested Eagly and Wood's (1999) findings for gender inequality were an artifact of 'Galton's problem' (i.e., autocorrelation across geographically close regions).

Given the controversy around the claim that sex differences in mate preferences co-vary with country-level differences in gender equality, we sought to replicate Eagly and Wood's (1999) results in a new dataset. By contrast with Eagly and Wood (1999), who used aggregated data to calculate sex-difference scores at the country level, we used multilevel models to analyze the mate preferences for individual participants (Pollet et al., 2014 and Lee et al., 2018) for detailed discussion of why the latter approach is preferable because it takes into account variability in preferences within each country.

3.2 Method

3.2.1 Mate-preference tasks

Participants completed the trait-rating mate-preference task and/or the trait-ranking mate-preference task originally used by Buss et al. (1990) and reanalyzed in Eagly and Wood (1999). Five hundred and thirteen participants completed only the trait-ranking mate-preference task, 93 participants completed only the trait-rating mate-preference task, with the remainder (N = 2654) completing both the trait-rating mate-preference and trait-ranking mate-preference task. For participants who completed both tasks, task order was fully randomized.

In the trait-rating mate-preference task, participants were asked to rate the following attributes for how important they are when choosing a romantic partner using a 4-point scale (3 = indispensable; 2 = important, but not indispensable; 1 = desirable, but not very

important; 0 = irrelevant or unimportant): good cook and housekeeper; pleasing disposition; sociability; similar educational background; refinement, neatness; good financial prospects; chastity (no previous experience in sexual intercourse); dependable character; emotional stability and maturity; desire for home and children; favorable social status or rating; good looks; similar religious background; ambition and industriousness; similar political background; mutual attraction – love; good health; education & intelligence. The order in which traits were presented for rating was fully randomized.

In the trait-ranking mate-preference task, participants were asked to rank the following traits on their desirability in someone you might marry (1 = most desirable trait, 13 = least desirable trait): kind and understanding; religious; exciting personality; creative and artistic; good housekeeper; intelligent; good earning capacity; wants children; easy-going; good heredity; college graduate; physically attractive; healthy. The initial order in which the traits were presented for ranking was fully randomized. Trait-rankings were reverse scored so that higher scores for a given trait indicated stronger preferences.

Following Eagly and Wood (1999), we only analyzed preferences for good earning capacity, physical attractiveness, and domestic skills. For the trait-rating task, these traits were operationalized as ratings for ‘good financial prospects’, ‘physically attractive’, and ‘good cook and housekeeper’, respectively (following Eagly & Wood, 1999). For the trait-ranking task, these traits were operationalized as rankings for ‘good earning capacity’, ‘good looking’, and ‘good housekeeper’, respectively (also following Eagly & Wood, 1999). For the trait-rating task, 35 participants did not rate all three traits, and were therefore removed from the dataset prior to analyses.

3.2.2 Gender equality measures

Participants took part in the study between 2011 and 2018. Gender equality for each country was estimated using the United Nations' Gender Inequality Index (GII) and Gender Development Index (GDI). The GII measures gender inequalities in reproductive health (maternal mortality ratio and adolescent birth rates), empowerment (proportion of parliamentary seats occupied by females and proportion of adult females over 25 years old with some secondary education), and economic status (labour market and force participation rate of female and male populations over 15 years old). The GDI measures gender differences in development of health, knowledge, and living standards using the same component indicators as the Human Development Index (HDI). These measures were chosen because of their similarity to the Gender Empowerment Measure and Gender-related Development Index used in Eagly and Wood (1999) and because Eagly and Wood's social roles theory emphasizes the importance of the combined effects of gender inequality in economic, political, and decision-making roles. GII and GDI data were retrieved from http://hdr.undp.org/en/data. Lower scores on the GII and higher scores on the GDI indicate greater equality. For each participant, the GII and GDI scores used were matched to the year in which they participated. Because GII and GDI scores were not available for 2018, we used 2017 values for participants tested in 2018.

3.3 Analysis

Analyses were carried out using R version 3.4.0. Preferences for good earning capacity, physical attractiveness, and domestic skills were analyzed in separate mixed-effect models, as were preferences assessed using the trait-rating and trait-ranking tests. Analyses used linear mixed models with random effects of country and region, participant age and participant sex as predictors, and random slopes specified maximally (see Barr, Levy, Scheepers, & Tily, 2013). Participant age was standardized at the participant-level and both Gender Inequality

Index (GII) and Gender Development Index (GDI) were standardized at the country-level prior to analyses. Participant sex was effect coded (female participants=-.5, male participants=.5). Following previous research on differences in behavior among countries (e.g., Lee et al., 2018), only responses from countries for which we had more than 9 participants were analyzed. This left us with a sample of 2986 participants from 36 countries for the ranking task, and 2524 participants from 30 countries for the rating data.

Following other recent work on differences in behavior among countries (Bulley & Pepper, 2017; Lee et al., 2018), we controlled for autocorrelation across geographically close regions (i.e., Galton's problem) in follow-up analyses by including the United Nation's geographic region classification in our models (in addition to country). All data (including trait ratings and rankings not analyzed here), analysis code, and the full specifications for each model are publicly available at https://osf.io/4sr5f/.

3.4 Results

We first tested for overall sex differences in preferences for good earning capacity, physical attractiveness, and domestic skills. Figure 1 summarizes men's and women's preferences for good earning capacity, physical attractiveness, and domestic skills in potential mates as assessed by responses on the trait-rating and trait-ranking tasks. Tables 3.1 and 3.2 show descriptive statistics for each country. Women showed stronger preferences for good earning capacity than men did for both ratings (estimate = -0.55, t = -11.16, $p < .001$) and rankings (estimate = -1.63, t = -5.96, p = .024). Men showed stronger preferences for physical attractiveness than women did for both ratings (estimate = 0.42, t = 9.25, p = .003) and rankings (estimate = 1.38, t = 7.90, p = .001). There were no significant effects of participant sex on the desirability of domestic skills in a potential mate for either ratings (estimate =

0.02, t = 0.52, p = .63) or rankings (estimate = 0.22, t =1.40, p = .26). Full results for each of these models are given at https://osf.io/4sr5f/.

Table 3.1 Descriptive statistics for each country and trait-ranking data. Numbers in parentheses are SD. (Continued)

Country	Gender equality		Participants number		Physical Attractiveness		Good Earning Capacity		Domestic skill	
	GII	GDI	Female	Male	Female	Male	Female	Male	Female	Male
Sweden	0.0508333	0.9946667	13	11	8.62 (2.47)	10.18 (3.09)	4.15 (1.86)	3.73 (2.33)	4.73 (2.65)	4.38 (2.22)
Denmark	0.0525	0.98075	11	6	8.36 (2.69)	9.17 (3.76)	4.73 (2.72)	4.17 (2.86)	5.67 (1.97)	4.18 (1.89)
Netherlands	0.05875	0.9635	11	16	8.91 (2.12)	9.81 (3.75)	5.36 (2.91)	3.88 (2.03)	4.19 (2.29)	4.18 (1.99)
Switzerland	0.0588333	0.9795	8	3	7.75 (2.71)	11.67 (1.53)	7.12 (3.09)	5.33 (2.08)	5 (3.61)	4.12 (1.73)
Norway	0.0675	0.9916667	13	4	8.31 (2.39)	9.5 (2.38)	4.62 (2.81)	5 (1.41)	7 (2.58)	5 (2.42)
Finland	0.0696667	1.0014167	12	5	10.08 (2.02)	10.8 (1.92)	4.83 (1.34)	3.2 (1.3)	6.4 (2.07)	5.92 (3.06)
Belgium	0.07725	0.9700833	9	5	7.89 (2.62)	10.8 (2.28)	6.22 (3.73)	5.4 (2.19)	4.8 (3.03)	4 (1.5)
Germany	0.09175	0.96125	36	23	8.56 (3.22)	10.13 (1.91)	5.25 (2.58)	4.48 (3.67)	4.3 (2.29)	4.72 (2.77)
Spain	0.0994167	0.976	8	10	9.25 (3.01)	9.5 (3.31)	5.25 (2.82)	5.7 (3.3)	5.4 (2.95)	5.62 (2.26)
Austria	0.1019167	0.9594167	9	2	10 (2.06)	10.5 (0.71)	4.67 (1.94)	5.5 (2.12)	4.5 (0.71)	5.22 (2.59)
Canada	0.1136364	0.9826667	171	41	8.44 (2.66)	10.02 (2.39)	6.19 (3.06)	4.39 (1.73)	5.24 (2.64)	4.42 (2.31)
Italy	0.1199167	0.9646667	20	11	10.1 (2.31)	10.82 (2.96)	5.5 (2.52)	5.64 (2.42)	4.55 (2.02)	4.7 (1.63)
France	0.1253333	0.9874167	29	25	9.21 (2.91)	9.68 (2.46)	5.76 (3.32)	5.12 (2.45)	5 (2.33)	5.48 (3.3)
Australia	0.1298333	0.9710833	43	17	9.28 (3.33)	10.41 (2.79)	5.81 (2.79)	4.35 (2.09)	4.29 (1.93)	4.58 (2.61)
Portugal	0.1319167	0.9850833	8	3	8.62 (2.33)	13 (0)	6.62 (3.85)	5.67 (1.53)	6 (2)	3.12 (2.9)
Ireland	0.1484167	0.9769167	26	10	8.96 (2.54)	9.4 (4.27)	5.27 (2.24)	4.7 (3.68)	5.2 (2.44)	4.42 (2.32)
Greece	0.1528333	0.9591667	6	4	8.5 (2.59)	7.25 (4.5)	4.5 (1.64)	7.75 (5.12)	5.75 (1.89)	3.5 (1.05)
Croatia	0.15325	0.9833333	5	5	8 (2)	8.4 (4.88)	5.2 (2.39)	4.4 (3.36)	5.6 (1.52)	4.2 (1.3)
The former Yugoslav Republic of Macedonia	0.15325	0.9158	7	3	9 (2.52)	8 (6.24)	7.71 (2.87)	7.33 (4.16)	6.33 (3.06)	5.86 (4.18)
Poland	0.1605833	1.00275	13	9	8.69 (2.87)	10.33 (1.87)	7.31 (1.93)	3.22 (2.11)	3.44 (2.07)	5.62 (3.45)
United Kingdom	0.1616667	0.96175	218	87	8.96 (2.57)	9.87 (2.94)	5.7 (2.48)	4.55 (2.84)	5 (2.87)	4.28 (2.45)
New Zealand	0.1670833	0.9665	21	5	8.14 (3.17)	10.2 (2.68)	5.76 (2.64)	5.4 (3.05)	3.6 (0.55)	3.9 (1.97)
Lithuania	0.1678333	1.0275	9	3	10 (2.6)	7.33 (1.15)	5.67 (2.24)	5.33 (2.08)	4.33 (0.58)	4.22 (2.86)

