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A influência da feminilidade/masculinidade e das ameaças ambientais nas preferências por potenciais parceiros românticos

The influence of femininity/masculinity and environmental threats on preferences for potential romantic partners

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KAMILA JANAINA PEREIRA

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por potenciais parceiros românticos**

**The influence of femininity/masculinity and environmental threats on preferences for
potential romantic partners**

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RESUMO

Pereira, K. J. (2019). *A influência da feminilidade/masculinidade e das ameaças ambientais nas preferências por potenciais parceiros românticos* (Tese de Doutorado). Instituto de Psicologia, Universidade de São Paulo, São Paulo.

Os humanos têm enfrentado a escolha entre preferências por traços femininos e masculinos, isto é, entre investimentos diretos (cuidado parental) e indiretos (qualidade genética) na reprodução, respectivamente, o que afeta a percepção de atratividade e indica qualidades biossociais. A FM é influenciada principalmente por hormônios reprodutivos, mas sua percepção é mediada por: 1) contextos biopsicossociais (autopercepção e percepção por terceiros), 2) múltiplos canais de informação (visual e vocal) e/ou 3) ameaças ambientais (patógenos e escassez de recursos). Estudos anteriores possuem limitações, como ausência de clareza quanto à associação entre autopercepção e percepção por terceiros da FM; incongruência nas informações das faces e vozes dos homens; e estudos focando principalmente nas preferências das mulheres por faces e vozes manipuladas digitalmente e usando um modelo de escolha forçada. Assim, examinamos: (a) possíveis associações entre percepções subjetivas (autopercepção e percepção por terceiros da FM e atratividade) e FM medida; (b) concordância na FM de mulheres e homens percebida por terceiros; e (c) influência de patógenos (PT) e escassez de recursos (ER) nas preferências pela FM no sexo oposto. Tiramos fotos faciais e gravamos vozes e danças de público-alvo de 41 mulheres e 38 homens e medimos o dimorfismo sexual da forma facial, a frequência fundamental vocal e o etograma das danças. Estes participantes também autoavaliaram sua FM e atratividade faciais, vocais e comportamentais. Posteriormente, 64 (43 mulheres) e 51 (28 mulheres) estudantes avaliaram respectivamente a FM e atratividade dos estímulos do público-alvo. Com as avaliações da FM escolhemos os cinco mais masculinos e os cinco mais femininos para cada estímulo, dentro de cada sexo. Finalmente, 370 estudantes (206 mulheres) leram um artigo de jornal da condição controle e um dos artigos da condição ambiental (PT ou ER); o artigo PT era sobre o *Aedes aegypti*, enquanto o artigo ER era sobre a crise econômica brasileira. Os participantes foram aleatoriamente designados para o contexto de relacionamento de curto ou longo prazo. Após cada artigo, os voluntários avaliaram a atratividade dos estímulos do público-alvo individualmente. Cada amostra conteve diferentes estudantes do estado de São Paulo com 18 a 35 anos. As percepções subjetivas das mulheres não refletiram as percepções dos terceiros nem as medidas objetivas. Todavia, a FM facial e

vocal delas se correlacionou, sugerindo concordância informacional. Diferentemente, as autoavaliações dos homens e as avaliações de terceiros quanto à FM e atratividade se correlacionaram. Ademais, o tom de voz mais masculino se associou com a FM autodeclarada e declarada por terceiros. Entretanto, as avaliações de terceiros quanto à FM facial e vocal não se relacionaram, indicando mensagens distintas. Além disso, no contexto de longo prazo, as mulheres preferiram um mosaico entre faces masculinas e vozes femininas após a ER. Os homens, por sua vez, preferiram vozes masculinas, sugerindo preferência por parceiros com maior acesso a recursos. Não houve efeito da condição PT no contexto de curto prazo, indicando a influência do modelo experimental. Finalmente, as danças não produziram qualquer efeito, sugerindo um desenvolvimento diferente das faces e vozes.

Palavras-chave: Feminilidade/masculinidade. Diferenças individuais. Percepção multimodal. Percepção subjetiva. Medidas objetivas. Estímulos ambientais. Preferências por parceiros.

ABSTRACT

Pereira, K. J. (2019). *The influence of femininity/masculinity and environmental threats on preferences for potential romantic partners* (Doctoral Thesis). Instituto de Psicologia, Universidade de São Paulo, São Paulo.

During evolution, humans faced the trade-off between preferences for feminine and masculine traits which are connected to direct (parental care) and indirect (genetic quality) investments into reproduction, respectively. Therefore, femininity-masculinity (FM) affects perceived attractiveness and indicates biosocial qualities. Physiological and morphological FM are primarily influenced by reproductive hormones; however, its perception can be mediated by: 1) biopsychosocial contexts (e.g. self- and other-perception), 2) multiple channels of information (e.g. visual and vocal information), and 3) environmental threats (e.g. pathogens and resource scarcity). However, previous studies show limitations. Firstly, it is unclear if self- and other-rated FM are associated. Secondly, results suggest that women's faces and voices present concordant information about their FM; however, mixed results are found for men. Finally, studies mainly focus on women's preferences for digitally manipulated male faces and voices in a forced-choice design. Thus, we examined: (a) possible associations between subjective perceptions (i.e. self- and other-rated FM and attractiveness), and measured FM; (b) whether women's and men's FM is concordantly perceived by third-party raters; and (c) the influence of pathogen threat (PT) and resource threat (RT) on women's and men's preference for FM in the opposite sex. We took facial photos, and recorded voices and dances of a target sample of 41 women and 38 men and we measured sexual dimorphism of facial shape, vocal fundamental frequency, and ethogram of videos. These participants also self-rated their facial, vocal, and behavioral FM and attractiveness. Later, 64 (43 women) and 51 (28 women) students independently rated facial, vocal and behavioral FM and attractiveness of the target sample, respectively. Finally, 370 (206 women) students were primed with newspaper-like articles on either PT (*Aedes aegypti*, and its mosquito-borne diseases) or RT (Brazilian economic crisis), and compared to a control condition (lions poisoned in a Kenyan Reserve). Participants were randomly assigned either for a short- or long-term relationship. After each priming article, participants rated attractiveness of the five most masculine and the five most feminine stimuli of the opposite sex of the target sample in a standalone-rating design. Each sample was independent and comprised students, aged 18-35 years, from universities across the state of Sao Paulo, Brazil. In women, results showed that

subjective perceptions did not reflect perceptions of others or objective measures. However, women's facial and vocal FM correlated positively, suggesting concordant information about mate quality. In contrast, men's self-rated FM and attractiveness correlated with third-party ratings, and male voice pitch correlated with self- and other-rated FM. Nevertheless, other-ratings on men's FM did not correlated, indicating multiple messages. Finally, for long-term context, women preferred a mosaic of men's masculine faces and feminine voices after primed with RT condition. Men, however, preferred masculine female voices, suggesting a preference for partners with easier access to resources. There was no effect of PT condition in short-term context, indicating the influence of the study design. Finally, no effect was found for dances, suggesting a different development than faces and voices.

Keywords: Femininity/masculinity. Individual differences. Multimodal perception. Subjective perception. Objective measures. Environmental cues. Mate preferences.

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1 INTRODUCTION

Since animal behavior is influenced by multiple variables, Tinbergen (1963) proposed that the analysis of behavior patterns should be made in four different levels: (1) proximate mechanisms or immediate causes, (2) development, (3) survival value or function, and (4) evolutionary history. The first level examines physical-chemical mechanisms influencing the behavior, such as hormones and membrane receptors. The development studies how the experiences faced by an individual over her/his lifetime influence behavior patterns. The third level examines what kind of advantages the behavior gave to our ancestors in the struggle to survive and reproduce, which influences natural selection. Finally, the evolutionary history covers tracking the evolution of the behavior in comparison with other species (Ferreira, 2011; Laland & Brown, 2011).

Some species' behaviors are also influenced hugely by conspecific members. In this case, the numerous interactions among conspecifics reflect on the development of complex societies (Smuts, Cheney, Seyfarth, Wrangham, & Strusaker, 1987) and can have distinct goals, including mating. In the case of humans, Tinbergen's (1963) four questions are also used to analyze behaviors; however, it is also necessary to pay attention to the theoretical perspective used, since it can modify how the study design and discussions will be carried out. Despite differences in approach, each academic subject examines the human mating behaviors on distinct levels, creating a wider understanding of the complex interactions (Hinde, 1982).

Therefore, the current thesis focused on the study of human preferences for romantic partners of the opposite sex following the perspectives of Evolutionary Psychology and Human Ethology. More precisely, the PhD student examined women's and men's preferences for feminine and masculine traits of the opposite sex. The stimuli comprised faces, voices, and dance movements. Firstly, it was investigated whether the subjective perception (i.e. self-reports and third-party ratings) of feminine and masculine stimuli were associated with objective measures of femininity-masculinity. We then examined how subjective perceptions and objective measures of femininity-masculinity correlate with self- and other-rated attractiveness. Then, the current thesis focused on the third-party's perception of femininity-masculinity. As a second chapter, it was examined whether faces, voices, and dance movements were perceived as a concordant channel of information on femininity-masculinity by third-party raters. Finally, in the third chapter we tested whether cues to pathogen threat and resource scarcity influenced human preferences for femininity-masculinity in the context

of short-term and long-term relationships. Each part was written as a scientific article presented in section 3.

The current study intended to address some limitations in previous research. In the context of romantic relationships, studies have usually focused on women's preferences, assuming that men show fixed responses irrespective of environmental influences. In addition, despite the multimodal nature of femininity-masculinity, most research has studied facial traits, especially manipulated faces. Finally, the majority of studies have analyzed samples from the USA, Canada, Western Europe, and Australia, neglecting cultural differences in sensory preferences.

To address such topics, an introduction was written to discuss general aspects that were not included in the scientific articles because it would be behind the scope of the papers. To introduce the current study, the literature review was divided into three parts. The first part reviews the evolutionary concepts that provided background to the hypotheses and discussions presented below. The second subsection reviews the development of facial, vocal, and behavioral femininity-masculinity in both sexes. Finally, the third subsection reviews the influence of pathogen threat and resource scarcity on human preferences for an opposite-sex partner.

1.1 Evolutionary concepts

In this subsection, we briefly review the main theories most important for the current thesis. Darwinian theories, parental investment, and human sexual strategies are discussed below.

1.1.1 Darwinian theories

In 1858, the Darwin-Wallace theory of evolution of species by natural selection was released (Darwin & Wallace, 1858). In the following year, Darwin released his famous book *On the Origins of Species*, and described the natural selection as the process in which individuals possessing advantageous traits to the external conditions and compared to other organic beings have higher chances of breeding and producing greater amount of offspring. Natural selection maintains and spreads the said variations through a group of individuals (Darwin, 1859/1872; Jones & Ratterman, 2009). More precisely, individuals with anatomical,

physiological, and/or behavioral characteristics that fit the environment better than their conspecifics will have the greatest chances of survival and reproduction, leading the population to change over time (Laland & Brown, 2011).

Nevertheless, some traits have been selected despite their negative effects upon survival, the peacock tail being the most famous example (Zahavi, 1975). The evolution of these traits was then explained by the concept of sexual selection. Darwin (1871/1874) described the sexual selection as characteristics that have given advantage to their owner over others of the same sex in respect of reproduction. That means that individuals have distinct reproductive success caused by characteristics that produce better competition for access to mates or fertilization opportunities (Andersson, 1994; Jones & Ratterman, 2009). Therefore, the owner of such traits would leave greater amount of offspring, which compensates any disadvantages to survival (Darwin, 1871/1874).

Sexual selection occurs through two mechanisms, namely intrasexual and intersexual selection (Jones & Ratterman, 2009). The former identifies characteristics that have evolved through intrasexual competition by enhancing competitive abilities among members of the same sex, e.g. physical fights and threats, and ritualized displays of courtship (Laland & Brown, 2011; Vasey & Sommer, 2006). The intrasexual selection favors weapons (like antlers, claws, and tusks), greater body size, strength, and aggression to defend restricted critical resources and have access to fertile females (Emlen, 2008; Puts, 2010).

On the other hand, some traits may have evolved through intersexual selection by enhancing the likelihood of being chosen as a mate (Laland & Brown, 2011; Vasey & Sommer, 2006). According to Jones and Ratterman (2009), intersexual selection depends on the preference of the opposite sex for such traits and thus individuals with the preferred trait will leave greater numbers of offspring, which increases the frequency of these traits in the population. Models to explain the evolution of mating preferences are based on either two major categories: direct-benefits model and indirect-benefits model (Andersson & Simmons, 2006; Jones & Ratterman, 2009). The former supposes that the preferences can evolve if the choosy sex gains direct benefits (Kuijper, Pen, & Weissing, 2012). Therefore, the preference for an ornament associates with immediate benefits to the selecting sex, such as high-quality territory, nutrition, parental care and/or protection (Andersson & Simmons, 2006; Jones & Ratterman, 2009; Kuijper et al., 2012), indicating that the ornament reflects some parental qualities and abilities of the owner.

The indirect-benefits model argues that the choosy sex increases its fitness as a consequence of its offspring having higher fitness, which is provided genetically by the trait's

owner (Andersson & Simmons, 2006; Jones & Ratterman, 2009). Jones and Ratterman (2009) suggested that these models can be lumped in a single category, namely Fisher-Zahavi models. According to the Fisherian model, the choosy sex will produce attractive offspring of the opposite sex, which in turn will have an advantage on intersexual selection (Andersson & Simmons, 2006; Kuijper et al., 2012), because the trait will increase their likelihood of reproducing and leaving a greater amount of offspring. Moreover, the choosy sex will also produce offspring of the same sex carrying the preference for the trait (Andersson & Simmons, 2006; Jones & Ratterman, 2009). Therefore, this model requires coevolving preference and ornament genes (Kuijper et al., 2012; Jones & Ratterman, 2009).