Country	Gender equality		Participants number		Physical Attractiveness		Good Earning Capacity		Domestic skill	
	GII	GDI	Female	Male	Female	Male	Female	Male	Female	Male
United States	0.2256364	0.9923333	1323	418	8.27 (2.92)	9.77 (2.66)	6.06 (2.91)	4.35 (2.8)	4.58 (2.54)	4 (2.55)
Russian Federation	0.3155833	1.0240909	11	7	7.45 (3.14)	11 (2.24)	8 (4.12)	4.29 (2.75)	5 (2.16)	6.18 (3.84)
Romania	0.3521818	0.9805	11	8	8.91 (3.05)	10.5 (2)	6.91 (3.02)	4 (3.3)	5.25 (3.2)	3.64 (1.69)
Chile	0.366	0.952	7	3	8.14 (2.91)	9 (5.2)	6.14 (2.12)	7 (5.2)	6.33 (4.51)	5.29 (3.15)
Argentina	0.3742727	0.9950833	9	6	9.22 (3.7)	10.17 (1.94)	6.67 (3.57)	2.83 (1.17)	3.67 (1.37)	5.89 (2.37)
Mexico	0.3904167	0.9434167	28	15	7.64 (3.34)	11 (2.2)	5.64 (2.74)	4.93 (3.24)	4.6 (2.23)	4.82 (3.04)
South Africa	0.4070833	0.979	7	6	7.57 (4.47)	9.83 (2.79)	6.29 (3.2)	3.83 (1.72)	4.33 (3.44)	4.29 (2.56)
Turkey	0.4085	0.8985	7	8	8.71 (3.5)	10.12 (3.83)	6 (1.83)	4.5 (3.07)	4 (1.31)	5.71 (4.46)
Brazil	0.4438333	1.0019091	16	14	9 (3.14)	8.43 (3.5)	5.62 (2.85)	6.21 (2.26)	5.93 (3.36)	6.06 (3.73)
Philippines	0.4460833	0.988	11	2	5.73 (3.58)	10 (1.41)	8 (4.15)	4.5 (2.12)	2.5 (2.12)	4.64 (3.17)
Indonesia	0.49125	0.92	7	3	8.86 (3.13)	12.33 (0.58)	6.86 (2.27)	5 (2.65)	4 (2.65)	4.29 (3.4)
Iran (Islamic Republic of)	0.5250833	0.8488333	2	8	6.5 (2.12)	7 (3.46)	3.5 (0.71)	4 (3.78)	4.88 (2.7)	7 (5.66)
India	0.5669091	0.80425	8	27	7.75 (2.96)	10.41 (2.89)	7.38 (3.93)	3.56 (2.42)	5.89 (2.93)	5 (2.51)

Table 3.2 Descriptive statistics for each country and trait-*rating* data. Numbers in parentheses are SD. (Continued)

Country	Gender equality		Participants number		Physical Attractiveness		Good Earning Capacity		Domestic skill	
	GII	GDI	Female	Male	Female	Male	Female	Male	Female	Male
Sweden	0.0508333	0.9946667	12	7	1.75 (0.62)	2.43 (0.53)	1.25 (0.75)	0.43 (0.53)	1.08 (0.79)	0.71 (0.76)
Denmark	0.0525	0.98075	10	4	1.5 (0.85)	2.25 (0.5)	1.3 (1.06)	1.25 (0.96)	1.1 (0.99)	1 (0.82)
Netherlands	0.05875	0.9635	12	9	1.83 (0.72)	2 (0.71)	1.17 (0.58)	0.89 (0.33)	1.08 (0.67)	1.22 (1.09)
Switzerland	0.0588333	0.9795	8	2	1.25 (0.46)	2 (1.41)	1.25 (0.89)	1.5 (2.12)	1 (0.93)	1.5 (2.12)
Norway	0.0675	0.9916667	11	4	1.91 (0.94)	2.5 (0.58)	1.18 (0.87)	1 (0.82)	1.09 (0.83)	1 (0.82)
Finland	0.0696667	1.0014167	10	4	1.6 (0.52)	2 (0.82)	0.9 (0.74)	1.5 (0.58)	1.4 (0.7)	1.75 (0.96)
Belgium	0.07725	0.9700833	6	4	2 (0.63)	2 (0)	1.5 (1.05)	0.75 (0.96)	1.17 (0.75)	1 (0.82)
Germany	0.09175	0.96125	31	15	1.71 (0.82)	2.33 (0.49)	1.23 (0.8)	0.93 (0.7)	1 (0.73)	0.73 (0.59)
Spain	0.0994167	0.976	6	7	1.67 (0.82)	2.29 (0.49)	1.33 (0.52)	0.71 (0.49)	1.33 (0.52)	1.57 (0.79)
Austria	0.1019167	0.9594167	9	2	1.89 (0.6)	1 (1.41)	1 (0.71)	1.5 (0.71)	1.67 (0.87)	2 (0)
Canada	0.1136364	0.9826667	149	33	1.82 (0.71)	2 (0.71)	1.59 (0.83)	0.94 (0.61)	1.26 (0.69)	1.3 (0.73)

Country	Gender equality		Participants number		Physical Attractiveness		Good Earning Capacity		Domestic skill	
	GII	GDI	Female	Male	Female	Male	Female	Male	Female	Male
Italy	0.1199167	0.9646667	18	7	2.06 (0.8)	2.29 (0.49)	1.22 (0.81)	0.86 (0.9)	0.89 (0.58)	1.14 (0.9)
France	0.1253333	0.9874167	23	19	1.87 (0.76)	2.16 (0.5)	1.52 (0.9)	1.11 (0.66)	1.17 (0.83)	0.95 (0.62)
Australia	0.1298333	0.9710833	42	12	1.79 (0.84)	2.25 (0.45)	1.6 (0.7)	0.83 (0.58)	1.26 (0.77)	1 (0.43)
Ireland	0.1484167	0.9769167	23	8	1.65 (0.71)	2 (0.76)	1.3 (0.76)	0.75 (0.71)	0.96 (0.56)	1 (0.76)
The former Yugoslav Republic of Macedonia	0.15325	0.9158	7	3	1.86 (0.9)	2.33 (0.58)	1.71 (0.95)	1 (1)	0.71 (0.49)	1.33 (0.58)
Poland	0.1605833	1.00275	11	7	1.82 (0.98)	1.86 (0.69)	1.45 (0.52)	0.43 (0.53)	1.09 (0.7)	0.57 (0.79)
United Kingdom	0.1616667	0.96175	201	76	1.7 (0.65)	2.22 (0.6)	1.48 (0.74)	0.95 (0.8)	1.08 (0.68)	1.2 (0.75)
New Zealand	0.1670833	0.9665	19	2	1.68 (0.82)	2 (0)	1.05 (0.78)	1 (0)	1.05 (0.71)	1.5 (0.71)
Lithuania	0.1678333	1.0275	7	3	2 (0.82)	2.67 (0.58)	1.29 (0.49)	1.33 (1.15)	1.29 (0.76)	1.67 (0.58)
United States	0.2256364	0.9923333	1142	364	1.78 (0.68)	2.14 (0.68)	1.69 (0.74)	1.14 (0.79)	1.13 (0.69)	1.18 (0.77)
Russian Federation	0.3155833	1.0240909	9	7	1.67 (0.71)	2.43 (0.98)	1.33 (0.87)	0.43 (0.79)	1 (1)	1.14 (0.9)
Romania	0.3521818	0.9805	11	7	1.82 (0.98)	2 (0.58)	1.36 (0.92)	1.14 (1.21)	0.73 (0.79)	1.43 (1.13)
Argentina	0.3742727	0.9950833	5	6	1.8 (0.45)	2.17 (0.75)	2.6 (0.55)	1.33 (0.82)	1.6 (0.89)	1 (0.89)
Mexico	0.3904167	0.9434167	24	13	1.58 (0.83)	2.15 (0.8)	1.67 (0.7)	1 (0.82)	1.08 (0.88)	1.15 (0.69)
South Africa	0.4070833	0.979	7	5	1.86 (0.9)	2.2 (0.84)	2 (0.82)	1.6 (0.55)	1 (0.82)	1.6 (0.55)
Turkey	0.4085	0.8985	7	7	2 (0.82)	2.29 (0.76)	1.14 (0.9)	0.86 (0.69)	1 (0.82)	1 (0.58)
Brazil	0.4438333	1.0019091	16	12	1.5 (0.63)	2.25 (0.75)	1.69 (1.08)	1.17 (0.58)	0.88 (0.62)	1 (0.95)
Philippines	0.4460833	0.988	8	2	1.5 (0.76)	2 (0)	1.75 (0.46)	1.5 (0.71)	1.5 (0.76)	1.5 (0.71)
India	0.5669091	0.80425	6	23	1.67 (0.82)	2.26 (0.75)	1.67 (0.82)	0.96 (0.77)	1.33 (0.52)	1.35 (0.93)