On the other hand, the Zahavi model (also known as good genes or handicap mechanism) also requires a third dimension (corresponding to heritable quality) (Andersson & Simmons, 2006; Kuijper et al., 2012; Jones & Ratterman, 2009). In this scenario, the ornament is a costly trait, since it decreases the survival of the individual (Kuijper et al., 2012; Zahavi, 1975). Therefore, individuals who reach the reproductive age with a more elaborate version of the ornament show good genotype (Jones & Ratterman, 2009; Zahavi, 1975, 1977). Selecting individuals showing preference for such traits can thus provide genetic benefits to their offspring (Andersson & Simmons, 2006), producing the enhancement of the offspring reproductive value (Kuijper et al., 2012).

Despite the differences, Fisherian and Zahavi models could occur simultaneously throughout the evolution of traits and mating preferences (Andersson, 1994; Andersson & Simmons, 2006). The same coevolution could have also happened between direct and indirect benefits (Kuijper et al., 2012).

In summary, sexual selection provided an explanation for ornaments that have evolved in the context of mate attraction (i.e. intersexual selection), and weapons and signals that have evolved in the context of mate competition (i.e. intrasexual competition). However, both mechanisms could have coevolved concomitantly in certain species, producing the evolution of traits that work in both scenarios (Berglund, Bisazza, & Pilastro, 1996; Kuijper et al., 2012).

1.1.2 Parental Investment

The theory of sexual selection allowed scientists to examine and understand mate behaviors, the rise of disadvantageous characteristics to survival, and the sexual dimorphism

(Andersson, 1994; Buss, 1998; Miller, 1998; Puts, Jones, & DeBruine, 2012). Nevertheless, Darwin was unable to explain why males usually compete to have access to female, whereas female usually choose a particular mate among males (Laland & Brown, 2011; Miller, 1998). Trivers (1972) gave a solution to this inquiry when he proposed the parental investment theory.

Trivers (1972) defined parental investment as “any effort – from metabolic to behavioral – by a parent in a single offspring to increase its chance of surviving”. However, the effort located to seek out a mate and/or dispended in intrasexual competition is not considered as parental investment, since it does not increase the offspring’s chance of surviving. The parental investment decreases the parent’s ability to invest in other descendants and thus the sex with greater parental investment becomes the limiting resource in the mate choice, while the sex with lesser parental investment competes with conspecifics for access to mate.

In a ‘typical species’, female would gestate, lactate, and/or provide most of the post-parturition care to offspring. Therefore, the potential reproductive rate of females is limited, creating a scenario where fewer fertile females will be reproductively available compared to males in a population. Males thus should search for potential females and compete intra-sexually to have access to them, whereas females should discriminate among potential males and choose the one that would contribute the most to offspring quality and survival (Trivers, 1972; Vasey & Sommer, 2006). Nevertheless, Trivers (1972) argued that the underlying force driving selection is not the individuals’ sex, but rather the amount of parental investment dispended per offspring. Thus, in ‘atypical species’ male parental investment exceeds the opposite sex, which selects females to compete intra-sexually for males, while males are selected to choose a potential female mate (Trivers, 1972; Vasey & Sommer, 2006). Finally, when both sexes have equal investments, females and males do not show big differences in mate choice and intra-sexual competition (Trivers, 1972).

In humans, women possess a high parental care investment like ‘typical species’. First of all, women invest heavily in each egg cell, which are also produced in fewer quantities compared to sperm (Trivers, 1972; Vieira, Rimoli, Prado, & Chelini, 2009). Moreover, women have a high physiological investment in gestating, birthing, breast-feeding and raising offspring (Jasińska, 2009), since nursing can go up to several years (Buss, 1998; Eibl-Eibesfeldt, 1989; Miller, 1998). Finally, due to changes in prolactin levels during lactation, women’s ovulatory cycle can cease (Sousa, Hattori, & Mota, 2009). Therefore, such large investment slows women’s reproductive rates, driving male-male competition to have access to fewer fertile females (Dixson, 2016; Puts, 2010).

Nevertheless, humans have evolved a cooperative mating system, in which men help raising children (Sear, 2016). Compared with males of most animal species, men invest heavily in offspring (Puts, 2010). Such system has been selected because human infants are born immature motorically and perceptually and thus demand great amount of parental care for a particularly long period of time (Bjorklund, 1997; Vieira et al., 2009). As a result, humans have evolved a mating system, in which both women and men tend to provide extensive parental effort, compete with same-sex individuals, and actively choose their mates (Buss, 1998; Campbell, 2004; Sousa et al., 2009; Puts, 2010). For example, women can compete through a more attractive look (Cashdan, 1996, 1998; Schmitt & Buss, 1996), while men may choose younger female partners to increase the rate of potential offspring (Buss, 1989; Buss & Schmitt, 1993, 2019; Wood, 1994).

1.1.3 Human sexual strategies

Despite women and men show high parental investment, distinct mating systems have evolved and they influence each sex distinctly (Marlowe, 2003, 2005). The allocation of time and energy may provide an explanation for such event. Mating effort is a finite resource (Jones, Feinberg, DeBruine, Little, & Vukovic, 2008), which has created constraints, such as competition to obtain romantic partners, mate choice, investment in offspring, etc. Therefore, strategies were selected because they solve these adaptive problems (Buss, 2006; Buss & Schmitt, 1993, 2019). In mate choice, sexual strategies evolved because they helped individuals to solve, consciously or unconsciously, the adaptive problems linked with reproduction. From this perspective, mate selection and attraction are not random events: recurring sexual problems selected psychological mechanisms that adaptively replied to significant environmental information, partner status and one's own condition (Buss, 1998; Sousa et al., 2009). Such psychological mechanisms are called strategies.

Buss and Schmitt (1993) specified two sexual strategies according to a temporal context: short-term and long-term relationships. The former refers to the search of a partner who will require minimum levels of parental investment for a relatively short period of time, while the latter describes a romantic mate who will commit high levels of parental investment for a longer amount of time (Buss & Schmitt, 1993). Gangestad and Simpson (2000) discuss that both men and women display short-term and long-term strategies, because they have evolved conditional mating strategies guided by cues of environmental needs. More precisely, distinct

tactics have evolved, because individuals who could change, consciously or unconsciously, their mating behavior in response to cues in the environment were able to survive, procreate and have more offspring (Gross, 1996; Oliveira, Taborsky, & Brockmann, 2008). Thus, women and men can enact the same tactics; however, the average adaptive values were not equal for both sexes (Buss & Schmitt, 1993, 2019; Gross, 1996; Oliveira et al., 2008; Sousa et al., 2009), leading to relatively distinct features searched in a romantic partner.

Due to differences in the mechanisms of intersexual and intrasexual selection that were explained previously, women and men show distinct trade-offs regarding sexual strategies (Buss & Schmitt, 1993, 2019; Sousa et al., 2009). Considering the sex differences in minimal parental investment, men may benefit more than women from copulation with a high number of short-term partners and thus they would prefer mates with cues to genetic quality and fertility (Buss & Schmitt, 1993, 2019; Gangestad & Simpson, 2000; Li & Kenrick, 2006; Sousa et al., 2009; van Straaten, Engels, Finkenauer, & Holland, 2008). On the other hand, women may benefit more than men from investments in long-term relationships, and thus they would prefer mates with cues to direct qualities (Buss & Schmitt, 1993, 2019; Gangestad & Simpson, 2000; Pettay, Helle, Jokela, & Lummaa, 2007; Shackelford, Goetz, LaMunyon, Quintus, & Weekes-Shackelford, 2004; Sousa et al., 2009).

However, women could use a short-term strategy to receive both direct (e.g. immediate resources, social status) and indirect benefits (e.g. genetic quality), and/or assess a potential long-term mate (Buss, 1998; Buss & Schmitt, 1993, 2019; Gangestad & Simpson, 2000; Li & Kenrick, 2006; Sousa et al., 2009). Similarly, men could benefit from a long-term strategy to have access to a women's reproductive potential, decrease the effort on mate choice and mate competition, and/or share workload with a long-term partner (Buss, 1998; Buss & Schmitt, 1993, 2019).

In summary, recurring sexual problems selected psychological mechanisms to change, consciously or unconsciously, mating behavior. As a result, preferences for certain characteristics have been selected; however, they do not necessarily result in mate choice (Todd, Penke, Fasolo, & Lenton, 2007), because preferences are qualities searched in an ideal partner, while mate choice is the actual mate (Jennions & Petrie, 1997). In the current thesis we have focused on preferences, rather than actual behavior, because preferences or tendencies can reflect evolutionary adaptations, while actual behaviors can be influenced and restricted by other immediate factors.

1.2 Sex dimorphic traits

After reviewing the main theories crucial for the current thesis, sex dimorphic traits will be discussed below. Firstly, a review of the development of sex dimorphism will be shown. Then, the femininity-masculinity in human faces, voices, and behavior will be discussed. Finally, a summary of multimodal channel of femininity-masculinity will be presented.

1.2.1 *Femininity-Masculinity*

As discussed above, sexual selection produces the evolution of bodily ornaments, because they were advantageous in dealing with adaptive problems of mate choice and intrasexual competition. In addition, energy and resources are finites, and they have to be allocated in distinct aspects of an individual's life, including the reproductive domain (Geary, 2002; Roff, 1992; Vieira et al., 2009). Therefore, to increase the efficiency and efficacy of mate choice, psychological mechanisms were selected because they allowed the assessment of ornaments produced by sexual selection (Buss, 1998; Sousa et al., 2009).

One way to obtain information about the quality of a potential mate is by assessing feminine and masculine characteristics. Both traits are influenced by sex hormones, particularly estrogen and testosterone in women and men (Holzleitner & Perrett, 2017), respectively, which develop sexual dimorphisms. Thus, femininity refers to an individual's characteristics related to female's reproductive physical and social traits, while masculinity refers to male's physical and social traits (Dixson, 2016).

In mammals, sexual dimorphism starts to develop during the prenatal period. Around six weeks of the human gestation, sex-determining regions in the sex chromosomes determine the gonad differentiation into either a testis or an ovary, leading to sex hormones production (Eggers & Sinclair, 2012). The sex hormones thus induce intersexual differences in anatomy and behavior (Berenbaum & Beltz, 2011; Eggers & Sinclair, 2012).

The second relevant moment to sexual dimorphism occurs at the pubertal period. Puberty is characterized by an increase in the frequency and amplitude of gonadotropin releasing hormone (GnRH) secretion, producing a hormonal cascade that activates the gonads. This leads to the secretion of sex hormones, i.e. estrogen and androgens (such as testosterone). The elevated levels of sex hormones result in the appearance of secondary sex characteristics in anatomy (Forbes & Dahl, 2010; Sisk & Zehr, 2005). Sex hormones, besides other biological

and social factors, also influence cognitive processes, motivational tendencies, and behavior (Forbes & Dahl, 2010; Schulz et al., 2004; Sisk & Zehr, 2005).

Therefore, prenatal and pubertal hormones influence the development of sexual dimorphisms perceived in human adults. In the current thesis, however, only the anatomical and behavioral traits will be discussed. More precisely, femininity-masculinity in faces, voices, and dance movements were examined and thus a summary of the influence of hormones in those traits is presented below.

1.2.2 Feminine-Masculine traits

In faces, there is a positive relationship between women's estrogen levels and markers of femininity (Law Smith et al., 2006; Thornhill & Grammer, 1999). During pubertal development, the action of estrogens develops women's round overall shape, smaller lower faces, fat deposits on the upper cheeks, wide eyes, and larger lips (Grammer, Fink, Møller, & Thornhill, 2003; Perrett et al., 1998). Contrarily, high levels of testosterone are associated with male masculinity (Penton-Voak & Chen, 2004; Perrett et al., 1998). Facial masculinity includes larger jaws, chins and noses; more robust midface, prominent brows, and small eyes (Folstad & Karter, 1992; Grammer et al., 2003; Miller & Todd, 1998).

In the case of human voices, higher levels of estrogen increase women's larynges in size, although maintaining the general proportion among the laryngeal cartilages (Kahane, 1982). Vocal tract also increases, but in a lower magnitude compared to men (Fitch & Giedd, 1999). Finally, estrogen also slows down vocal fold development, lowering the fundamental frequency (i.e. the lowest frequency reached) by one third (Abitbol, Abitbol, & Abitbol, 1999). However, the women's vocal pitch (i.e. the perception of fundamental frequency) is still higher than men's (Abitbol et al., 1999; O'Connor, Re & Feinberg, 2011). On the other hand, testosterone causes a 60% increase in men's vocal fold length relative to women (Harries, Hawkings, Hacking, & Hughes, 1998; Titze, 1994), and develops a further descended larynx, increasing the lengthening of the vocal tract (Fitch & Giedd, 1999; Vorperian et al., 2009). Thus, men possess lower fundamental frequency (Fant, 1960) that is twice as low as the average woman's voice pitch (Feinberg, 2008; Fitch & Giedd, 1999; Titze, 1994).

Sexual dimorphism is also seen in behaviors, such as dance movements. For example, female judges assessed male dancers who were exposed to more prenatal testosterone

(measured by lower 2D:4D ratios of index and ring fingers) as more dominant, masculine, and attractive (Fink, Seydel, Manning, & Kappeler, 2007). Moreover, previous studies indicated that women and men show distinct body movements while walking: the former shows more hip movements (feminine body movement), while the latter presents more shoulder movements (masculine body movement) (Kozłowski & Cutting, 1977; Pollick, Kay, Heim, & Stringer, 2005; Saunders, Williamson, & Troje, 2010; Troje, 2002).

The intersexual variations in dance and body movements in general may be related to the display of sexual dimorphisms in body composition. According to Hanne (1988, 2010), dance was sexually selected to display beauty, health, strength, and sexual attractiveness. Sex hormones influence many aspects; however, waist-to-hip ratio (WHR), and waist-to-shoulder ratio (WSR) are the most related to intersexual variations in body movements.

Firstly, sex hormones influence sexual dimorphism in body composition (Evans, 1972; Jasińska, Ziolkiewicz, Ellison, Lipson, & Thune, 2004; Kasperk et al., 1997), through the distribution of fat and muscle (Biro et al., 2003; He et al., 2004; Kasperk et al., 1997). Women develop permanent stores of fat in some bodily areas, like around the buttocks and thighs (Grammer et al., 2003). On the other hand, men's body deposits fat especially around the abdomen, shoulders, arms, and neck (Braun & Bryan, 2006; Lourenço & Queiroz, 2010).

Higher levels of testosterone also develop muscularity, resulting in broad shoulders, and narrow hips in men (Grammer et al., 2003; Hönekopp, Rudolph, Beier, Liebert, & Müller, 2007; Samson et al., 2000). Sexual dimorphism in body composition results in a difference of about 15-20% in body mass (Mayhew & Salm, 1990), i.e. men are usually heavier than women. Nevertheless, these proportions increase to 40%, when fat-free mass is considered (Lassek & Gaulin, 2009; Mayhew & Salm, 1990). Moreover, men have 60% more total lean muscle (Lassek & Gaulin, 2009; Mayhew & Salm, 1990), when the whole body is considered. Further, men possess 80% greater arm muscle mass and 50% more lower body muscle mass (Abe, Kearns, & Fukunaga, 2003), when the body is divided into body segments. In summary, women's body composition is characterized by a higher amount of body fat and a lower amount of muscle mass relative to men (Folland & Williams, 2007; Kirchengast, 2010; Wells, 2007, 2012). Finally, masculinity also influences height (Grammer et al., 2003; Kempe, Puts, & Cárdenas, 2013; Samson et al., 2000): on average, pubertal men grow 7% taller than women (Gaulin & Boster, 1985).

The sexual dimorphism in body composition also creates a significant difference in body shape. Women are characterized by a greater discrepancy between the measurements of the waist and hips (i.e. WHR), while men possess a greater discrepancy between the

measurements of the waist and shoulders (i.e. WSR) (Biro et al., 2003; He et al., 2004; Jasińska et al., 2004; Tanner, 1981).

However, it is important to remember that there is also an intrasexual variation in the exposure to sex hormones. In fact, Mikach and Bailey (1999) discussed that, irrespective of sex, individuals that show a higher degree of an overall masculinization (i.e. individual who were exposed to higher levels of testosterone) are expected to show more masculine traits, while the opposite is correct for individuals with lower exposure to masculinization. Therefore, women and men show distinct levels of masculinization, which creates variations in the traits of femininity-masculinity. The implications of these intrasexual variations are discussed in the next section.

1.2.3 Cues of Femininity-Masculinity and Sexual Strategies

Previous studies suggest that physiological masculine traits might be a proxy for indirect investment in men. Women choose men with more masculine features in circumstances of high levels of male intra-sexual competition (Little, DeBruine, & Jones, 2013), social inequality (Brooks et al., 2011), poor health environment (DeBruine, Jones, Crawford, Welling, & Little, 2010a; Penton-Voak, Jacobson, & Trivers, 2004), and in conditions of high pathogen load (Lee & Zietsch, 2011; Little, DeBruine, & Jones, 2011a; Watkins, DeBruine, Little, Feinberg, & Jones, 2012). This happens because testosterone also causes immunosuppression and thus masculinity is considered a costly handicap that signals good health (Boothroyd, Scott, Gray, Coombes, & Pound, 2013; Folstad & Karter, 1992; Foo, Nakagawa, Rhodes, & Simmons, 2017; Thornhill & Gangestad, 2006; Zahavi, 1975).

Indeed, more masculine characteristics have been related to good health in men. Masculine physical characteristics in men (like faces, voices, body height, and broad shoulders) correlated negatively with respiratory disease, antibiotic use (Thornhill & Gangestad, 2006), and urinary biomarkers of low oxidative stress (Gangestad, Merriman, & Thompson, 2010). These findings are consistent with analyses of medical records and ratings of perceived health (Johnston, Hagel, Franklin, Fink, & Grammer, 2001; La Batide-Alanore et al., 2003; Rhodes, Chan, Zebrowitz, & Simmons, 2003; Scarbrough & Johnston, 2005; Scott, Swami, Josephson, & Penton-Voak, 2008; Thornhill & Gangestad, 2006). Rantala et al. (2012) also found that higher levels of salivary testosterone are associated with antibody response to a hepatitis B vaccine.

In addition to measures of health, testosterone correlated positively with apparent size (Feinberg, Jones, Little, Burt, & Perrett, 2005), dominance (Mazur & Booth, 1998; Puts, 2010; Puts, Gaulin, & Verdolini, 2006; Puts, Hodges, Cárdenas, & Gaulin, 2007), social status (Eisenegger, Haushofer, & Fehr, 2011; Gawley, Perks, & Curtis, 2009) and competitive advantage (Li et al., 2014). Finally, men's masculine features also predict reproductive potential (Puts, 2005; Rhodes, Simmons, & Peters, 2005) and mating success (Apicella, Feinberg, & Marlowe, 2007; Nettle, 2002; Peters, Simmons, & Rhodes, 2008; Puts, 2016; Prokop & Fedor, 2013).

Studies also suggested that men's attributes are not only cued via static representations, but also via body movements, like men's dance. Dance depends on muscle strength (Fitt, 1981; Koutedakis & Sharp, 1999), agility, balance, and flexibility (Bushey, 1966). Thus, dance communicates beauty, health, strength, vigor and sexual attractiveness, hence playing a role in mate choice (Hanna, 1988, 2010; Byers, Hebets, & Podos, 2010). Dancers at the peak of their abilities are able to learn complex sequences of movements, and synchronize their actions to changing musical speed and rhythm and thus reflecting physical, cognitive, and aesthetic qualities (Bläsing et al., 2012). Moreover, dance could also indicate psychological characteristics and genetic resistance to developmental stressors, since women rated dance movements of men who scored higher on sensation seeking as more attractive and possessing risk-taking behavior (Hugill, Fink, Neave, Besson, & Bunse, 2011), and more symmetrical men were rated as more attractive dancers (Brown et al., 2005). Indeed, dance of masculine men was rated as more assertive, attractive, and dominant (Fink et al., 2007; Hugill, Fink, Neave, & Seydel, 2009). Finally, Neave et al. (2010) identified that the movement of neck, trunk, and knee predicted females' ratings of dance quality, leading the authors to suggest that those movements cued health, vigor and strength.

According to the results presented above, women should prefer men with more masculine features as romantic partners. Nevertheless, studies show that women have a weak or inconsistent preference for masculine traits (Komori, Kawamura, & Ishihara, 2009; Said & Todorov, 2011; Scott, Pound, Stephen, Clark, & Penton-Voak, 2010; Thornhill & Gangestad, 2006), or they even prefer more feminine male individuals (Boothroyd, Jones, Burt, & Perrett, 2007; Perrett et al., 1998). As explained above, humans show conditional mating strategies, which are, among other factors, influenced by environmental needs. Hence, women's preferences might be influenced by the trade-off between indirect and direct investments into offspring.

Previous studies indicated that masculine characteristics in men are related to increased risk of aggression (Carré & McCormick, 2008), sociosexuality (Varella, Valentova, Pereira, & Bussab, 2014), preference for short-term relationships (Boothroyd, Jones, Burt, DeBruine, & Perrett, 2008; Rhodes et al., 2005), the likelihood of being unfaithful to a romantic partner (Booth & Dabbs, 1993; Hughes & Gallup, 2003; O'Connor & Feinberg, 2012), and higher rates of antisocial behavior (Booth, Granger, Mazur & Kivlighan, 2006; Hooper, Gangestad, Thompson, & Bryan, 2011; Mascaro, Hackett, & Rilling, 2013), as well as low equality (Price, Kang, Dunn, & Hopkins, 2011) and low investment in partner and offspring (Fleming, Corter, Stallings, & Steiner, 2002; Gray, Kahlenberg, Barrett, Lipson, & Ellison, 2002). Moreover, research indicated that women are aware of such association, since they can relate male masculinity to men's unwillingness to commit to romantic partners (O'Connor et al., 2011) and a tendency to infidelity (O'Connor, Fraccaro, & Feinberg, 2012a).

Since masculine features act as cues to indirect investments, mating strategy theories suggest that the costs associated with selecting masculine mates are bypassed and women can actually benefit from securing men's masculinity when seeking a short-term relationship (Dixson, Sulikowski, Gouda-Vossos, Rantala, & Brooks, 2016; Gangestad & Thornhill, 1997; Li et al., 2013). Such preferences appear for men's faces, bodies (Dixson, Dixson, Bishop, & Parish, 2010; Feinberg, DeBruine, Jones, & Little, 2008a; Johnston et al., 2001; Little, Jones, Penton-Voak, Burt, & Perrett, 2002; Little, Jones & Burriss, 2007b; Rhodes et al., 2005), voices (Feinberg et al., 2006; Puts, 2005) and body movements (Provost, Troje & Quinsey, 2008). For instance, in a limited budget situation, women prioritize male attractiveness (which cues to indirect quality) in a short-term mate (Li & Kenrick, 2006). Moreover, previous studies show that men's attractiveness is important for women's willingness to accept a request for casual sex (Schützwohl, Fuchs, McKibbin, & Shackelford, 2009), and women show better memory for men's physical features compared to verbal information, when considering a short-term relationship (Horgan, Broadbent, McKibbin, & Duehring, 2015). A preference for masculine male features in a short-term mating strategy may have adaptive value, since it can lead to healthier or stronger offspring that are more likely to survive (Gangestad & Thornhill, 1997; Kruger, 2006).

On the other hand, reduced phenotypic masculinity may be preferred by women in the context of long-term mating, as such men are perceived as more socially amenable, cooperative, and paternally investing as long-term partners (Buss, 1989; Buss & Schmitt, 1993, 2019; Dixson et al., 2016; Li & Kenrick, 2006; Li et al., 2013; Van Anders & Goldey, 2010). Such men thus display cues to higher direct qualities. For example, good male dancers

were described as less masculine and dominant, but more feminine, friendlier, more socially agreeable, warmer, and possibly as good long-term partners (Fink et al., 2012). Moreover, in a limited budget situation, women prioritized men's status and resources in a long-term mate (Li, Bailey, Kenrick, & Linsenmeier, 2002), as well as women perceived relatively more feminine male voices as more likely to be financially generous with their partner and as more likely to invest time and effort in a relationship (O'Connor et al., 2012a; Wade, Weinstein, Dalal, & Salerno, 2015). This trade-off in preferences for favoring direct qualities rather than indirect qualities in a long-term mate appears to have adaptive value, leading to increased reproductive success via better survival rates for both women and their children (Pettay et al., 2007).

Accordingly, research indicates that femininity might be a proxy for indirect investment in women. For example, facial femininity is related to fertility (Johnston, 2000; Law Smith et al., 2006; Rhodes et al., 2005), while high vocal pitch partly reflects age and is perceived as more attractive and youthful (Awan, 2006; Collins & Missing, 2003; Feinberg, DeBruine, Jones, & Perrett, 2008b; Nishio & Niimi, 2008; Röder, Fink, & Jones, 2013). Moreover, feminine body shape, e.g. low waist-to-hip ratio, was associated with reproductive maturity, fecundability, regular menstrual cycles, and perception of attractiveness and health (Jasińska et al., 2004; Singh, 1993; Singh & Singh, 2006, 2011), in part because large body fat stores are needed for ovulation, pregnancy, lactation, and fetal and infant brain development (Jasińska et al., 2004; Lassek & Gaulin, 2006, 2008; Singh, 1993). Finally, it seems as dance also cues to sex hormones. Miller, Tybur, and Jordan (2007) reported that female lap dancers earned higher tips in high-fertility days, while Fink, Hugill, and Lange (2012) showed that men assessed women's dance as more attractive in days of high fertility. Röder, Weege, Carbon, Shackelford, and Fink (2015) suggested that female dancers display greater variation in their waist and hip to draw men's attention to these body areas and their underlying qualities. In fact, Doyle (2009) reported a peak shift effect in male attractiveness perception of female bodies during movement due to alternating left and right waist and hips side.

Men's emphasis on female physical attractiveness varies with mating context. Selection pressures may have increased these associations in short-term mating strategies. More precisely, men's preference for women's physical attractiveness (which cues to indirect quality) increased in short-term relationships, especially for features indicating women's health and fertility (Buss, 1989; Buss & Schmitt, 1993, 2019; Gangestad & Simpson, 2000). For instance, men showed higher preference for attractive, feminine faces as short-term mates

(Burris, Welling, & Puts, 2011). Similar results were found for women's feminine voices (Puts, Barndt, Welling, Dawood, & Burriss, 2011).

In the case of long-term context, men prioritize traits like honesty, warmth, trustworthiness, fidelity, intelligence, and likeability (Buss & Schmitt, 1993, 2019; Fletcher, Tither, O'Loughlin, Friesen, & Overall, 2004). Such traits are related to direct investment. Moreover, previous research indicates that women's feminine faces are also important for long-term relationships, because they might cue to fecundity (Grammer & Thornhill, 1994; Wagstaff, Sulikowski, & Burke, 2015). For example, when given a mutually exclusive choice, men exhibited a stronger preference to see women's face rather than their body (Confer, Perilloux, & Buss, 2010; Jing Lu & Chang, 2012). In accordance, Röder et al. (2015) found that movement harmony judgements predicted men's perception of the attractiveness of women's dance movements in the long-term context, because dance could indicate genetic resistance to developmental stressors. However, there are still few studies on men's preferences for female femininity-masculinity, and some of them showed a male preference for female masculinity in long-term relationships (Little, Cohen, Jones, & Belsky, 2007a; Pettijohn & Tesser, 2005).

In summary, research indicates that physical femininity-masculinity influence human mate choices, however in a distinct way in accordance with the individual's sex and the sexual strategies. Women are more prone to choose indirect qualities (i.e. male masculinity) in short-term context, and direct qualities (i.e. male femininity) in long-term context. Contrarily, men seem to pick female femininity in both cases, but for different reasons: especially, cues to health and fertility in short-term, and cues to parental investment and fecundity in long-term relationships (however, results in the opposite direction for long-term partners are also found).

Nevertheless, indirect and direct investments are not mutually exclusive and might happen simultaneously in the same individual. But Waynforth (2001) argues that it is more likely that women and men are prone to show either quality in a stronger intensity. Moreover, especially in the case of women, the most preferred mate is the one that display both traits, but it may not be possible for most individuals to secure such mate, hence leading to a trade-off between indirect and direct investments (Buss & Schmitt, 1993, 2019; Gangestad & Simpson, 2000; Horgan et al., 2015; Little et al., 2002; Puts et al., 2012).