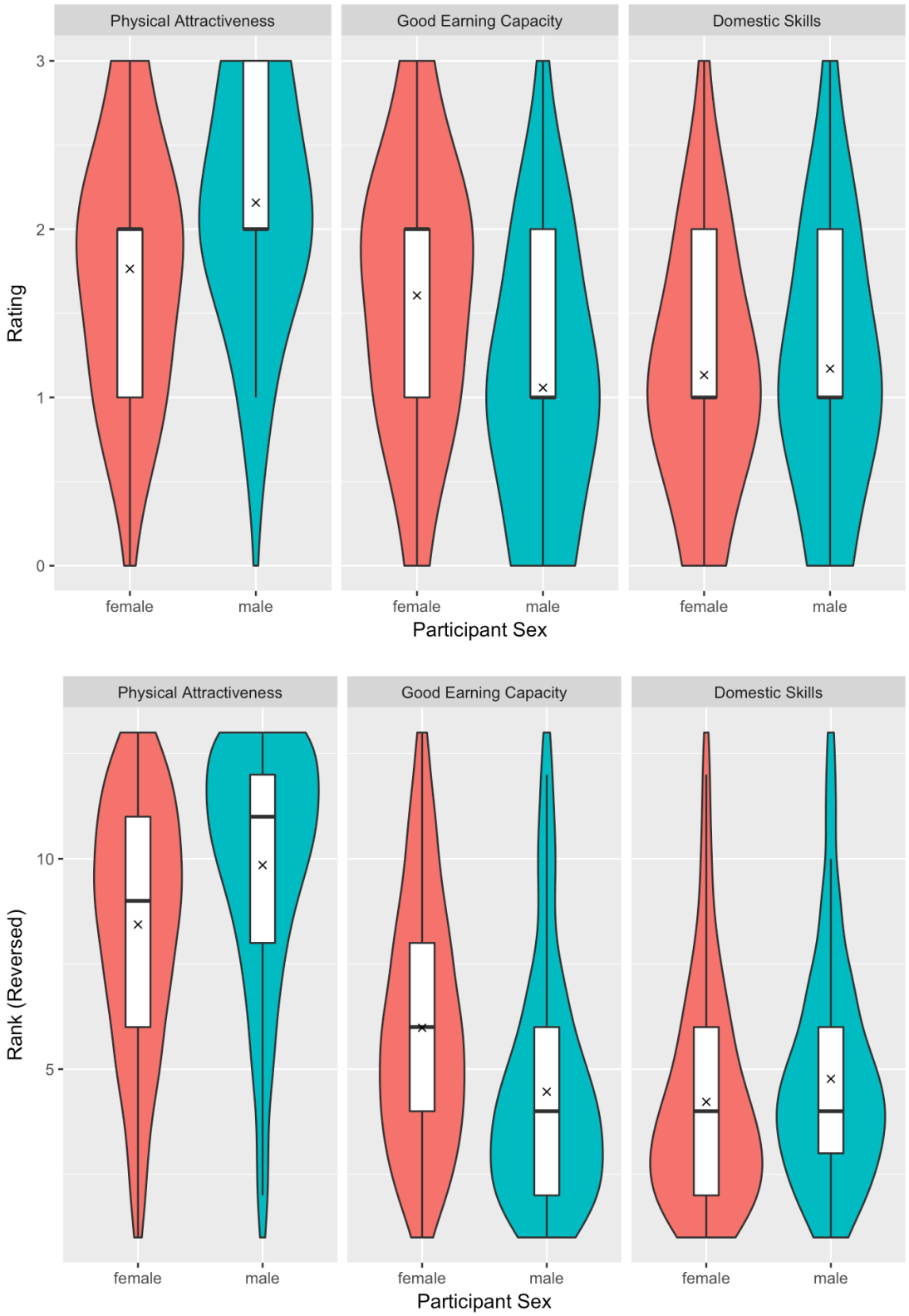

Figure 3.1 Violin plots showing men's and women's preferences for good earning capacity, physical attractiveness, and domestic skills in potential mates as assessed by responses on the trait-rating (top row) and trait-ranking (bottom row) tasks. Rankings have been reverse scored

so that higher scores on both tasks indicate stronger preferences. The thick horizontal bar indicates the median and x indicates the mean.

We repeated each of the models described above, this time including either Gender Inequality Index (GII) or Gender Development Index (GDI) as additional predictors, along with their two-way interactions with participant sex and participant age. Of the twelve models testing for possible effects of gender inequality, none showed a significant (i.e., $p<.05$) interaction between gender equality and participant sex (all absolute estimates < 0.65, all absolute ts < 2.10, all $p > .051$). Full results for each of these models are given at https://osf.io/4sr5f/. Results of tests for the critical interactions between the effects of gender equality and participant sex are summarized in Table 3.3. Graphs showing each of these interactions are shown in Figure 3.2.

Table 3.3 Results of tests for interactions between the effects of gender equality and participant sex in analyses controlling for Galton's problem. GII refers to the Gender Inequality Index and GDI refers to the Gender Development Index.

trait	gender	task type	estimate	t	p
physical attractiveness	GII	rating	0.13	1.67	.10
physical attractiveness	GII	ranking	0.48	1.90	.06
physical attractiveness	GDI	rating	-0.09	-0.82	.41
physical attractiveness	GDI	ranking	-0.25	-0.60	.55
good earning capacity	GII	rating	-0.11	-1.33	.19
good earning capacity	GII	ranking	-0.64	-2.09	.06
good earning capacity	GDI	rating	0.04	0.31	.76
good earning capacity	GDI	ranking	0.24	0.56	.58
domestic skills	GII	rating	0.14	1.73	.09
domestic skills	GII	ranking	0.08	0.35	.73
domestic skills	GDI	rating	-0.05	-0.36	.73
domestic skills	GDI	ranking	-0.27	-0.68	.50

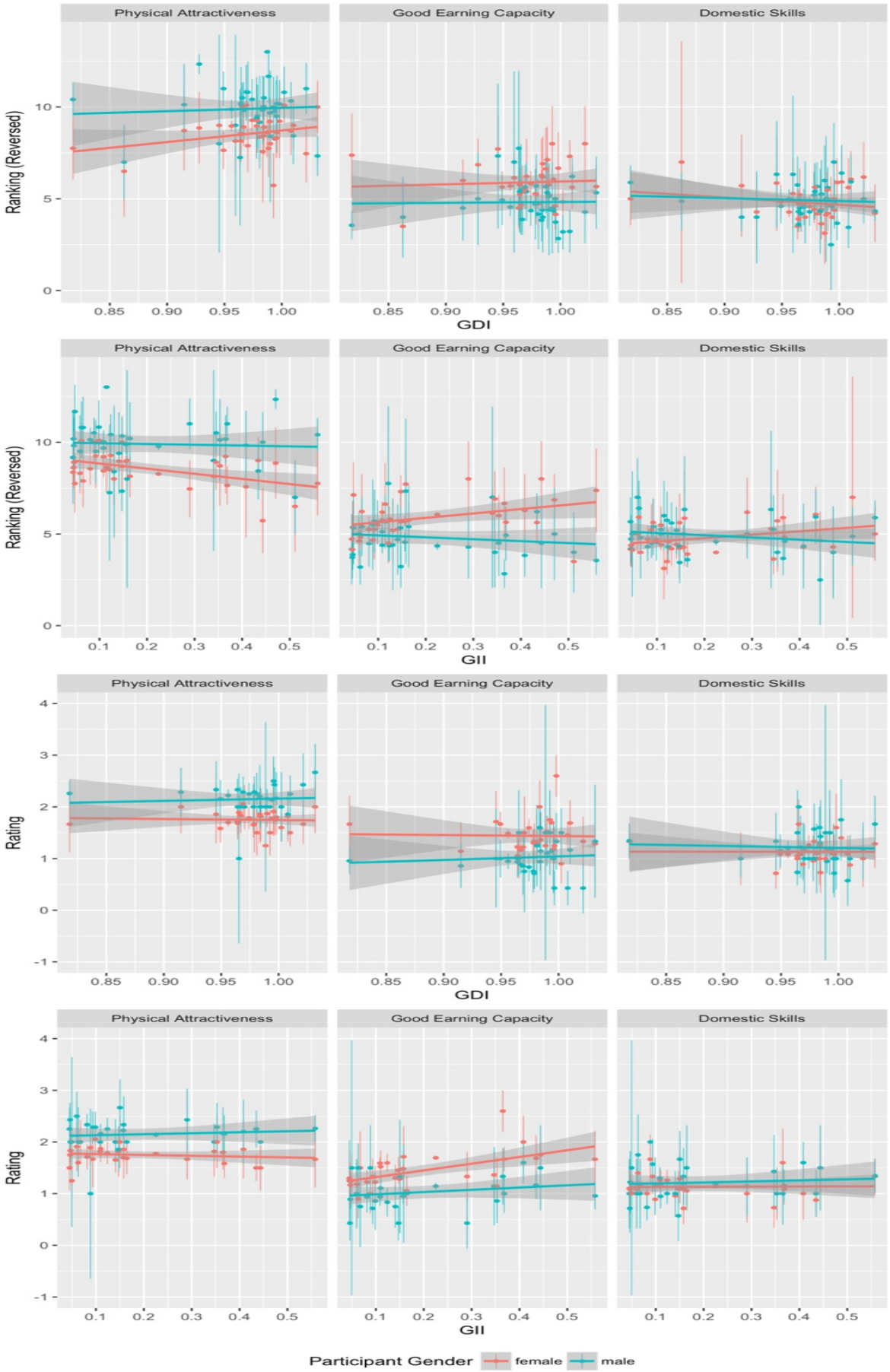
Physical Attractiveness
Good Earning Capacity
Domestic Skills
Ranking (Reversed)
GDI
GII
Rating
Participant Gender
female
male

Figure 3.2 Interactions between participant sex and gender-equality measures for each combination of trait and rating task. Dots show means and lines show SEM. Lower scores on the GII and higher scores on the GDI indicate greater equality.

Repeating these twelve tests for possible effects of gender equality on mate preferences, this time with world region removed from our analyses (i.e., not controlling for Galton's problem), only altered results in one case (see https://osf.io/4sr5f/). This exception was the analysis of good earning capacity assessed using the trait-ranking method, for which there was a significant interaction between participant sex and GII (estimate = -0.65, t = -2.30, p = .027).

3.5 Discussion

Our analyses of sex differences in the desirability of physical attractiveness and good earning capacity in potential mates replicate the sex differences reported in previous research (see Buss & Schmitt, 2018 for a recent review). Specifically, we found that women (on average) reported stronger preferences for good earning capacity than men did, while men (on average) reported stronger preferences for physical attractiveness than women did. These sex differences were strong, consistent across two methods for assessing mate preferences (responses on the trait-ranking and trait-rating tasks), and were present when controlling for variability in responses across countries and geographic regions. Collectively, these features of our analyses provide further evidence that robust sex differences in preferences for good earning capacity and physical attractiveness of potential mates are relatively stable across geographic regions. We found no evidence for sex differences in preferences for potential mates with domestic skills in our sample (see also Buss et al., 1990).

Although we found the expected sex differences in preferences for both physical attractiveness and good earning capacity, evidence that these sex differences were smaller in countries with greater gender equality was less convincing. We saw no evidence that the sex difference in preference for physical attractiveness was greater in countries with greater gender equality. One analysis suggested that the sex difference in preference for good earning capacity was smaller in countries with greater gender equality, but this was only observed for one combination of preference task and gender equality measure (responses on the trait-ranking method analyzed in relation to the Gender Inequality Index). This effect was also not significant when we controlled for Galton's problem and would not be significant if alpha was corrected for multiple comparisons. Thus, we cannot discount the possibility that this relationship is a false positive. Collectively, these results provide little support for the social roles account of sex differences in mate preferences.

That we do not replicate previous results for gender inequality and mate-preference sex differences is unlikely to be due to our study being underpowered relative to previous studies. We tested 36 countries, which is a similar sample size to the 37 countries tested in two of the previous studies (Eagly & Wood, 1999; Kasser & Sharma, 1999) and a considerably larger sample size than the 10 countries tested by Zentner and Mitura (2012). Some countries indeed had relatively few data points, so we do not rule out the possibility that not detecting very small effects may have been a false negative. The null results in the current study also cannot be explained by the measures of gender inequality we employed. These are similar to those used in previous work on the topic that reported significant effects of gender inequality and, crucially, explicitly measure the combined effects of gender equality in economic, political, and decision-making roles that Eagly and Wood emphasized as being of critical importance for their observed effects. Indeed, while Eagly and Wood stated that using gender equality measures from different years than the preference data were collected was a

limitation of their study, we matched our gender equality measures to the year in which preference data were collected (only substituting 2017 gender equality data for 2018 data because the 2018 data were not available).

An important limitation of the current study (and of work on this topic, generally) is that we assessed participants' preferences for traits in potential mates, rather than the traits their actual partners possessed. Although some research suggests some aspects of mate preferences predict actual partner choices relatively well (see DeBruine et al, 2006 for a review), other work suggests that for highly desirable traits, the ability to translate preferences into actual partner choices depends on one's own market value (Wincenciak et al., 2015). Whether gender equality predicts sex differences in partner choices is an open (and important) question.

In summary, we replicated previous reports that women (on average) show stronger preferences for good earning capacity in potential mates than men do, while men (on average) show stronger preferences for physical attractiveness in potential mates than women do. However, we did not replicate Eagly and Wood's (1999) finding that sex differences in preferences for physical attractiveness and domestic skills are smaller in countries with greater gender equality. We saw some evidence that the sex difference in preference for good earning capacity was smaller in countries with greater gender equality, but this effect was inconsistent across measures of mate preferences and gender equality, was not significant when controlling for Galton's problem, and would not be significant when alpha was corrected for multiple comparisons. Together, these results present little compelling evidence for the social role theory of sex differences in mate preferences.

Chapter 4: A data-driven test for cross-cultural differences in face preferences

The following chapter is based on work published in Perception

Zhang, L., Holzleitner, I. J., Lee, A. J., Wang, H., Han, C., Fasolt, V., ... & Jones, B. C. (2019). A data-driven test for cross-cultural differences in face preferences. *Perception*, *48*(6), 487-499.

Methods were preregistered on the Open Science Framework prior to data collection, also, full data and analyses can be found in https://osf.io/7wy3t/.

Abstract

Previous research has shown strong cross-cultural agreement in facial attractiveness judgments. However, these studies all used a theory-driven approach in which responses to specific facial characteristics are compared between cultures. This approach is constrained by the predictions that can be derived from existing theories and can therefore bias impressions of the extent of cross-cultural agreement in face preferences. We directly addressed this problem by using a data-driven, rather than theory-driven, approach to compare facial attractiveness judgments made by Chinese-born participants who were resident in China, Chinese-born participants currently resident in the UK, and UK-born and -resident White participants. Analyses of the principal components along which faces naturally varied suggested that Chinese and White UK participants used face information in different ways, at least when judging women's facial attractiveness. In other words, the data-driven approach used in the current study revealed some cross-cultural differences in face preferences that were not apparent in studies using theory-driven approaches.

4.1 Introduction

Facial attractiveness judgments influence important social outcomes, including hiring decisions and interpersonal relationships (Langlois et al., 2000; Little, Jones, Debruine, & Caldwell, 2011; Rhodes, 2006). Cross-cultural agreement in facial attractiveness judgments is widely interpreted as strong evidence that face preferences transcend culture (Langlois et al., 2000; Rhodes, 2006).

Previous research investigating cross-cultural agreement in facial attractiveness judgments has used a top-down, theory-driven approach (Apicella et al., 2007; Anthony C. Little, Apicella, & Marlowe, 2007; Perrett et al., 1998). In this approach, specific characteristics identified from evolutionary theories of attractiveness (e.g., symmetry, averageness, sexual dimorphism, Little et al., 2011 and Thornhill & Gangestad, 1999) are experimentally manipulated in face images using computer graphics (Apicella et al., 2007; Anthony C. Little et al., 2007; Perrett et al., 1998; G. Rhodes, Yoshikawa, et al., 2001).

Studies using this theory-driven approach have found that Japanese and Hadza participants showed preferences for facial symmetry and averageness similar to those reported for Western cultures (Apicella et al., 2007; Little et al., 2007; Rhodes et al., 2001). Other studies using this approach found that manipulating sexually dimorphic shape characteristics in face images had similar effects on Japanese and Western participants' attractiveness judgments (Perrett et al., 1998). For example, both Japanese and Western participants preferred feminized versions of faces to masculinized versions (Perrett et al., 1998).

Results like those described above are typically interpreted as evidence for cross-cultural agreement in face preferences (Apicella et al., 2007; Little et al., 2007; Perrett et al., 1998;

Rhodes et al., 2001). However, manipulating characteristics such as sexual dimorphism in two-dimensional(2D) face images can also alter perceptions of more changeable characteristics, such as head orientation or tilt (see, e.g., Hehman, Leitner, & Gaertner, 2013; Schneider, Hecht, & Carbon, 2012). Moreover, the theory-driven approach used in these studies has 2 important limitations.