1.2.4 Multimodality of Femininity-Masculinity

As shown before, sex hormones are one of the factors that influence distinct aspects of women and men and thus femininity-masculinity can be assessed through multiple traits. In fact, in the mating context, various species integrate information from multiple sensory modalities for production and perception of cues (Candolin, 2003; Higham & Hebets, 2013; Hebets & Papaj, 2005; Iwasa & Pomiankowski, 1994; Partan & Marler, 1999). Assessing multiple cues of the same underlying mate quality may be adaptive if it aids in the selection of higher quality mates. Such multimodal information can be advantageous for both the producers and the perceivers. The former may efficiently advertise their own qualities, while the latter may increase the fidelity of the received information, reduce the efficacy of potentially dishonest cues, and obtain information in situations where only one of the sources is available (Candolin, 2003; Rowe, 1999).

Firstly, multiple cues can comprise unimodal or multimodal information: the former is characterized by multicomponent cues to a single sensory modality, while the latter is the production of multicomponent cues to multiple sensory modalities (Rowe, 1999). Moreover, they characterize either redundant (also known as backup signals), or non-redundant messages (also known as multiple message). Redundant cues refer to multiple cues conveying similar information through different communication channels. Therefore, they can enhance the transmission of information to the recipient and elicit the same response, which reduces the probability of making inaccurate assessments of mate quality. On the other hand, the non-redundant messages claim that different cues carry different information. Hence, they work independently and can modulate each other effect, or they can create a combination that transmits a difference message (Bro-Jørgensen, 2010; Johnstone, 1996, 1997; Moller & Pomiankowski, 1993; Partan & Marler, 2005).

Thus, this discussion raises two important issues: 1) do multiple cues affect both sexes similarly?, and 2) how can we differentiate redundant and non-redundant messages? Firstly, from the perceiver's perspective, it is expected that the sex with higher level of parental investment would be more attentive to mating cues of femininity-masculinity in a potential partner. As discussed previously, women and men tend to show extensive parental effort and thus both sexes are expected to use multiple sensory cues during mating context (Valentova, Varella, Havlíček, & Kleisner, 2017). Secondly, correlations between traits are considered as evidence of redundancy, whereas uncorrelated traits are considered as evidence of non-

redundancy (Wells, Baguley, Sergeant, & Dunn, 2013; Wells, Dunn, Sergeant, & Davies, 2009).

Accordingly, several characteristics correlate among each other. For example, individuals were able to match unknown faces and voices, because ratings of facial femininity-masculinity correlated with ratings of voices (Smith, Dunn, Baguley, & Stacey, 2016). More precisely, women with voices rated as feminine also had faces rated as feminine (Penton-Voak et al., 2001), and third-party ratings of feminine female voices and faces correlated (Fraccaro et al., 2010). Finally, men preferred both women's feminine faces and voices (Fraccaro et al., 2010; O'Connor, Fraccaro, Pisanski, Tigue, & Feinberg, 2013), and men's assessments of women's facial and vocal attractiveness also correlated (Collins & Missing, 2003; Valentova et al., 2017).

In the case of men's stimuli, previous studies found correlated preferences for men's masculinity among women who rated still images of faces and voices independently (Feinberg et al., 2008a; Feinberg, DeBruine, Jones, & Perrett, 2008b), and among women who rated dynamic video stimuli in which male faces and voices were simultaneously manipulated (O'Connor et al., 2012). However, the association between men's vocal and facial attractiveness is not always supported (Lander, 2008; Saxton, Burriss, Murray, Rowland, & Roberts, 2009; Valentova et al., 2017; Wells et al., 2013).

In summary, previous research indicated a positive correlation between ratings of facial and vocal femininity-masculinity and attractiveness; however, the said association was found in particular for women's stimuli. This suggests that female traits are evaluated simultaneously to improve information exchange in the context of mate choice. Contrarily, men's different characteristics can convey different information about the organism, and are thus not redundant. Nevertheless, despite the multimodal nature of masculinity and femininity, most current studies still focus on isolated cues (Wells et al., 2009), especially facial traits. Therefore, other channels of information are neglected (Groyecka et al., 2017; Roberts et al., 2011), like dance movements. In line with this reasoning, the current thesis examined traits of femininity-masculinity on faces, voices, and dance movements in both men and women.

1.3 Influence of Pathogen Threat and Resource Scarcity

The current introduction has reviewed some aspects of the evolution of human mate choice. More precisely, it has been discussed how sexual strategies (i.e. short-term and long-term relationships) may influence preferences for intrasexual variations in facial, vocal, and behavioral femininity-masculinity of a potential partner of the opposite sex. In the section below, we discuss how ecological variables, in particular pathogen threat and resource scarcity, can influence human sexual strategies.

1.3.1 Environmental Threats and Sexual Strategies

As previously mentioned, the variation in mating preferences occurs because human mind is a set of information-processing mechanisms, and at least some of those have been selected to solve adaptive problems throughout our evolutionary history (Cosmides & Tooby, 1997; Moura & Oliva, 2009; Tooby & Cosmides, 2015). These problems might have been partly posed by environmental constraints, which changed the dynamics of mate choice and preferences (Buss & Schmitt, 1993, 2019). Thus, mental mechanisms have allowed their owners to process this environmental information and modify behavior in accordance (Cosmides & Tooby, 1997; Tooby & Cosmides, 2015).

Previous research showed evidence that human preferences vary in accordance with ecological factors, like conditions of high pathogen load (DeBruine et al., 2010a; Low, 1990; Marcinkowska et al., 2014; Nettle, 2009; Penton-Voak et al., 2004) and resource scarcity (Batres & Perrett, 2014; Nelson & Morrison, 2005; Penton-Voak et al., 2004; Pettijohn & Jungeberg, 2004; Pettijohn, Sacco, & Yerkes, 2009; Pettijohn & Tesser, 1999). This scenario causes a trade-off between indirect and direct benefits of femininity-masculinity for reproduction and parenting.

Gangestad and Simpson (2000) argued that in environments where there is a high prevalence of pathogens, humans would emphasize traits cueing indirect benefits in a potential partner. Parasites are strong selective forces, because they evolve in response to their hosts' defenses, which can decrease the probability of offspring survival and eventual reproduction (Gangestad & Grebe, 2014; Gangestad & Simpson, 2000; Tybur & Gangestad, 2011). Therefore, indirect investment into reproduction (e.g., genetic quality) might be essential to offspring survival. On the other hand, environments with low resource availability (e.g., food and water) increase the need for biparental care and commitment to the romantic partner, and thus generally humans would seek cues of direct investments into reproduction

(Gangestad & Simpson, 2000). Although it has some limits, this reasoning gained some empirical support.

Following the hypotheses of human conditional mating strategies by Gangestad and Simpson (2000), previous studies examined the influence of pathogen threat and resource scarcity on mating preferences for femininity-masculinity. Firstly, authors have examined correlational studies. Women living in countries with high pathogen prevalence showed greater preference for masculine male faces (DeBruine et al., 2010a; Penton-Voak et al., 2004). Moreover, pathogen disgust predicted women's preference for masculinity in men's faces, voices, and bodies (DeBruine, Jones, Tybur, Lieberman, & Griskevicius, 2010b; Jones et al., 2013). Similar results were found for men's preferences for women's femininity (Lee et al., 2013), although few studies have been done. Finally, correlational studies have also demonstrated the association between resource scarcity and women's preferences for more feminine traits in a potential male partner of the opposite sex (Lee et al., 2013; Stewart, Stinnett, & Rosenfeld, 2000), though no research was found for men's preferences.

1.3.2 Priming Experiments on Environmental Threats

Priming experiments have been conducted to investigate the influence of pathogen threat and resource scarcity on human preferences for femininity-masculinity. Little et al. (2011a) presented cues of pathogens to men and women. Their work consisted of composite face images, i.e. facial images were averaged from several individual facial photographs of the same sex – therefore, the composite photos do not represent real individuals. The composite images were shown in pairs: one masculinized and one feminized version of the same composite face were shown and participants were asked to choose the most attractive image. After presenting a slideshow of images with cues to high pathogen prevalence, women preferred more masculine male faces, while men preferred more feminine female faces – no changes were observed for the evaluations of the same-sex faces.

A similar design was used by Lee and Zietsch (2011). Three different questionnaires were applied as primes: 1) pathogen prevalence, 2) resource scarcity, and 3) irrelevant threat. After completing one of the surveys, women were requested to allocate a limited number of 'mate dollars' to construct an ideal partner with traits of indirect benefits (e.g. intelligence, high social level) and/or direct benefits (e.g. emotionally warm, high earning potential). Women who were primed with cues of pathogen prevalence showed greater desire for traits indicative

of genetic quality, while those who were primed with cues of resource scarcity preferred features of parental quality.

Watkins et al. (2012) also used priming questionnaires; however, they only used the questionnaires on pathogen prevalence and resource scarcity - having therefore no control condition. After answering one of the surveys, women rated pairs of faces – each pair consisting of one masculinized and one feminized version of a male face image – choosing the most attractive version. Women primed with pathogen threat preferred more masculine images than did women primed with resource scarcity.

Some studies have shown variations in the method of creating cues of pathogen threat and resource scarcity and thus Lee and Zietsch (2015) decided to investigate whether experiment design could affect results. The researchers employed three distinct experiments. Firstly, women were requested to choose one of two composite male facial photos, which were manipulated on masculinity and femininity. Moreover, female raters and facial images consisted of young and old adults. As a result, the authors found that the association between female preference for masculinity and pathogen loaded environment was only found when young women rated young men. In the second study, the composite photographs of young men were manipulated using templates of older faces, while the opposite occurred with the composite images of older men. In this case, no association was found. Finally, in the third study, women evaluated natural faces varying in masculinity and age, and they rated the attractiveness of each image on a 100-point scale. Once again, no association between male masculinity and pathogen threat was found. Therefore, the researchers argued that the age of the stimuli and the experiment design might influence the results.

Finally, Little et al. (2007a) asked participants to imagine themselves in a harsh or a safe environment. Then, volunteers were requested to choose the most attractive face as a short-term or long-term partner between a pair of composite facial photos (varying in femininity-masculinity). Results showed that women assessed feminized men as more attractive, while men preferred masculinized women for long-term relationships. Thus, this study raised doubts in men's preference for women's femininity for a long-term relationship in the context of resource scarcity.

However, only a few studies have tested men's preference for female masculinity and the association between masculinized women and direct benefits. For instance, Cashdan (2008) argued that more masculine features would increase success in resource competition, because masculinized women are more competitive (Cashdan, 2003) and aggressive (Dabbs & Hargrove, 1997; Harris, Rushton, Hampson, & Jackson, 1996). Moreover, feminine

women were assessed as more likely to be unfaithful and pursue short-term relationships (Boothroyd et al., 2008). Therefore, more studies are needed to investigate this issue.

In summary, previous studies examined the influence of pathogen threat and resource scarcity generally on women's mate preference. The exception was Little et al. (2011a), and Little et al. (2007a). However, the former only investigated cues of pathogen incidence (not resource scarcity), while the latter examined a general concept of environmental harshness. Moreover, the majority of studies used composite faces to test preferences for femininity-masculinity, with exception of Lee and Zietsch (2015), who studied unmanipulated faces of men in their third experiment and found no association between women's preference for male masculinity and pathogen threat. Further, tests have mainly examined faces. Jones et al. (2013) are an exception, as they also studied men's voices and bodies; nevertheless, their aim was to study pathogen disgust and preferences for femininity-masculinity, and in this correlational design they found positive correlations between women's pathogen disgust and their preferences for masculinity in men's voices, faces and bodies. Finally, most studies have used the forced-choice paradigm, but Lee and Zietsch (2015) showed that the study design might influence the results.

1.4 Aims of the Thesis

Above we briefly outlined selected aspects of human sexual strategies. We focused on intrasexual variation in femininity-masculinity and how it could influence women's and men's preferences for a potential partner of the opposite sex. Moreover, we examined how external ecological factors, i.e. pathogen threat and resource scarcity, could modify human preferences for variation in femininity-masculinity.

We also showed that there are some limitations in the current literature. Firstly, there is a lack of studies examining the association between self-perceptions and third-party perceptions of femininity-masculinity, as well as the relationships between subjective perceptions and objective measures of femininity-masculinity. Then, considering the third-party ratings, studies have also lacked to investigate whether a potential mate perceive the cues to femininity-masculinity concordantly across different channels of information. Finally, studies have not integrated the influence of environmental threats on women's and men's preferences for femininity-masculinity when searching for long-term and short-term partner of the opposite sex.

Moreover, there are some general limitations. Past research has usually focused on data collected among Americans, Canadians, Australians, and Western Europeans. In addition, studies have mainly used manipulated faces as stimuli, neglecting other channels of information, like voices and dance movements. Further, men's preferences for cues to femininity-masculinity in an opposite-sex partner have been poorly tested, as well as general conditional male mate preferences. Finally, there is a lack of discussion on the influence of study design on the current results.

To address these limitations, we conducted a bigger research project and from these data we wrote three articles that are shown below. '3.1 Chapter one' addresses the association between subjective perceptions and objective measures of femininity-masculinity and attractiveness in faces, voices, and dance behavior. The second chapter (see '3.2 Chapter two') discusses the association between third-party ratings on facial, vocal, and behavioral femininity-masculinity. Finally, '3.3 Chapter three' examined the influence of pathogen threat and resource scarcity on preferences for femininity-masculinity in faces, voices, and dance movements in potential partners for short-term or long-term relationships. In the last study, third-party raters assessed the stimuli in a standalone rating design using unmanipulated stimuli. Importantly, the three studies were conducted among Brazilians. The three articles aimed to fill important gaps in the knowledge on underlying processes of human sexual strategies and mate preferences.