First, the facial characteristics investigated in these studies may not necessarily contribute substantially to facial attractiveness judgments. For example, Said and Todorov (2011) found that the combined effects of sexual dimorphism and averageness explained only ~5% of the variance in women's attractiveness ratings of male face images (see also Holzleitner et al., 2019). Second, the range of hypotheses that can be tested using the theory-driven approach is constrained by existing theoretical frameworks. Because the ability to detect cultural differences will then depend entirely on which specific stimulus characteristics are manipulated, this constraint can bias our impressions of the extent of cross-cultural agreement in responses to social signals (Jack, Crivelli, & Wheatley, 2018). By contrast, bottom-up, data-driven approaches do not have this constraint, meaning that they can reveal cultural differences that existing theories of social perception do not predict (Jack et al., 2018). Indeed, data-driven approaches to studying facial expressions of emotion have revealed cultural differences in emotion perception that were not evident (or predicted) in studies using theory-driven approaches (Jack et al., 2018).

In light of the earlier discussion, we first used a data-driven approach (Principal Component Analysis, PCA) to identify the principal components (shape PCs) along which face images naturally varied. We then tested whether these PCs predicted Chinese and White UK participants' attractiveness ratings of the faces in different ways. We used attractiveness

ratings made by three different groups of participants (White UK-born UK-resident participants, Chinese-born UK-resident participants, and Chinese-born China-resident participants). We tested both Chinese and White UK face images.

4.2 Methods

4.2.1 Face stimuli

Stimuli were face photographs of 50 Chinese men (mean age=24.39 years, SD=3.52 years), 50 Chinese women (mean age=23.94 years, SD=2.63 years), 50 White UK men (mean age=22.97 years, SD=5.95 years), and 50 White UK women (mean age=21.95 years, SD=3.60 years). These men and women first cleaned their face with hypoallergenic face wipes to remove any make-up. Face photographs were taken a minimum of 15 minutes later in a small windowless room against a constant background, and under standardized diffuse lighting conditions. The men and women were instructed to pose with a neutral expression. Camera-to-head distance and camera settings were held constant. Six photographs of each individual were taken simultaneously from a variety of angles. Images were collected using a DI3D system (www.di4d.com) using six standard digital cameras (Canon EOS100D with Canon EF 50 mm f/1.8 STM lenses). Only the front-view face images were used in this study. In this image capture system, camera height is adjusted for each participant to minimize variation in head tilt due to camera height.

4.2.2 Face ratings

Faces were rated for attractiveness using a 1 (very unattractive) to 7 (very attractive) scale by 15 Chinese China-resident men (mean age=23.7 years, SD=1.9 years), 15 Chinese China-resident women (mean age=21.7 years, SD=2 years), 15 Chinese UK-resident men (mean age=24.6 years, SD=2.7 years; mean time resident in UK=352 days, SD=652 days), 15

Chinese UK-resident women (mean age=23.8 years, SD=2.7 years; mean time resident in UK=420 days, SD=606 days), 15 White UK men (mean age=21.4 years, SD=2.2 years), and 15 White UK women (mean age=21.4 years, SD=3.5 years). Following previous work that used similar data-driven methods to study Western participants' attractiveness judgments (Said & Todorov, 2011), participants rated the attractiveness of opposite-sex faces only. Trial order was fully randomized. Simulations (see https://osf.io/x7fus/) sampling from a population of 2513 raters, each of whom had rated the attractiveness of 102 faces, indicated that >99% of 1000 random samples of 15 raters produced Cronbach's alphas >.8 (90% of all alphas were >.85). This indicates that 15 raters per group are typically sufficient to obtain reliable average ratings. For ratings, each image was standardized on pupil positions and masked so that hairstyle and clothing were not visible.

Consistent with the results of our simulations, inter-rater agreement (Cronbach's alphas) for ratings of individual faces was high for each of the six groups of raters (Chinese China-resident raters judging men's faces=.88; Chinese UK-resident raters judging men's faces=.85; White UK raters judging men's faces=.87; Chinese China-resident raters judging women's faces=.80; Chinese UK-resident raters judging women's faces=.87; White UK raters judging women's faces=.85). For each face, the mean attractiveness rating was calculated separately from each group's ratings (Chinese China-resident raters, Chinese UK-resident raters, White UK raters). These mean ratings served as the dependent variables in our analyses. Following previous research that used similar data-driven methods to study Western participants' attractiveness judgments (Holzleitner et al., 2019; Said & Todorov, 2011), raw ratings were standardized (converted to z scores) prior to averaging. Before standardizing, ratings were similar to those reported for attractiveness in studies using similar stimuli (Bronstad,

Langlois, & Russell, 2008; Kościński, 2013; Torrance, Wincenciak, Hahn, DeBruine, & Jones, 2014; Wang, Hahn, DeBruine, & Jones, 2016; see Table 4.1).

Table 4.1 Descriptive statistics for attractiveness ratings.

	White UK raters	Chinese UK-resident	Chinese Chinese-resident
Chinese male faces	2.82 (0.57)	2.32 (0.48)	2.54 (0.50)
Chinese female faces	2.85 (0.61)	2.95 (0.69)	2.80 (0.51)
White UK male faces	3.12 (0.74)	2.81 (0.56)	3.24 (0.64)
White UK female faces	2.80 (0.66)	3.05 (0.51)	2.83 (0.46)

Note.Table shows means (and standard deviation in parentheses). Descriptive statistics are for raw ratings.

4.2.3 Principal Component Analysis (PCA) of face shape

Orthogonal face principal components were derived from 132 points on each of the 200 faces using a method described in Wolffhechel et al. (2015). Note that this is a larger number of images than has been used to derive face PCs in many previous studies (Holzleitner et al., 2014; Komori, Kawamura, & Ishihara, 2011; Scott, Pound, Stephen, Clark, & Penton-Voak, 2010). Images were Procrustes aligned prior to analyses (using the 2D images, following, e.g., Scott et al., 2010). The image-analysis code used to calculate face PCs is publicly available on the Open Science Framework (https://osf.io/7wy3t/).

Table 4.2 Average eigenvalues for first three shape PCs by face group.

face ethnicity	face sex	PC1	PC2	PC3
Chinese	Female	0.49583770	0.7619386	0.13630340
Chinese	Males	-0.08793491	0.5106452	-0.19655207
White UK	Female	-0.01282015	-0.2182166	-0.05068316
White UK	Male	-0.39508264	-1.0543672	0.11093182

Note. PC = principal component

We used the broken stick criterion to select the PCs to be included as predictors in our preregistered analyses (see Jackson, 1993 for a discussion of the benefits of this criterion). This method selected 12 PCs, cumulatively explaining 81% of the variance in 2D face shape. The first three of these PCs, which explained 48% of the variance in face shape (27%, 11%, and 10%, respectively), are visualized in Figure 4.1 (visualizations of all 12 PCs are at https://osf.io/7wy3t/). These three PCs appeared to reflect head tilt and sexual dimorphism, face ethnicity, and elongation, respectively. PCs 1 and 3 are similar to those reported in previous work on PCAs of White faces (e.g., Hancock, Bruce, & Burton, 1998). PC2 is presumably a consequence of including two distinct racial groups in our image set. Average eigenvalues for PCs 1 to 3 for each of the four face groups are shown in Table 4.2 (shown for all 12 shape PCs at https://osf.io/7wy3t/). Conducting the PCA on male and female face shapes separately revealed similar PCs 1 to 3 (see https://osf.io/7wy3t/ for visualizations).

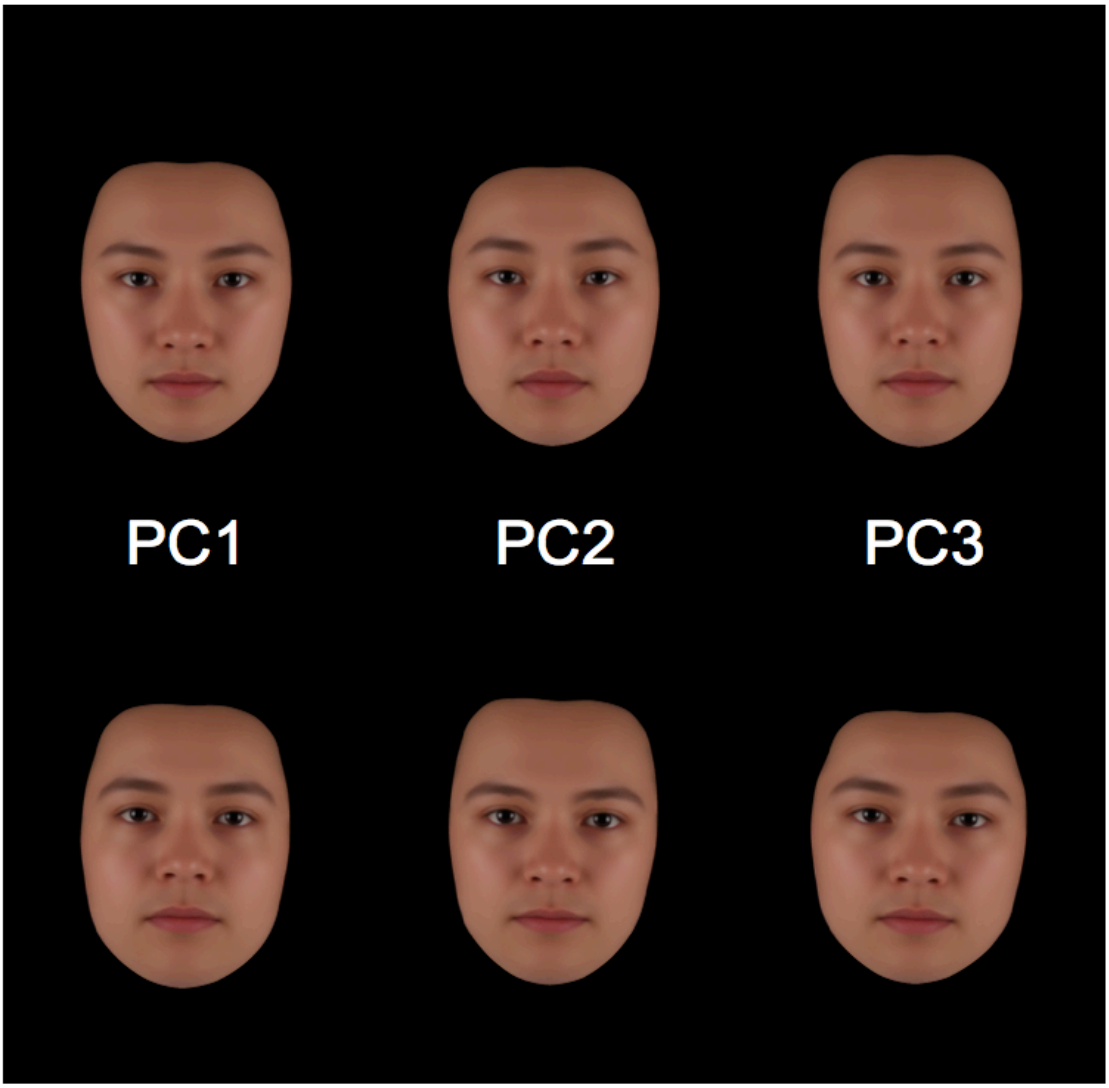

Figure 4.1 Visualization of the first three PCs. These three PCs explained 48% of the variance in face shape. Components are applied to the average face from the image set for visualization. Each PC is visualized at +1.5SD (top) and -1.5SD (bottom). PC1, PC2, and PC3 appear to correspond primarily to head tilt and sexual dimorphism, face ethnicity, and elongation, respectively.

Note: Please refer to the online version of the article to view the figures in colour.

4.2.4 Statistical analyses

We had preregistered our analysis plan prior to data collection (https://osf.io/7wy3t/). However, the reviewers suggested that our preregistered models could be prone to

overfitting. To address this concern, we have altered our analyses. The main difference between the analyses reported here and those outlined in our preregistration is to focus on the three PCs that explained the most variance in face shape (new analyses), rather than all PCs selected using the broken stick method (preregistered analyses). We report the analyses requested by the reviewers in the main manuscript (below), report our preregistered analyses in full on the OSF (https://osf.io/7wy3t/), and include a section at the end of our Results section describing the differences in the results from these two sets of analyses. Analyses were conducted using R version 3.4.2 (R Core Team, 2016), with lme4 version 1.1-13 (Bates, Mächler, Bolker, & Walker, 2014) and lmerTest version 2.0-33 (Kuznetsova, Brockhoff, & Christensen, 2014). Linear mixed models were required to take into account the non-independence of different groups' attractiveness ratings of the same stimuli. Separate linear mixed models were conducted for attractiveness ratings of male and female faces and for each combination of the three rater groups (Chinese China-resident raters, Chinese UK-resident raters, White UK raters) who rated those faces. In each model, predictors were the three PCs that explained the most variance in face shape, face ethnicity (effect coded: Chinese=0.5, White UK=-0.5), rater group (effect coded: see details for each model in the relevant "Results" subsections below), and all possible two- and three-way interactions. Full model specifications and full outputs are given in the online Supplemental Materials. Data files and analysis scripts are publicly available on the Open Science Framework (https://osf.io/7wy3t/). For each model, we report Akaike Information Criterion (AIC) as a measure of model fit.

4.3 Results

4.3.1 Women's facial attractiveness

Model 1. The first model compared the effects of shape PCs on attractiveness ratings by Chinese UK-resident male raters (effect coded as 0.5) and White UK male raters (effect coded as -0.5). This analysis revealed significant interactions between rater group and both PC1 (standardized beta = -0.20, t = -3.45, p < .001) and PC2 (standardized beta = -0.23, t = -3.55, p < .001). Neither of these two-way interactions was qualified by a three-way interaction with face ethnicity (both absolute ts < 1.00, both ps >.32). There were no significant effects involving PC3 (all absolute ts < 1.95, all ps >.05). Full results of this analysis are shown in Table 4.3. AIC for this model was 281.9.

Table 4.3 Full results of Model 1 (Chinese UK-resident male raters versus White UK male raters) for women's facial attractiveness.

	Standardized	Standard	t	p
PC1	0.13	0.08	1.67	.10
PC2	0.05	0.09	0.57	.57
PC3	-0.06	0.06	-1.00	.32
rater group	0.07	0.06	1.26	.21
face ethnicity	-0.11	0.16	-0.67	.51
PC1 x rater group	-0.20	0.06	-3.45	<.001
PC2 x rater group	-0.23	0.06	-3.55	<.001
PC3 x rater group	0.00	0.05	0.05	.96
PC1 x face ethnicity	0.13	0.16	0.83	.41
PC2 x face ethnicity	0.17	0.17	0.99	.32
PC3 x face ethnicity	-0.25	0.13	-1.95	.05
face ethnicity x rater group	-0.16	0.12	-1.36	.18
PC1 x face ethnicity x rater group	-0.03	0.11	-0.23	.82
PC2 x face ethnicity x rater group	-0.11	0.13	-0.90	.37
PC3 x face ethnicity x rater group	-0.05	0.09	-0.57	.57

Model 2. The second model compared the effects of shape PCs on attractiveness ratings by Chinese China-resident male raters (effect coded as 0.5) and White UK male raters (effect coded as -0.5). This analysis also revealed significant interactions between rater group and both PC1 (standardized beta = -0.16, t = -3.06, p < .01) and PC2 (standardized beta = -0.19, t = -3.24, p < .01). Again, neither of these two-way interactions was qualified by a three-way interaction with face ethnicity (both absolute ts < 1.45, both ps >.15). There were no significant effects involving rater group and PC3 (all absolute ts < 1.76, all ps >.08). Full results of this analysis are shown in Table 4.4. AIC for this model was 244.1.

Table 4.4 Full results of Model 2 (Chinese China-resident male raters versus White UK male raters) for women's facial attractiveness.

	Standardized	Standard	t	p
PC1	0.15	0.07	2.13	<0.05
PC2	0.07	0.08	0.86	.39
PC3	-0.04	0.06	-0.65	.51
rater group	0.03	0.06	0.57	.57
face ethnicity	-0.01	0.14	-0.06	.95
PC1 x rater group	-0.16	0.05	-3.06	<.01
PC2 x rater group	-0.19	0.06	-3.24	<.01
PC3 x rater group	0.06	0.04	1.29	.20
PC1 x face ethnicity	0.07	0.14	0.54	.59
PC2 x face ethnicity	0.14	0.16	0.93	.35
PC3 x face ethnicity	-0.20	0.11	-1.76	.08
face ethnicity x rater group	0.04	0.11	0.35	.73
PC1 x face ethnicity x rater group	-0.13	0.11	-1.28	.20
PC2 x face ethnicity x rater group	-0.17	0.12	-1.44	.15
PC3 x face ethnicity x rater group	0.05	0.09	0.53	.60

Thus, the results of our first and second models suggest that Chinese men (regardless of country of residence) used the information in PC1 (head tilt and sexual dimorphism) and PC2 (face ethnicity) differently from White UK men when judging women's attractiveness.

Model 3. The third model compared the effects of PCs on attractiveness ratings by Chinese China-resident male raters (effect coded as 0.5) and Chinese UK-resident male raters (effect coded as -0.5). The two-way interactions between rater group and PC1 and PC2 that were significant in our first two models were not significant in this model (standardized beta = -0.34, t = 0.73, p = .47; standardized beta = 0.03, t = 0.64, p = .52). Full results of this analysis are shown in Table 4.5. AIC for this model was 241.6.

Table 4.5 Full results of Model 3 (Chinese UK-resident male raters versus Chinese China-resident) for women's facial attractiveness.

	Standardi	Standard	t	p
PC1	0.05	0.08	0.65	.52
PC2	-0.05	0.09	-0.54	.59
PC3	-0.04	0.06	-0.57	.57
rater group	-0.04	0.05	-0.87	.39
face ethnicity	-0.09	0.16	-0.56	.58
PC1 x rater group	0.03	0.05	0.73	.47
PC2 x rater group	0.03	0.05	0.64	.52
PC3 x rater group	0.05	0.04	1.39	.17
PC1 x face ethnicity	0.06	0.15	0.40	.69
PC2 x face ethnicity	0.09	0.17	0.51	.61
PC3 x face ethnicity	-0.23	0.12	-1.80	.07
face ethnicity x rater group	0.20	0.10	2.03	.05
PC1 x face ethnicity x rater group	-0.11	0.09	-1.15	.25
PC2 x face ethnicity x rater group	-0.06	0.11	-0.54	.59
PC3 x face ethnicity x rater group	0.10	0.08	1.27	.21

4.3.2 Men's facial attractiveness

We used the same three models to investigate women's judgments of men's facial attractiveness.

Model 1. The first model compared the effects of PCs on attractiveness ratings by Chinese UK-resident female raters (effect coded as 0.5) and White UK female raters (effect coded as -0.5). This analysis revealed no significant interactions involving rater group. Full results of this analysis are shown in Table 4.6. AIC for this model was 256.3.