2 EMPIRICAL RESEARCH

The data collection was divided into two parts, namely three pretests and one experiment. The pretests were carried out to test the effectiveness of the priming material (i.e. newspaper-like articles), and choose facial, vocal, and behavioral stimuli according to femininity-masculinity. More precisely, ‘pretest 1’ was conducted to determine which photographs should be used in the articles, while ‘pretest 2’ tested the newspaper-like articles. In both cases, it was examined whether the pictures and the articles were effective as primes. Moreover, ‘pretest 3’ was carried out to select the five most feminine and the five most masculine facial images, voices, and dance movements of each sex. Finally, the experiment tested whether participants’ preferences for femininity-masculinity were influenced by the priming conditions.

The project was approved by the Institute of Psychology’s Human Research Ethics Committee in April 2016. For the project approval letter, see Annex A. For a summary of the study design, see Table 1.

Table 1 – Study design

| | Aims | Description | Survey date |
|-------------------|--|--|--|
| Pretest 1 | To choose images of pathogen threat and resource scarcity to be part of the newspaper-like articles on pathogen threat and resource scarcity. | 14 women and 7 men rated 15 photographs related to the <i>Aedes aegypti</i> mosquito and 15 pictures associated to the economic crisis in Brazil. Six photographs (three related to the pathogen threat) were selected to be in the newspaper-like articles. | From May 7 th 2016 to May 15 th 2016 |
| Pretest 2 | To test whether the newspaper-like articles are effective as primes. | 15 women and 10 men assessed the newspaper-like articles on pathogen-priming condition, resource-priming condition and control condition. | From May 23 th 2016 to June 2 nd 2016 |
| Pretest 3 | To select the five most masculine and the five most feminine stimuli (faces, voices, and dances) of each sex. | 43 women and 21 men assessed facial photographs, vocal recordings, and dance videos of both sexes, according to perceived femininity-masculinity. | From May 17 th 2017 to August 28 th 2017 |
| Experiment | To examine whether pathogen threat and resource scarcity influence participants’ preferences for femininity-masculinity in long-term and short-term relationship contexts. | (A) In the long-term context: 58 women and 45 men were primed with ‘control + pathogen threat’, while 46 women and 43 men were primed with ‘control + resource scarcity’. (B) In the short-term context: 51 women and 33 men were primed with ‘control + pathogen threat’, while 51 women and 43 men were primed with ‘control + resource scarcity’. | From October 30 th 2017 to February 16 th 2018 |

2.1 Description of the data collection

A more detailed description of the pretexts and the experiment is shown below. The current subsection contains further details on the methodology, since the academic journals impose word limitations for publication. Section 3 contains the scientific papers written with the data collected and that were submitted to publication.

2.1.1 Pretest 1

The main experiment of the current thesis is composed of three newspaper-like articles created by the PhD student, following previous methodologies (e.g. Hill, Rodeheffer, Griskevicius, Durante, & White, 2012). Hence, it was necessary to test whether the priming conditions would influence people's perceptions about pathogen threat and resource scarcity and thus two pretests were carried out.

The first pretest was conducted to determine which pictures would be used as visual cues on the newspaper-like articles about pathogen threat and resource scarcity. Using a Google search, 30 images were selected: (a) 15 photographs represented the 2015 *Aedes aegypti* epidemic in Brazil, and (b) 15 photographs showed the 2015 Brazilian economic crisis. All selected images can be found in '3.3 Chapter three'.

Emails were sent to the postgraduate students of the Department of Experimental Psychology at the Institute of Psychology, University of Sao Paulo, to request their participation in the study. The survey was carried out online using the Qualtrics platform (<https://www.qualtrics.com/>) and it possessed seven pages, including a Free Consent Term, some basic demographic questions, the priming images, and some rating scales. The Free Consent Term had a brief description of the aims, duration, information about Human Research Ethics Committee and the PhD student, and how volunteers could quit in any point. Moreover, participants had the possibility of downloading the Free Consent Term at the end of the survey, if they wanted. Moreover, the demographic questions were about sex, age, education, ethnic origin, sexual orientation, and monthly household income. The Free Consent Term and all the questions can be found in Appendix A.

The images were divided into two blocks: 1) pathogen threat, containing the photos of the *Aedes aegypti* epidemic; and 2) resource scarcity, possessing the photos of the Brazilian economic crisis. Below each photograph, participants had to answer three questions on a 10-point scale. The order of the questions was randomized twice by Qualtrics platform. Firstly, both blocks were randomized and thus some participants rated first the images about pathogen

threat, while others assessed photos about resource scarcity in the first place. Secondly, each block showed the images randomly.

The survey was collected from May 7th 2016 to May 15th 2016, and it lasted around 20 minutes. Twenty-one postgraduate students (14 women and seven men) completed the study. After the statistical analyses, three images about pathogen threat and three images about resource scarcity were selected to be on the newspaper-like articles. More details are found on '3.3 Chapter three'.

2.1.2 Pretest 2

The second pretest was designed to determine if the journal articles fitted properly as primes. Three articles were written containing the following features: (a) the first information was the headline, varying from eight to 11 words, and using font size 20; (b) the line below comprised the subheading, from 16 to 25 words, font size 12; (c) one picture were placed subsequently with a caption, varying from 12 to 17, using font size 9 – all those elements were shown in a single-column format. Then, the text was presented in a two-column format, on two pages and contained 700 words, using font size 12. On the second page, the two remaining photos were placed – the first one had a caption varying from 11 to 13 words, while the second, from eight to 15 words; but both using font size 9. The whole text used Times New Roman font. The three articles are shown in '3.3 Chapter three'.

One article was written to prime the pathogen threat condition and it consisted of information about the 2015 *Aedes aegypti* epidemic in Brazil. Information was collected online, from October 2015 to February 2016, on the main Brazilian newspapers using Google search. The search comprised information about the mosquito *Aedes aegypti*, Dengue fever, Zika Virus disease, and Chikungunya virus.

The second article aimed to prime the resource scarcity condition. It contained information about the 2015 Brazilian economic crisis, including increasing unemployment rates, industry and trade deficit, and a decline in state educational investments. Information was collected online, from August 2015 to February 2016, using the same methodology described above.

The last article was written to prime a control condition. For that reason, it included information on lions poisoned in a Kenyan Reserve on December 2015. The subject was chosen because it had no association with pathogen threat or resource scarcity. Nevertheless, it was also an emotional topic as the previous ones. Information was gathered using the same

methodology described above. The control article also contained three pictures that were related to the event; however, such photographs did not take part in ‘pretest 1’.

‘Pretest 2’ was conducted in a similar way as ‘pretest 1’ considering the online platform, Free Consent Term, and demographic questions. The survey was divided in three blocks. Each block consisted of one newspaper-like article and six questions on a 7-point scale. The six questions comprised the same ones presented in ‘pretest 1’ about the pathogen threat and resource scarcity. Once again, the survey was randomized twice, i.e. the three blocks and the questions in each block were randomly showed. Such information is found in Appendix B.

Twenty-five postgraduate students (15 women and 10 men) completed the survey, from May 23th 2016 to June 2nd 2016, and it lasted around 30 minutes. They were recruited at the University of Sao Paulo, campus of São Paulo city. Results indicated that the newspaper-like articles led people to perceive threats of pathogen and resource differently and thus they were used in the experiment as primes. For more details, see ‘3.3 Chapter three’.

2.1.3 Pretest 3

After the pretests of the newspaper-like articles, the facial, vocal, and behavioral stimuli were chosen. Facial photographs, vocal recordings and dance videos were shown to third-party raters to assess femininity-masculinity. The goal of ‘pretest 3’ was to select the five most masculine and the five most feminine faces, voices, and dances of each sex among a previously collected sample.

The stimuli were collected by Professor Jaroslava V. Valentova and Dr. Marco A. C. Varella in 2011, as part of an intercultural study on human mating strategies (see Havlíček et al., 2017; Valentova et al., 2017a; Varella et al., 2014). Back then, MS. Kamila J. Pereira was an undergraduate student and she took part in the Brazilian sample collection. Participants were recruited at the University of Sao Paulo, campus of Sao Paulo city, mostly in the Institute of Psychology surrounds. They were informed about the basic aims of the study, and were invited into the laboratory. In the laboratory, volunteers received more information and signed a Free Consent Term. The whole procedure took around 60 minutes. From the initial sample, 41 women and 38 men were selected to provide stimuli for ‘pretest 3’. Each volunteer was photographed and had their voices and dance movements recorded. More details about the procedure and participants can be found on Chapters 1, 2 and 3.

The photographs consisted of frontal view faces of men and women. They were taken under standardized condition in a quiet room and by a single researcher (Professor Jaroslava Varella Valentova). The equipment used was a Canon EOS 350D (lenses Canon EF 50mm f/1.8) placed on a Velbon Sherpa 600R tripod. Participants worn standardized clothes (white T-shirts, and grey pants), and makeup remover and elastic bands were provided when needed. Finally, volunteers were requested to stand 1.5 meters away from the tripod/camera at a determined spot in front of a standardized grey background, and adopt a neutral facial expression. Moreover, to standardize the light conditions, two spotlights were used. Subsequently, using Photoshop CS5, each photo was placed on a neutral grey background (RGB 191, 191, 191), and were standardized for inter-pupil distance and height of eyes (Valentova et al., 2017a).

Then, dance recordings were made using the same clothes and background. Participants were requested to dance as naturally as possible on a rhythm played from a computer. The final recordings consisted of 10-seconds videos, in which faces were blurred to avoid any influence of facial features. For more details, see Chapters 1, 2 and 3.

Vocal samples were recorded in the previous room by a single researcher (Dr. Marco A. C. Varella). Firstly, participants did a small vocal exercise to reduce stress and familiarize them with the recording procedure. Then, men and women repeated standardized sentences printed on a paper in Portuguese, namely “Hi, my name is Pedro and I am from Belo Horizonte”, and “Hi, my name is Ana and I am from Belo Horizonte”, respectively. The record was made with a digital voice recorder and vocal spectrograms were analyzed by Praat software (www.praat.org) (Valentova et al., 2017a).

The stimuli were presented to third-party raters to assess perceived FM on a 100-point scale ranging from 0 (*very feminine*) to 100 (*very masculine*). Participants were recruited at the University of Sao Paulo, campus of Sao Paulo, and comprised 43 women and 21 men. An email was sent to the institutes requesting for propaganda among undergraduate and postgraduate students.

‘Pretest 3’ was conducted similarly to the previous ones regarding the platform, Free Consent Term, and demographic questions. After reading the Free Consent Term, participants were presented with one photograph, one vocal recording, and one dance video to test whether their computer system would show the stimuli properly. Afterwards, faces, voices, and dance movements were divided into three distinct blocks, respectively, in a way that volunteers assessed each type of stimuli separately. The three blocks were presented in a random order, as well as the stimuli inside each block. The Free Consent Term and all the

questions can be found in Appendix C. The survey was collected from May 17th 2017 to August 28th 2017, possessed ten pages, and lasted around 80 minutes.

An average score was calculated and analyzed for each stimulus. No statistical difference was found among items and thus the five most feminine and the five most masculine stimuli were chosen for each sex (20 facial photographs, 20 vocal recordings, and 20 dance videos in total). The choice was also conducted to create homogeneous stimuli and thus avoiding some confounding variables: distinct ethnicity, voice pitch, and abnormal dance movements were left out. Therefore, we excluded photographs of Asian and Black people, one women's voice that was too deep in comparison to the other masculine female voices, and dancers who turn their backs to the camera.

2.1.4 Experiment

The newspaper-like articles and the chosen stimuli of faces, voices, and dance behavior comprised the main experiment of the current thesis. Three hundred seventy individuals (206 women and 164 men) were recruited online among public and private universities across the state of Sao Paulo to examine the influence of pathogen threat and resource scarcity on the preference for femininity-masculinity. The sampling strategy involved a multi-modal approach: 1) emails were sent to the institutes requesting for propaganda among students; 2) messages were spread among the universities' *Facebook* groups; and 3) via snowball sampling.

The experiment was carried out similarly as previous pretests regarding the online platform, Free Consent Term, and demographic questions. After reading the Free Consent Term, similarly to 'pretest 3' volunteers saw one photograph, one vocal recording, and one dance video to check whether their computer system would show the stimuli properly. Afterwards, participants were randomly assigned to either short-term or long-term context. In the former, they were requested to assess the attractiveness of each stimulus as a potential short-term partner (e.g. one-night stand, uncommitted relationship). In the latter, the stimulus should be assessed as a potential long-term partner (e.g. dating, engagement, or marriage). Finally, in both cases, volunteers were asked to make the assessment according to first impressions caused by the stimuli.

Participants were, then, randomly assigned to either the pathogen-priming or resource-priming condition. In both cases, they were exposed to the control condition as well.

Moreover, conditions were shown randomly. After reading one of the newspaper-like articles, volunteers assessed stimuli of the opposite sex (picked on 'pretest 3') according to attractiveness on a 100-point scale. Finally, at the end of the survey, additional explanations on the purpose of the experiment were provided for participants, as requested by the Ethics Committee.

The whole experiment lasted around 40 minutes and it happened from October 30th 2017 to February 16th 2018. The Free Consent Term and all the questions can be found in Appendix D. More details are found in '3.3 Chapter three'.

3 CHAPTERS

The pretexts and the experiment were written as three scientific articles and they have been submitted to three international journals. The articles are shown below as Chapter 1, Chapter 2, and Chapter 3. ‘3.1 Chapter one’ comprised the article on the association between subjective perceptions and objective measures of femininity-masculinity and attractiveness. It was submitted to *Personality and Individual Differences* in February 2019 and named ‘Femininity-masculinity and attractiveness – associations between self-ratings, third-party ratings and objective measures’. For submission details see Annex B. The second chapter consisted of the article called ‘Positive association between facial and vocal femininity/masculinity in women but not in men’. It was submitted to *Behavioural Processes* in April 2018 and it examined if women’s and men’s femininity-masculinity is concordantly perceived by third-party raters from faces, voices, and dance movements. Submission details are provided in Annex C. Lastly, ‘3.3 Chapter three’ comprised the scientific paper about the influence of pathogen threat and resource scarcity on women’s and men’s preferences for femininity-masculinity in potential long-term and short-term partners of the opposite sex. It was submitted to *Evolution and Human Behavior* in February 2019 and named ‘The influence of resource scarcity on multimodal preference in long-term, but not pathogen threat in short-term relationships’. See Annex D for submission details.