Table 4.6 Full results of Model 1 (Chinese UK-resident female raters versus White UK female raters) for men's facial attractiveness.

	Standardized	Standard	t	p
PC1	0.13	0.05	2.72	<.001
PC2	-0.06	0.07	-0.85	.40
PC3	0.04	0.05	0.05	.78
rater group	-0.07	0.07	-1.07	.29
face ethnicity	0.32	0.17	1.92	.06
PC1 x rater group	-0.01	0.04	-0.20	.84
PC2 x rater group	-0.11	0.06	-1.82	.07
PC3 x rater group	0.06	0.04	1.69	.10
PC1 x face ethnicity	0.10	0.09	1.08	.28
PC2 x face ethnicity	-0.02	0.15	-0.16	.88
PC3 x face ethnicity	-0.28	0.09	-3.00	<.001
face ethnicity x rater group	0.00	0.13	0.03	.97
PC1 x face ethnicity x rater group	0.11	0.07	1.48	.14
PC2 x face ethnicity x rater group	-0.11	0.12	-0.95	.35
PC3 x face ethnicity x rater group	0.10	0.07	1.41	.16

Model 2. The second model compared the effects of PCs on attractiveness ratings by Chinese China-resident female raters (effect coded as 0.5) and White UK female raters (effect coded as -0.5). This model did not converge, so we ran a reduced model that excluded all three-way interactions. This model also did not converge, so we ran separate models for each PC. Each model initially included all main effects, two-way interactions, and three-way interactions involving the PC, rater group, and face ethnicity. These models converged for PC1 and PC3, but not PC2. Models for PC1 and PC3 showed no significant interactions between PC and

rater group. A model for PC2 in which the three-way interaction was removed converged and showed a significant interaction between PC2 and rater group (standardized beta = -0.16, t = -3.61, p = <.001). This interaction suggested that the negative effect of PC2 on attractiveness was weaker in the White UK rater group. Full results of these analyses are shown in Tables 4.7, 4.8, and 4.9. Akaike information criterion for these models were all > 276.

Table 4.7 Full results of models comparing Chinese China-resident female raters' and White UK female raters' ratings of men's facial attractiveness for PC1.

	Standardized	Standard	t	p
PC1	0.09	0.05	2.02	.05
rater group	0.00	0.05	-0.05	.96
face ethnicity	0.52	0.10	5.03	<.001
PC1 x rater group	-0.04	0.04	-0.88	.38
PC1 x face ethnicity	0.07	0.09	0.78	.44
face ethnicity x rater group	0.39	0.09	4.17	<.001
PC1 x face ethnicity x rater group	0.09	0.08	1.03	.31

Table 4.8 Full results of models comparing Chinese China-resident female raters' and White UK female raters' ratings of men's facial attractiveness for PC2.

	Standardized	Standard	t	p
PC2	-0.08	0.07	-1.08	.28
rater group	-0.04	0.05	-0.91	.37
face ethnicity	0.35	0.17	2.12	.04
PC2 x rater group	-0.16	0.04	-3.61	<.001
PC2 x face ethnicity	0.01	0.15	0.06	.96

Table 4.9 Full results of models comparing Chinese China-resident female raters' and White UK female raters' ratings of men's facial attractiveness for PC3 (Continued).

	Standardized	Standard	t	p
PC3	0.04	0.05	0.97	.33
rater group	0.00	0.04	-0.02	.98
face ethnicity	0.45	0.10	4.53	<.001

	Standardized	Standard	t	p
PC3 x rater group	0.07	0.04	1.61	.11
PC3 x face ethnicity	-0.27	0.09	-2.94	<.001
face ethnicity x rater group	0.36	0.09	3.99	<.001
PC3 x face ethnicity x rater group	0.05	0.08	0.60	.55

Thus, the results of our first and second models suggest that there was little evidence that Chinese and White UK women differed in how they used face information.

Model 3. The third model compared the effects of PCs on attractiveness ratings by Chinese China-resident female raters (effect coded as 0.5) and Chinese UK-resident female raters (effect coded as -0.5). This analysis revealed no significant interactions involving rater group. Full results of this analysis are shown in Table 4.10. AIC for this model was 204.2.

Table 4.10 Full results of Model 1 (Chinese UK-resident female raters versus Chinese China-resident female raters) for men's facial attractiveness.

	Standardized	Standard	t	p
PC1	0.10	0.05	2.26	.03
PC2	-0.10	0.07	-1.43	.16
PC3	0.07	0.04	1.53	.13
rater group	0.03	0.05	0.59	.56
face ethnicity	0.44	0.16	2.74	<.001
PC1 x rater group	-0.04	0.03	-1.50	.14
PC2 x rater group	0.03	0.05	0.61	.54
PC3 x rater group	0.00	0.03	0.07	.94
PC1 x face ethnicity	0.14	0.09	1.52	.13
PC2 x face ethnicity	-0.03	0.14	-0.24	.81
PC3 x face ethnicity	-0.24	0.09	-2.77	.01
face ethnicity x rater group	0.23	0.11	2.18	.03
PC1 x face ethnicity x rater group	-0.04	0.06	-0.65	.52
PC2 x face ethnicity x rater group	0.09	0.09	0.94	.35
PC3 x face ethnicity x rater group	-0.04	0.06	-0.67	.50

4.3.3 Differences between results of the analyses described earlier and those of our preregistered analyses

The primary difference between the results of the analyses described earlier and those produced by our preregistered analyses occurred for women's judgments of men's facial attractiveness. Differences in how White UK and Chinese women used PCs 2 and 3 that were significant in our preregistered analyses (see online Supplemental Materials) were not significant in the analyses requested by the reviewers (i.e., the analyses described earlier).

4.4 Discussion

This study used a data-driven method (principal component analysis) to compare the face information that Chinese and White UK participants use to make attractiveness judgments. Our analyses of men's ratings of women's facial attractiveness (both those suggested by the reviewers and those in our preregistered analysis plan) suggested that White UK men find both downward-tilted, more feminine female faces and female faces with Chinese face shapes more attractive than Chinese men do. Importantly, these effects were independent of the effects of stimulus ethnicity on attractiveness judgments, indicating they cannot simply be due to own-race biases in face processing.

By contrast with our results for men's ratings of women's facial attractiveness, evidence for cultural differences in how women used male face information was mixed. On one hand, the analyses requested by the reviewers showed little evidence for cultural differences in women's face preferences, but Chinese women born in China showed stronger preferences for White male faces than the other rater groups did. On the other hand, our preregistered analyses also suggest that Chinese women find male faces with White UK shape and more elongated face more attractive than White UK women do. On the basis of these mixed results,

we tentatively suggest that ethnicity and elongation of face could be a fruitful line of inquiry in studies examining possible cultural differences in White UK and Chinese women's face preferences.

We characterized PC1 as reflecting information regarding head tilt and sexual dimorphism. Disentangling these two aspects of faces in 2D face images is not straightforward, since altering head tilt affects face proportions and altering face proportions alters apparent head tilt (see, e.g., Hehman et al., 2013 and Schneider et al., 2012). Regardless, even if PC1 did primarily reflect head tilt, rather than facial morphology, this would not be uninteresting. Several lines of research have demonstrated the importance of variable aspects of facial appearance for facial attractiveness (e.g., Main, DeBruine, Little, & Jones, 2010), with some researchers arguing they are, in fact, more important for attractiveness judgments than morphological cues (Jenkins, White, Van Montfort, & Burton, 2011).

Unexpectedly, an interaction between face ethnicity and PC3 was present across all models in women's judgments of men's facial attractiveness. This interaction suggested that preferences for narrow faces were stronger for judgments of White UK male faces than for judgments of Chinese male faces. This result demonstrates that the effects of facial characteristics can vary according to the ethnicity of the face presented, in addition to the ethnicity of the rater.

Many researchers have hypothesized that cultural differences in face preferences occur because of differences in recent visual diet (i.e., are, at least partly, a consequence of cultural differences in the types of faces people have recently been exposed to, Little et al., 2011; Scott et al., 2014). This hypothesis is consistent with experimental evidence that face

preferences can be rapidly recalibrated by viewing faces whose appearance was manipulated in a consistent way (e.g., to increase masculinity or feature spacing, Little, DeBruine, & Jones, 2005; Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003). In our study, we saw no evidence that UK-resident Chinese and Chinese-resident Chinese participants differed in their use of face information. This suggests that differences between Chinese and White UK participants' face preferences are not due to differences in recent visual experience. Although our data do not straightforwardly support the visual diet explanation of cultural differences in face preferences, our data cannot speak to the possibility that visual diet early in life calibrates face preferences and that this calibration is relatively robust to changes in visual diet that occur in adulthood (i.e., there may be a 'critical period' during development in which visual diet affects face preferences).

A potentially important limitation of the current study is that the majority of faces in our sample scored below the midpoint of the scale. In other words, our sample included few faces that were considered highly attractive. Although this is not unusual for studies using standardized face stimuli (see, e.g., Bronstad et al., 2008; Kościński, 2013; Torrance et al., 2014; Wang et al., 2016), it means that our results may not necessarily generalize to judgments of highly attractive faces.