3.1 Chapter one

Femininity-masculinity and attractiveness – associations between self-ratings, third-party ratings and objective measures

3.1.1 Introduction

Perception of human attractiveness has been shaped by both culture and evolution. Attractiveness thus provides cues to both social and reproductive qualities of possible mates (Cunningham, Barbee, & Philhower, 2002). Alexander (1979) suggested that self-awareness in humans evolved as a way to compare ourselves with potential reproductive rivals. The accurate assessment of a potential mate’s quality and one’s self-perceived mate value would help avoid wasting resources on valuable mates one could not attain, or on less valuable mates

who would reduce one's reproductive success (Miller, 2000; Regan, 1998a). Thus, potential reproductive success depends on accurate calibration of self- and other-perception. In line with this reasoning, we can expect that people perceive their own attractiveness and other evolutionary relevant characteristics in accordance with other people's judgments.

Previous research mostly used either self-rated or other-rated attractiveness, but studies rarely examined the association between self-perceptions and third-party perceptions. For example, in women, some research found that self-rated and other-rated attractiveness correlate positively (Weeden & Sabini, 2007), but other studies reported a negative (Clark, 2004) or non-significant correlation (Mulford, Orbell, Shatto, & Stockard, 1998). Further, some studies showed that self-rated and other-rated attractiveness are differently related to objective predictors of attractiveness. For example, female self-perceived facial attractiveness was predicted by BMI and fluctuating asymmetry, while female facial attractiveness rated by men was predicted more by maturity (Muñoz-Reyes, Iglesias-Julios, Pita, & Turiegano, 2015). Thus, both measurements of attractiveness are, at least to some degree, dissociated, and more studies are needed to investigate these associations. Further, studies have mostly examined the association between self-ratings and other-ratings of facial appearance (e.g., Muñoz-Reyes et al., 2015), overlooking other domains, e.g. voice, body, or behavior. Similarly, associations between self- and other-perceived evolutionary relevant characteristics other than attractiveness, such as femininity-masculinity, health, or social status, should be explored more.

In particular, feminine and masculine (FM) characteristics influence preferences for potential mates. Physical traits indicating exposure to sex hormones cue to fertility, reproductive value, and health and thus are relevant for assessing mate qualities (Jasieńska et al., 2004; O'Connor et al., 2013). Indeed, women's femininity is usually perceived as attractive (Rhodes, 2006). In contrast, there appears to be a trade-off between benefits associated with male masculinity and cost related to perceived aggression (Carré & McCormick, 2008) and lower parental investment (Mascaro et al., 2013). This can explain the mixed results for preferences of men's masculinity (e.g., DeBruine et al., 2006; Valentova, Roberts, & Havlíček, 2013).

However, studies use different methods to measure FM, including objective measurements (e.g., facial morphology, voice pitch, and body circumferences), ratings by others, or self-ratings. Thus, to analyze whether others accurately assess self-evaluations and

whether perceived appraisals accurately reflect objective measures, it is important to test the association between self-rated, other-rated, and objectively measured FM in both men and women.

3.1.1.1. Aims

In this study, we examined possible associations between subjective perceptions (i.e., self-ratings and other-ratings) and measures of facial, vocal, and behavioral attractiveness and femininity-masculinity. We tested whether self-reports correlated with third-party ratings and whether subjective perceptions of faces, voices, and dance videos correlated respectively with: (a) facial sexual shape dimorphism, (b) vocal fundamental frequency, and (c) dance movements.

3.1.2 *Material and methods*

3.1.2.1 Participants

The target sample consisted of 41 women (mean age = 24.0 years, SD = 5.05, range 18-35) and 38 men (mean age = 23.6 years, SD = 3.28, range 19-32). Participants were Brazilian heterosexual students, comprising undergraduates (76.0%), postgraduates (20.2%), and postdocs (3.8%); 74.7% rated themselves as white, 17.7% as mixed race, 5.1% as black, with no response from 2.5%.

3.1.2.2 Procedure

Participants were approached and invited to the laboratory, or came after reading information sheet spread around the Sao Paulo campus of the University of Sao Paulo. They read and signed a consent form and then had their faces photographed, voices recorded and dance movements videotaped. Volunteers wore standardized white T-shirts and light grey trousers. Makeup and accessories were removed, and hair bands were provided when needed.

No financial reward was given. The IRB of the Institute of Psychology at the University of Sao Paulo (Nr 53719416.5.0000.5561) approved the experiment.

3.1.2.3 Objective measures

Photographs and recordings, were taken under standardized conditions, for details, see (Valentova et al., 2017a). For the rating session, images consisted of frontal facial photographs placed on a neutral grey background using Photoshop, and voices consisted of the following sentence read by participants in Portuguese “Hi, my name is Ana/Pedro and I am from Belo Horizonte” – “Ana” for all women, and “Pedro” for all men.

Behavior recordings consisted of participants dancing to a standard rhythm (130 beats per minute), which was generated using an automatic random rhythmic generator in Max/Msp. Participants danced for around 40 seconds in a 1 m² space in front of a standardized grey background. Videos were recorded on a JVC Everio digital video camera placed on a Velbon Sherpa 600R tripod, which were located 2.5 meters in front of the participants.

Each video was digitally edited using Videomux software. Firstly, any sound was excluded, videos were converted to black and white, and contrast was increased. For the rating session, we extracted a 10 second-video from the original 40 second-footage using the middle part to avoid some confounding variables (e.g. standstill, anxiety in the beginning, and tiredness in the end). Finally, Adobe Premiere Pro CC was used to cover participants’ faces, but leaving head movements and position still recognizable. Part of pixelated layer (i.e. mask) with Mosaic effect was inserted on top of original video layer and mask tracking and frame-by-frame manual correction was carefully positioned, so that the whole face and a majority of hair was pixelated and indistinguishable. Mask feather (i.e. the strength of the effect) was set on value 16. By using this mosaic density, participants’ faces were blurred.

3.1.2.4 Subjective perceptions

The subjective perceptions consisted of self-ratings and other-ratings of attractiveness and femininity-masculinity (FM). Target participants were asked to rate attractiveness and

FM of their own faces, voices, and behavior on a 7-point scale (1 = very feminine/not at all attractive; 7 = very masculine/very attractive).

Then, targets' photographs, vocal recordings, and dance videos were assessed on a 100-point scale (0 = very feminine; 100 = very masculine) by 43 women (mean age = 24.1 years, SD = 4.56, range 18-34) and 21 men (23.9 years, SD = 4.62, range 18-34). Further, 28 women (mean age = 23.8 years, SD = 3.8, range 18-34) and 23 men (mean age = 23.6 years, SD = 3.56, range 18-30) rated attractiveness of the opposite-sex stimuli on a 7-point scale (0 = not at all attractive; 7 = very attractive).

Third-party raters were unrelated to the target participants. Raters of FM were mostly students of the University of Sao Paulo recruited by email. Data were collected online via Qualtrics software, version 2017. Raters of attractiveness were recruited personally at the University of Brasilia, and they completed their ratings in the lab. In both cases, the stimuli were shown in three blocks (i.e., blocks of faces, voices, and dances separately). Each block and the stimuli were presented randomly.

Raters of FM assessed stimuli of both sexes. Spearman test indicated a strong correlation between women's and men's ratings of all stimuli (all ρ 's ≥ 0.85 , all p 's < 0.001), and thus the mean scores of FM for each target across all raters were used for analysis. Finally, Cronbach's alphas of FM ratings were high for facial ($\alpha = 0.78$), vocal ($\alpha = 0.83$) and behavioral ($\alpha = 0.89$) ratings. Similarly, Cronbach's alphas of attractiveness ratings were high for facial (female raters' $\alpha = 0.93$, male raters' $\alpha = 0.96$), vocal (female raters' $\alpha = 0.94$, male raters' $\alpha = 0.87$) and behavioral (female raters' $\alpha = 0.90$, male raters' $\alpha = 0.96$) ratings.

3.1.3 Analyses

3.1.3.1 Bivariate correlations

Data were analyzed with SPSS 21.0. A Shapiro-Wilks test indicated that some variables violated the normality assumption of distribution and thus Kendall rank correlation was chosen. First, we analyzed the association between age and all the variables. We only found a positive correlation between women's age and femininity of dance ($\tau_b = .246$, $p = .04$) and thus age did not enter into the subsequent analyses.

We defined 72 landmarks on each facial portrait using tpsDig2 software (Version 2.31). The definition of landmarks (including 36 semilandmarks) was adopted from our previous studies (Danel, Dziedzic-Danel, & Kleisner, 2016; Danel et al., 2018). Landmark configurations were subsequently superimposed by Generalized Procrustes Analysis (GPA) using the “gpagen” function within Geomorph package in R (Adams & Otárola-Castillo, 2013). The positions of semilandmarks were optimized by an algorithm based on minimizing the bending energy. To measure the individual degree of development of sexually dimorphic traits in the human face, i.e. Facial Sexual Shape Dimorphism (FSShD), we calculated average facial configuration separately for faces of men and women. Subsequently we projected all individual faces on an axis connecting male and female average facial shape. The projections of all faces on this axis are represented as one-dimensional scores and used as an objective measure of individual degree of facial sexual dimorphism (Mitteroecker, Windhager, Müller, & Schaefer, 2015; Komori, Kawamura, & Ishihara, 2011; Valenzano, Mennucci, Tartarelli, & Cellerino, 2006). Higher positive FSShD scores indicate increasing maleness whereas higher negative scores imply increasing femaleness.

3.1.3.2 Vocal analyses

All voice samples were analyzed using Praat software. The average fundamental frequency (F0) was measured using Praat’s autocorrelation algorithm with parameters set to a pitch floor of 75 Hz and a pitch ceiling of 300 Hz for men, and a pitch floor of 100 Hz and a pitch ceiling of 500 Hz for women, with all other values set to default. The F0 ranged from 92 to 177 Hz in men (mean 125 Hz), and from 177 to 253 Hz in women (mean 209 Hz).

3.1.3.3 Behavioral analysis

Shoulders and hip movements were analyzed through Interact software (Version 16.0.0), because higher hip movements are associated with female sex-typicality, and higher shoulders movements, to male sex-typicality (Johnson, Gill, Reichman, & Tassinary, 2007). Video analysis was performed in two stages using an ethogram composed of two types of body movements, and three levels of intensity (see Table 2).

Table 2. Ethogram of hip and shoulders movements.

| | | Body Movements | |
|-----------|--------|--|--|
| | | Shoulders | Hip |
| Intensity | Low | Little lateral motion, and little or no front-back motion combined with up-down motion | Little or no lateral motion combined with no up-down motion or front-back motion |
| | Medium | Higher degree of lateral motion, and a medium degree of front-back motion combined with up-down motion | Lateral motion combined with longitudinal motion, but no front-back motion |
| | High | Higher degree of lateral motion, and a high degree of front-back motion combined with up-down motion | Three-dimensional motion |

First, two evaluators of both sexes observed eight videos (four videos of women dancing) according to the ethogram. The duration of shoulders and hip movements was computed separately in seconds, and the intensity of body movements was computed on a 3-point scale (0 = low; 3 = high). Then, duration was multiplied by intensity to generate one single score, and the results were analyzed through Lin's Concordance correlation coefficient. After reaching a moderate agreement (hip's $\rho_c = 0.68$; shoulders' $\rho_c = 0.73$) between the evaluators' responses, the male evaluator observed and coded the remaining videos. Finally, for each participant, the final score of hip movement was subtracted from the final score of shoulders movements and thus positive results indicate a masculine pattern of dance, while negative results suggest a feminine pattern of dance.

3.1.2. Results

Table 3. Kendall correlations between self-rated, other-rated, and measured facial femininity-masculinity and attractiveness. Correlations for women's subsample are reported above diagonal and for men's subsample below diagonal.

| | Self-rated FM | Other-rated FM | Facial shape FM | Self-rated ATTR | Other-rated ATTR |
|------------------|---------------|----------------|-----------------|-----------------|------------------|
| Self-rated FM | | .143 | .049 | -.250 | -.143 |
| Other-rated FM | .481** | | .255* | -.016 | -.590** |
| Facial shape FM | .073 | 0.70 | | -.003 | -.210 |
| Self-rated ATTR | -.097 | -.051 | .091 | | .041 |
| Other-rated ATTR | -.064 | .029 | .069 | .162 | |

Note. FM = femininity-masculinity. ATTR = attractiveness. * = $p < .05$. ** = $p < .01$

As shown in Tables 3, 4, and 5, men's self-rated facial and vocal masculinity are positively correlated with other-rated masculinity, while no such association is found in women. In women, facial, vocal, and behavioral other-rated femininity were correlated with other-rated attractiveness and only other-rated femininity was correlated with feminine facial and vocal measures. Moreover, women's self-reports of vocal femininity were associated with self-reported attractiveness. In men, self- and other-ratings of vocal masculinity were associated with low fundamental frequency and other-rated attractiveness, and only other-ratings of vocal masculinity were correlated with self-rated attractiveness. Finally, vocal and behavioral self-rated attractiveness were associated with other-rated attractiveness.

Table 4. Kendall correlations between self-rated, other-rated and measured vocal femininity-masculinity and attractiveness. Correlations for women's subsample are reported above diagonal and for men's subsample below diagonal.

| | Self-rated FM | Other-rated FM | F0 | Self-rated ATTR | Other-rated ATTR |
|------------------|---------------|----------------|---------|-----------------|------------------|
| Self-rated FM | | .194 | -.168 | -.289* | .028 |
| Other-rated FM | .343** | | -.380** | .074 | -.393** |
| F0 | -.436** | -.280* | | .030 | -.023 |
| Self-rated ATTR | .051 | .312* | .151 | | -.102 |
| Other-rated ATTR | .244* | .676** | -.184 | .308* | |

Note. FM = femininity-masculinity. ATTR = attractiveness. F0 = vocal fundamental frequency. * = $p < .05$. ** = $p < .01$

3.1.3 Discussion

Table 5. Kendall correlations between self-rated, other-rated and measured behavioral femininity-masculinity and attractiveness. Correlations for women's subsample are reported above diagonal and for men's subsample below diagonal.

| | Self-rated FM | Other-rated FM | Dance FM | Self-rated ATTR | Other-rated ATTR |
|------------------|---------------|----------------|----------|-----------------|------------------|
| Self-rated FM | | .080 | -.140 | -.086 | -.066 |
| Other-rated FM | .110 | | .049 | -.024 | -.482** |
| Dance FM | -.125 | -.208 | | .000 | -.076 |
| Self-rated ATTR | .200 | -.030 | .021 | | -.003 |
| Other-rated ATTR | -.032 | .128 | .039 | .261* | |

Note. FM = femininity-masculinity. ATTR = attractiveness. Dance FM = femininity-masculinity obtained from ethogram of dance videos. * = $p < .05$. ** = $p < .01$

The current study examined the association between self-rated and other-rated attractiveness and femininity-masculinity (FM), and objectively measured FM in three

domains: faces, voices, and non-verbal behavior (dance). Other-ratings on women's facial and vocal femininity were associated with facial sexual shape dimorphism and high fundamental frequency, respectively. Further, in women other- and self-rated femininity in all three domains were mostly associated with other- and self-rated attractiveness. However, no women's self-ratings correlated with other-ratings or measured FM in any of the domains. In contrast, men's self-ratings and other-ratings were mostly in accordance. Moreover, self-rated vocal masculinity in men was associated with low voice pitch and with other-rated attractiveness.

Self-rated attractiveness and sex typicality significantly influence decision making in several contexts, including mate preferences (e.g. Vukovic et al., 2008). Such self-concepts are susceptible to social pressures and comparisons, particularly among women (Ben Hamida, Mineka, & Bailey, 1998; Little & Mannion, 2006). Indeed, we did not find any statistically significant correlation between self- and other-rated FM and attractiveness among women, while in men self- and other-rated facial and vocal FM were correlated. Moreover, self- and other-rated attractiveness were not associated either in men or women; the exception being men's voices.

In line with previous studies, we showed that women's self-perceived and third-party rated attractiveness are, in least in part, independent variables (Feingold, 1992; Muñoz-Reyes et al., 2015), and we expanded these findings to the ratings of FM and vocal and behavioral (dance) stimuli. This finding has implications for theoretical concepts and research on attractiveness and FM in women. Studies systematically show that people agree on what is attractive and what is not, in particular when judging facial appearance (e.g. Chatterjee, Thomas, Smith, & Aguirre, 2009). As we showed, women's FM rated by others is more connected to objective measures, but self-ratings seem to be independent. It was shown that attractiveness applied to self is flexible and can be altered rapidly by context (e.g. Little & Mannion, 2006). The influence of social environment on women's self-image (Ben Hamida et al., 1998; Little & Mannion, 2006) can explain the lack of association between self-assessments and objective physical measures of faces and voices. Therefore, female self- and other-perceived attractiveness or FM should not be used interchangeably in research.

In contrast, other-ratings of women's facial and vocal FM were associated with objective measures and other-ratings of attractiveness. This is in line with previous research (Rhodes, 2006), suggesting that feminine physical traits can provide cues to reproductive value and health (Jasińska et al., 2004; O'Connor et al., 2013). Interestingly, we found no

correlation between other-ratings of female attractiveness and objective measures of FM. Thus, although perceived female femininity is associated with attractiveness and with objective measures of femininity, attractiveness is not linked to objective measures of femininity. It seems that components, such as skin quality, eye color, maturity, adiposity, voice timber, or any other trait that is not directly connected to femininity contribute to female attractiveness. Sadly, these were not explored in this study.

In men, despite self- and other-rated FM of faces and voices being positively associated, only voice pitch was positively correlated with both subjective perceptions of vocal masculinity. First, other factors, such as symmetry (Mogilski & Welling, 2017) and the amount of facial hair (e.g. Valentova, Varella, Bártová, Štěrbová, & Dixson, 2017b), could have influenced third-party ratings of male faces. This could explain the lack of association between subjective perceptions of facial FM and facial shape. On the other hand, previous studies suggested that men's voices provide cues to dominance (Rezlescu et al., 2015), which is relevant for men's mate value (Ben Hamida et al., 1998) and it thus explains the association between subjective perceptions of masculinity and masculine (i.e. low) voice pitch. Further, ancestral men faced stronger intrasexual competition (Puts, 2010), and they would thus benefit from having a more realistic self-perception regarding masculinity in order to avoid disadvantageous conflicts compared to women.

Interestingly, although men with lower voice pitch were perceived as more masculine, men's attractiveness did not correlate with voice pitch (see Namibian sample in Šebesta et al., 2017). Male masculinity is associated with indirect investments into reproduction (health, genetic quality), but also with aggressiveness (Carré & McCormick, 2008). Therefore, women face a trade-off between masculine and feminine male traits (reviewed in Buss & Schmitt, 2019), which could explain the lack of association between masculinity and attractiveness.

For dance movements, subjective perceptions of FM and attractiveness did not correlate with the behavioral analysis of hip and shoulders movements, and we were thus not able to replicate the association between body movements and the perception of FM reported earlier (Troje, 2003). Nevertheless, previous studies showed that static measures of bodies are correlated with the subjective perception of FM, such as the BMI, waist-to-hip ratios, and breast size (Brooks, Shelly, Jordan, & Dixson, 2015; Havlíček et al., 2017; Swami & Tovée, 2005) and thus such features could influence raters' assessments and explain the association between men's self- and other-rated attractiveness. Moreover, since dance is a complex and universal set of rhythmic body movements influenced by culture (Niemitz, 2010; Weege,

Lange, & Fink, 2012), we can speculate that it develops via distinct processes than facial and vocal physiology and morphology, which could also explain the association between men's self- and other-rated attractiveness.

Present study had some limitations. First, dances were recorded in an unnatural situation, which could have influenced participants' spontaneous behavior. Moreover, we did not test for variables which might have influenced self-ratings of FM or attractiveness, such as relationship context or experiment design (Chen, Jiang, Fan, Yang, & Ren, 2018). Finally, our samples were not diverse, as most of our participants were students from a middle economic class who considered themselves white (Henrich, Heine, & Norenzayan, 2010) and thus a more representative Brazilian sample should be explored to support the existing results. However, accessing this Brazilian sample of men and women to examine FM and attractiveness through distinct channels of information (faces, voices, and dance movements) are novelties that broaden the scope of the literature.

To sum up, in general men and third-party raters assessed men's femininity-masculinity and attractiveness concordantly, and voice pitch was associated with subjective perceptions of vocal FM. In women, there was no association between self-ratings and ratings by others, or between self-ratings and objective measures of femininity-masculinity. Thus, self-perception and other-ratings probably follow different cues in women and different methods used to measure female attractiveness should reflect upon this discrepancy.

3.2 Chapter two

Positive association between facial and vocal femininity/masculinity in women but not in
men

3.2.1 Introduction

Animals communicate with intraspecific and interspecific individuals in distinct contexts, such as parental care (e.g. Redondo & Castro, 1992), predator deterrence (e.g. Zuberbühler, & Jenny, 1999), and mate choice (e.g. Lardner & Bin Lakim, 2002; Sweeney, Jiggins, & Johnsen, 2003). Some characteristics, such as sex dimorphic traits, can cue to the producers' health, fertility, hormonal status and/or other qualities (Gallup &

Frederick, 2010). Humans are sexually dimorphic in several aspects (see, Puts, 2016), such as in facial and vocal characteristics (Puts et al., 2012), and behavior (Berenbaum & Beltz, 2011). Among other factors, levels of reproductive hormones influence development of feminine and masculine traits (e.g. Feinberg, 2008), thus affecting communication. For instance, estrogen is associated with higher vocal pitch (Raj, Gupta, Chowdhury, & Chadha, 2010), facial feminine features (Law Smith et al., 2006), and maternal behavior (Law Smith et al., 2012). Testosterone is linked to lower vocal fundamental frequency (Evans, Neave, Wakelin, & Hamilton, 2008), masculine facial characteristics (Penton-Voak & Chen, 2004), and aggressive behavior (Batrinos, 2012).

Masculine and feminine traits that coevolved with perceptual propensities of potential mates are important cues in the mate choice process. Indeed, men find more attractive sex hormone-dependent characteristics of female body and behavior, such as feminine faces (Moore, Law Smith, Taylor, & Perrett, 2011; Perrett et al., 1998; Rhodes et al., 2003), voices (Apicella & Feinberg, 2009; Puts et al., 2011; Re, O'Connor, Bennett, & Feinberg, 2012), and dance (Röder et al., 2016). However, studies are inconsistent about women's preferences for male masculinity (e.g. DeBruine et al., 2006; Fink & Penton-Voak, 2002; Re et al., 2012; Rhodes, Hickford, & Jeffery, 2000; Stephen et al., 2012).

In real life context, usually the traits are not evaluated separately, but rather holistically using multimodal information that can improve information exchange. In women, perception of distinct sensory cues (e.g. faces and voices) is intercorrelated, thus, different modalities seem to carry concordant information about fertility and genetic quality (e.g. Collins & Missing, 2003; Fraccaro et al., 2010; Wheatley et al., 2014). Again, mixed results were found for intercorrelation of perception of male stimuli (Feinberg et al., 2008a; Little, Connely, Feinberg, Jones, & Roberts, 2011b; Valentova et al., 2017a). Despite the multimodal nature of masculinity and femininity in humans, most of the current research still focuses on isolated cues, e.g. either faces or voices (for a review, see Wells et al., 2009). Thus, more research on perceptions from multiple channels of information is needed.

Further, most research has studied facial traits, neglecting other channels of information, such as voice and odor (for further discussion, see Groyecka et al., 2017). Moreover, body movements, such as dance or gait, have been rarely studied in the mate choice context (Fink, Weege, Neave, Pham, & Shackelford, 2015), despite dance behavior being an important part of courtship in many human societies. To the best of our knowledge, no study yet has tested a possible correlation between perception of faces, voices and dance movements. Finally, studies have usually analyzed samples from the USA and Europe.

However, some cultural differences have been found regarding the sensory preference (e.g. Havlíček et al., 2008; Marcinkowska et al., 2014; Scott et al., 2014), thus showing the necessity of studies from different localities and cross-cultural research.

3.2.1.1. Aims

In the current study, we tested whether femininity-masculinity (FM) is concordantly perceived from faces, voices, and dance behavior in a sample of Brazilian women and men. We hypothesized that, at least in women, perceived FM of faces, voices and behavior would be intercorrelated.

3.2.2. *Material and methods*

Sixty women and 56 men were recruited at the University of Sao Paulo, Brazil. Those who identified themselves as bisexual and homosexual (3-6 on Kinsey scale) were excluded as they possess slightly distinct morphology and behavior (Johnson et al., 2007; Valentova, Rieger, Havlíček, Linsenmeier, & Bailey, 2011; Valentova, Kleisner, Havlíček, & Neustupa, 2014; Wang & Kosinski, 2018). Moreover, one foreign student, and participants who did not complete the survey were also excluded. The final sample consisted of 38 men (age $M = 23.55$, $SD = 3.28$) and 41 women (age $M = 24.00$, $SD = 5.05$). Self-reports indicated that most participants were undergraduates (70.9%) and white (74.7%). Mann-Whitney U test showed no significant age difference between sexes ($U = 790$, $p = 0.76$).

3.2.2.1. Procedure

Participants were informed about general aims of the study and invited to the laboratory. Subsequently, they read and signed a consent form. The procedure was part of a larger intercultural study on human mating strategies (for other details, see Havlíček et al., 2017; Valentova et al., 2017a; Varella et al., 2014), and lasted 40-60 minutes. The experiment consisted of a set of questionnaires, basic body measurements, standardized facial photographs, and vocal and dance recordings. Participants were asked to wear standardized white T-shirt and grey trousers in three sizes, and were given privacy to change their clothes.

Makeup was removed, and hair band was provided when needed. No financial reward was given. The IRB of University of Sao Paulo (Nr. 53719416.5.0000.5561) and Charles University (Nr. 2011/7) approved the experiment.

3.2.2.2. Photographs and recordings

A standardized photographic equipment, camera distance, light, background, and clothes were used for facial photographs and video recordings. Participants were instructed to adopt a neutral facial expression for the facial pictures. Subsequently, using Photoshop software each photograph was placed on a neutral grey background (Valentova et al., 2017a). For videos, participants were instructed to dance as naturally as possible under a standard simple rhythm (130 beats per minute) that was synthesized using an automatic random rhythmic generator in Max/Msp. Each video comprised 40 seconds, but only ten seconds of the middle part of the recordings were used for the rating session. Each video was cut and digitally edited using Videomux software, so that black and white videos with higher contrast were obtained. Finally, faces were covered (blurred) using Adobe Premiere Pro CC. Voices were recorded in a quiet room and participants were instructed to repeat the following sentence in Portuguese “Hi, my name is Pedro/Ana and I am from Belo Horizonte” – ‘Pedro’ for all men, and ‘Ana’ for all women (for details see, Valentova et al., 2017a).

3.2.2.3. Facial, vocal, and behavior ratings

The stimuli were presented to a distinct and unrelated sample of 30 men and 58 women to assess FM on a 100-point scale ranging from 0 (very feminine) to 100 (very masculine). Participants were recruited online from students of University of Sao Paulo and were directed to Qualtrics platform (<https://www.qualtrics.com>). Non-heterosexuals (scoring 3 to 6 on Kinsey scale), one pregnant woman, and individuals older than 35 years were excluded, leaving a sample comparable to the target sample. The final sample comprised 21 men (age $M = 23.86$, $SD = 4.62$) and 43 women (age $M = 24.14$, $SD = 4.56$), composed mostly of undergraduate (57.8%) and white (71.9%) students. The sexes did not differ significantly in age ($U = 470$, $p = 0.79$).

Participants completed a basic demographic questionnaire and assessed the stimuli of both sexes in three randomized blocks (ratings of facial, vocal and behavioral stimuli). Within

each block, the individual stimuli were also randomized. Thus, participants judged each stimulus in a randomized order and only once. There was a strong correlation between males' and females' ratings in all rated stimuli (all ρ 's ≥ 0.85 , all p 's < 0.001) and the Cronbach's alphas of FM ratings were reasonably high for facial ($\alpha = 0.78$), vocal ($\alpha = 0.83$) and behavioral ($\alpha = 0.89$) ratings.