In summary, we used a data-driven method to compare how Chinese and White UK raters use information when assessing facial attractiveness. White UK men found downward-tilted, more feminine female faces and female faces with Chinese face shapes are more attractive than Chinese men did. Evidence for cultural differences in women's use of male face information was mixed, however. Nonetheless, our data-driven approach to comparing attractiveness judgments revealed cross-cultural differences in face preferences that were not

apparent in studies using more traditional, theory-driven approaches, at least for men's judgments of women's facial attractiveness.

Chapter 5: General discussion

5.1 Summary of main findings

The first empirical chapter (Chapter 2) reports a registered report that investigated hypothesized cross-cultural similarities in mate-preference sex differences between UK and Chinese samples. It reported a large-scale study that used a budget -allocation paradigm to compare sex differences in preferences for physical attractiveness and social status, following Li et al (2011). This study also examined sex differences in age preferences. Three main similarities between China and UK participants' mate preferences were observed.

First, the sex differences in preferences for physical attractiveness and social status were evident in both the Chinese and UK samples, complementing previous research by Li et al. (2011). Chinese and UK women allocated significantly more mate dollars to social status than men did and men allocated significantly more mate dollars to physical attractiveness than women did. Thus, our findings revealed the same cultural similarities and robust sex differences in preferences for these traits that were reported in previous research (e.g. Buss, 1989a; Chang et al., 2011; Li et al., 2011). Second, women in both cultures showed stronger preferences for older partners than men did and people had stronger preferences for older partners in long-term relationships than short-term relationships. These results also replicate results of previous studies (Buss & Schmitt, 1993; Gangestad & Simpson, 2000). Third, although sex differences in mate preferences exist for attractiveness and social status, women and men in both cultures assigned more mate dollars to physical attractiveness for short-term mating than long-term mating.

Alongside the cultural similarities highlighted above, we observed some striking cultural differences between the two groups of participants. Specifically, Chinese women placed greater importance on social status than UK women did. This result replicated Li et al's (2011) result that Singaporean women showed stronger preferences for social status in long-term partners than US women did. This suggests that stronger preferences for social status may be a general difference between western and eastern women.

Chapter 3 reported results of a large-scale empirical study that attempted to replicate previously reported links between sex differences in mate preferences and country-level measures of gender equality in a sample of 3073 participants from 36 countries. The analyses provided further evidence that robust sex differences in preferences for good earning capacity and physical attractiveness of potential mates are relatively stable across cultures (Buss & Schmitt, 2018). Specifically, women placed greater emphasis on good earning capacity in romantic partners than men did and men reported stronger preferences for physical attractiveness than women did. However, and importantly, our results did not replicate Eagly and Wood's (1999) result that sex differences in preferences for both physical attractiveness and good earning capacity in potential mates were smaller in countries with greater gender equality. These results then provide no clear support for the social roles account of sex differences in mate preferences.

By contrast with two approaches described above, the final empirical chapter (Chapter 4) used a data-driven method to test for cross-cultural differences in Chinese and UK men's and women's face preferences. Analyses showed that White UK men found downward-tilted, feminine face shapes more attractive than Chinese men did. Chinse women showed stronger preferences for male faces with Western face shape than UK women did. On the other hand,

analyses showed that, in both cultures, women's preferences for narrow faces were stronger for judgments of White UK male faces than for judgments of Chinese male faces. These results then suggest that both head tilt and face elongation could be a fruitful line of inquiry in studies examining possible cultural differences in White UK and Chinese women's face preferences. For example, Holzleitner et al.'s (2019) further work supports that face elongation appears to be an important predictor of face shape preference and believes it may relate to height. And head tilt will be discussed further below. Overall, this chapter used a novel data- driven approach to comparing attractiveness judgments to reveal cross-cultural differences in face preferences that were not apparent in previous studies using theory-driven methods that focused on preferences for averageness, symmetry, and sexual dimorphism.

In the following sections, I will discuss some of the issues raised by the results presented in the previous three chapters, discuss the limitations of the current studies, and highlight some possible directions for future research.

5.2 Head tilt preference

Head tilt emerged as an important feature for cultural differences in face preferences when we used a data-driven method to study face preferences in Chapter 4. This is consistent with previous studies suggesting that head tilt is an important, but understudied, factor in attractiveness (Sulikowski, Burke, Havlíček, & Roberts, 2015). In Japan, for example, Osugi and Kawahara (2015) manipulated portraits by bending them forward to mimick bowing and found that tilting facial portraits enhanced their attractiveness. Moreover, in Australia, female faces tilted downward are rated as more attractive and feminine than the upward-tilted ones (Burke & Sulikowski, 2010). While Chapter 4 found differences in preferences for head tilt

between Chinese and UK participants, future work may reveal additional cultural differences in head tilt preferences and provide insight into the function of such preferences.

5.3 Female's mate preference in short-term relationship

Our study in Chapter 2 did not find an interaction between the effects of participant sex and relationship context, by contrast with some previous work. However, we did find that both Chinese and UK women showed stronger preferences for physical attractiveness in short-term relationships than long-term relationships. This effect has also been observed in studies across the world (Schmitt et al., 2001). For instance, in Brazil, women also place a premium on physical appearance in short-term mating (Castro & De Araujo Lopes, 2011).

This pattern of preferences is thought by many researchers to function to aid women in obtaining heritable "good genes" for healthy offspring (Buss & Schmitt, 1993; Cashdan, 1996; Greiling & Buss, 2000; Li & Kenrick, 2006). However, results of research linking male physical attractiveness to aspects of their underlying health are equivocal (Hönekopp et al., 2007; Weeden & Sabini, 2005). Further research, ideally also investigating alternatives to the dominant "good genes" explanation may shed light on the robust effect of relationship context on women's preferences for physical attractiveness.

5.4 Cross-cultural variability in mate-preference sex differences

Eagly and Wood (1999) proposed the social role and the division of labour theory as an explanation for cultural differences in the magnitude of mate-preference sex differences. They argued that the mate preferences of men and women were more similar in countries with greater gender equality in Buss's (1989a) sample. Zentner and Mitura (2012) observed similar results in a different sample. However, Gangestad et al. (2006) showed that Eagly and

Wood's findings were simply a consequent of autocorrelation. My work also demonstrated that failing to account for autocorrelation can generate misleading results regarding regional differences in mate preferences.

There was also little evidence for the social roles of cultural differences in mate-preference sex differences in Chapter 3. Furthermore, a more recent empirical study also found that gender inequality did not predict the magnitude of mate-preference sex differences (Walter et al., 2020). Thus, results of cross-country level tests of the social role account have been strikingly inconsistent and, even when the effects of gender equality are observed, they appear to be artifacts of autocorrelation. Further work is needed to establish what factors reliably predict cultural differences in mate-preference sex differences.

5.5 Eastern and Western differences in social status preferences

The results of Chapter 2 demonstrated that Chinese women placed greater value on social status in potential mates than UK women did. As mentioned previously, this pattern of results is consistent with previous work reporting that Singaporean women placed greater value on social status in potential mates than US women did. The reasons for this apparent difference between Western and East Asian women's preferences for social status are currently unclear. One possibility is that it reflects the greater value placed on status in general in East Asian cultures and the tendency for East Asian families to prioritise the resources of potential mates when giving their approval to romantic partners (Kline, 2009). It might because of cultural tradition that Chinese and Singapore family have stronger desire for their daughter to marry one good men and have a better life (Kline, 2009). It can be seen that different cultural value to extent influence how much women value their partner's social status. Alternatively, it may reflect differences in individualism versus collectivism, which is a dimension on which

Western and East Asian cultures typically differ markedly and that is hypothesized to shape cultural differences in mate preferences (Fong and Goetz, 2010).

5.6 Age preference

Age preference is typically highly consistent across cultures (Buss, 1989a; Kamble et al., 2014; Sprecher et al., 1994), with women preferring mates who older than themselves and men preferring mates who are younger than themselves. However, in Chapter 2, the men in our study expressed a preference for mates *older* than themselves, particularly for long-term relationships. All our participants were from a university sample and most of them were bachelor students in their late teens and early twenties (women's average age was 20.60 years, men's average age was 20.54 years). Thus, it is possible that this surprising result reflected men in our sample being more educated and younger than is typical for these studies. Indeed, some previous studies have suggested that men's preference for younger women is minimal in their youth and increases as men get older (Kenrick & Keefe, 1992; Oda, 2001). This could explain why we saw preferences for slightly older women in our samples. Further work is needed to fully explore this issue.

5.7 Kindness

Both sexes seem to prioritise potential partner's kindness when they pursue a long-term relationship. For example, Chapters 2 and 3 suggested that men place similar value on physical attractiveness and kindness in their long-term mate preferences. It has been suggested that this reflects the close association between kindness and courtship behaviours such as food sharing, gift giving, promise and empathy in listening and talking (Miller, 2008). Moreover, men and women will get greater reproductive rewards from a kind partner if kinder partners are more likely to invest resources in their partner and offspring (Li et al.,

2002a). Further work that investigated these traits more directly, rather than having them be subsumed under the general term ‘kindness’ might shed light on this issue.

5.8 Conclusion

In conclusion, this thesis used a range of methods to demonstrate cross-cultural differences in mate preferences. Findings indicated that sex differences in preference for mates high in physical attractiveness and status were evidence across a wide range of cultures. While the results reported in this thesis showed clear evidence for sex differences in mate preferences, they showed little support that gender equality predicts the magnitude of these sex differences across cultures. Thus, the causes of cultural differences in mate-preference sex differences remain unclear.

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