3.2.2.4. Analyses

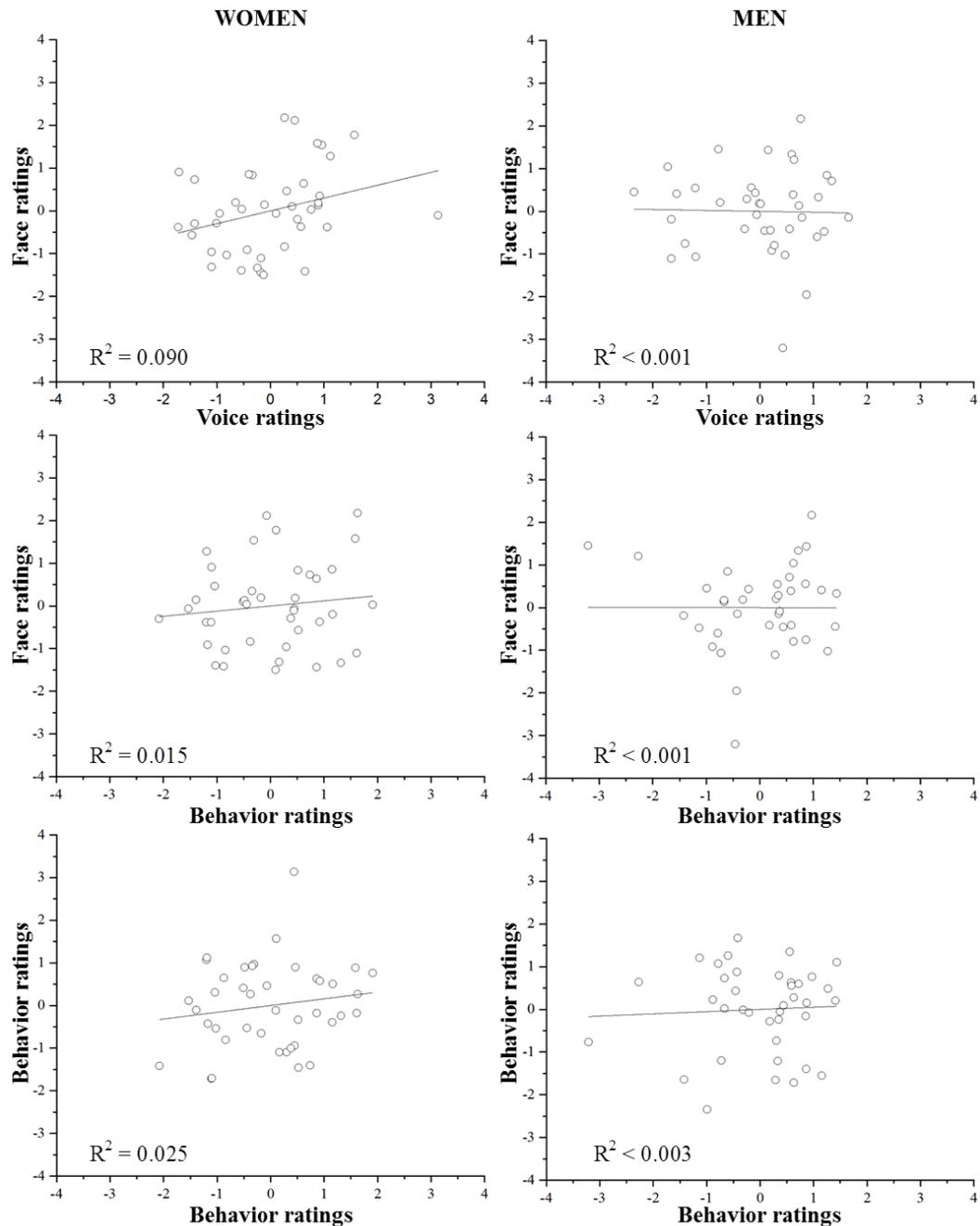
Shapiro-Wilks test was used to check the normality of data. Since some variables departed from normality, Spearman rank correlation was used to examine the relation between all the modalities ratings. All data were analyzed via SPSS 21.0 (IBM Corp.). Data were transformed into Z-Scores to perform a figure using OriginPro 9.5 (OriginLab).

3.2.3. Results and Discussion

As shown in Figure 1, in women, we found a significant correlation between the mean perceived facial and vocal femininity-masculinity (FM) ($N = 41$, $\rho = 0.33$, $p = 0.03$). However, there was no significant correlation between behavioral FM and facial ($N = 41$, $\rho = 0.09$, $p = 0.59$) or vocal FM ($N = 41$, $\rho = 0.08$, $p = 0.62$).

In men, there was no significant correlation between facial and vocal FM ($N = 38$, $\rho = -0.02$, $p = 0.89$), behavioral and facial ($N = 38$, $\rho = 0.14$, $p = 0.40$), or behavioral and vocal FM ($N = 38$, $\rho = 0.02$, $p = 0.93$).

Figure 1. Correlations of femininity-masculinity ratings between facial, vocal, and behavioral stimuli separately for male and female targets.



In women, we have replicated the positive association between perceived FM of faces and voices (Fraccaro et al., 2010; Feinberg et al., 2005; Smith et al., 2016). The current results indicate that female facial and vocal FM can offer concordant underlying information. Rowe (1999) argues that multicomponent stimuli increase information reception. Studies suggest that women's femininity indicates health, fertility, and parenting skills (Feinberg, 2008; Jasińska et al., 2004; Law Smith et al., 2012). Accordingly, feminine traits are assessed as more attractive (Moore et al., 2011; Perrett et al., 1998; Valentova et al., 2017a),

and are preferred by men (Re et al., 2012). Additionally, facial and vocal attractiveness predicted the overall attractiveness ratings of women (Wells et al., 2013), and attractiveness ratings of feminine faces increased when presented along with vocal femininity (O'Connor et al., 2013).

In men, faces and voices show no concordance and can, thus, indicate different qualities of the individual. Wells et al. (2013) showed that men's faces and voices contribute independently to attractiveness. Accordingly, Varella et al. (2014) found that women preferred men with a mosaic of masculine and feminine traits. In the same line, women's ratings of male attractiveness increased with a negative covariance between girth, and facial and vocal masculinity (Hill et al., 2013). Thus, testosterone synthesis and mechanisms of tissue response in different parts of the body and behavior may have evolved independently (Hau, 2007).

Men's non-concordant information may be adaptive and reflect women's highly flexible preferences for FM. Previous studies show that women's mate choice varies according to stage of menstrual cycle, resource and pathogen exposure, relationship status, or women's own mate quality (Brooks et al., 2011; Gildersleeve, Haselton, & Fales, 2014; Little et al., 2011b; Lyons, Marcinkowska, Moisey, & Harrison, 2016; Moore et al., 2013), indicating a variable preference for indirect (e.g. genetic quality) and direct (e.g. parental care) paternal investment according to the context (Gray et al., 2002; Kruger & Fitzgerald, 2011).

We found no correlation between ratings of FM of dance videos and FM rated from voices and faces, either in men or women. Thus, dance has no concordance with the other variables, and may thus convey different messages. We can speculate that complex behavior, such as dance, which is aerobically costly, represents and develops via distinct process than facial and vocal display. Indeed, FM of behavior is emergent already during early childhood, while vocal and facial FM develops largely through exposure to sex hormone during puberty (Hines, 2011; Puts et al., 2012; Rieger, Linsenmeier, Gygax, & Bailey, 2008).

In summary, we found a positive correlation between perception of women's facial and vocal FM, but that did not occur in men. Furthermore, dance was not associated with either vocal or facial FM in either men or women. The current study thus advanced the discussion concerning the use of multiple sensory modalities in the context of assessing masculinity-femininity. Differently from previous research, besides studying facial and vocal perception, we also focused on complex behavior, dancing (for further discussion, see Groyecka et al.,

2017). As our study sample was relatively small and conducted on a specific population (Brazilian men and women), further studies are needed. Different populations can show distinct results in perception of faces, voices, and other sensory modalities, as shown by previous studies (e.g. Havlíček et al., 2008; Marcinkowska et al., 2014). Further, we collected samples in artificial environment, and recruited mostly university students. Future studies, thus, should investigate higher diversity of indicators, ideally in cross-cultural and more realistic mate choice settings.

3.3 Chapter three

The influence of resource scarcity on multimodal preference in long-term, but not pathogen threat in short-term relationships

3.3.1 Introduction

Human mate preferences are far from random but the specific mechanisms of partner choice are still a matter of discussion and empirical testing. Women's mate preferences have been shown to be sensitive to both personal (e.g., relationship status, phase of menstrual cycle, own attractiveness) (Gildersleeve et al., 2014; Kandrik & DeBruine, 2012; Lyons et al., 2016) and environmental contexts (e.g. resource scarcity, pathogen threat, economic status of the population, health of the population) (DeBruine et al., 2010a; Lee & Zietsch, 2011; Watkins et al., 2012). Studies focusing on environmental contexts showed that in their potential long-term male partners, women in resource scarcity conditions preferred rather feminine morphological traits associated with willingness and abilities to invest, and with partnering and parenting skills. In contrast, in environments characterized by poor health and high mortality, women preferred rather masculine characteristics in men which presumably provide cues to better immunity system and health. Such findings were corroborated in both correlational (DeBruine et al., 2010a; DeBruine et al., 2010b; Feinberg et al., 2012; Jones et al., 2013; Stewart et al., 2000) and priming studies (Lee et al., 2013; Lee & Zietsch, 2011; Little et al., 2007a; Watkins et al., 2012), although see also (Lee et al., 2013; Lee & Zietsch, 2015) for null results.

Variation in men's preferences is, however, only rarely studied. Similarly to results in women, previous research showed that men preferred more feminine female faces in a pathogen threat condition (Lee et al., 2013), but such a context was only tested in a correlational design. For contexts of poorer resources and lower socioeconomic status, men preferred women with higher BMI (Nelson & Morrison, 2005; Swami & Tovée, 2006); nevertheless, studies investigating men's preferences for women's femininity-masculinity were not found.

These results are in line with findings showing that men with masculine characteristics and women with feminine characteristics are perceived as healthy (e.g. Rhodes et al., 2003; Scott et al., 2008; Gray & Boothroyd, 2012; Singh & Singh, 2006), and may provide cues to actual health and fertility (e.g. Dunson et al., 2002; Gangestad et al., 2010; Jasińska et al., 2004; Kirchengast & Gartner, 2003; Rantala et al., 2012; Rhodes et al., 2003; Roberts et al., 2004; Thornhill & Gangestad, 2006; Venners et al., 2006). Thus, such characteristics are preferred in particular in environments of poor health. In contrast, environments with resource scarcity raise the need for biparental care (Buss & Schmitt, 2019; Gangestad & Simpson, 2000) and privileged are men who are willing to invest directly, and women who are able to find and secure resources.

Importantly, preferences for masculine and feminine characteristics are also influenced by the temporal context of the relationships. As humans evolved a cooperative mating system, in which both women and men provide parental care, and both actively choose their mates (Campbell, 2004; Sear, 2016), a higher selectiveness of potential mates is expected in particular for long-term relationships that are characterized by higher investments. However, due to gestation, birth, lactation and raising offspring (Jasińska, 2009) women have a higher initial investment and higher risk in reproduction than men, and a high selectiveness is expected also in short-term relationships. Thus, environmental conditions can influence preferences for masculinity and femininity particularly in long-term relationships in both sexes, and potentially also short-term relationships in women. Previous research investigating environmental effects on mate preferences mostly did not specify the temporal context of the relationships (Lee et al., 2013; Lee & Zietsch, 2011; Nelson & Morrison, 2005; Swami & Tovée, 2006; Watkins et al., 2012). The exception was Little et al. (2007a), but they only examined facial cues. Thus, it would be of importance to incorporate the temporal context of mate choice into the question of environmental effects on preferences for masculinity and femininity.

Interestingly, past research investigating the effect of environmental conditions on mate preferences mostly focused on facial stimuli (for exceptions, see for example Lee & Zietsch, 2011 and Lee et al., 2013, who assessed preferences for cognitive and physical characteristics, and social status). Although facial appearance is highly important in the formation of the first impressions and in mate evaluations, potential influence of environmental conditions on preferences for more dynamic behavioral traits is yet to be studied. Moreover, facial stimuli used in previous studies comprised composite faces, i.e., facial photographs that were digitally manipulated to vary according to femininity-masculinity (Lee et al., 2013; Little et al., 2007a; Little et al., 2011b; Watkins et al., 2012). It would be of a great importance to use more ecologically valid stimuli, such as photographs of natural faces. In addition, participants were mainly exposed to a forced-choice design in which they had to choose between the masculine and the feminine stimuli. As an exception, Lee and Zietsch (2015) and Lee et al. (2013) allowed participants to rate the stimuli individually but they did not find any significant effect in the pathogen threat condition. Thus, different methodologies would strengthen the previous conclusions which were submitted to a valid critique (see Scott et al, 2012, Scott et al., 2014).

Finally, conclusions on mate preferences for femininity-masculinity under different environmental conditions were mostly based on data collected among North Americans, Australians and Western Europeans (e.g., Feinberg et al., 2012; Jones et al., 2013; Lee et al., 2013; Lee and Zietsch, 2011; Little et al., 2007a; Lyons et al., 2016; Watkins et al., 2012) which are well developed countries with relatively high standards of living. Thus, it is important to study the influence of environmental threats on women's and men's preferences for femininity-masculinity in developing countries with different socio-economic conditions, in particular where environmental threats are more common.

3.3.1.1. Aims

In the current study, we tested whether a pathogen condition and a resource-scarcity condition influence preferences of Brazilian women and men for masculine and feminine faces, voices, and dance videos of opposite-sex individuals in short-term and long-term relationship contexts. Based on previous literature, we predicted that (1) when primed with cues of pathogen threat in a short-term context, both women and men would increase their

preference for partners with greater indicators of indirect investment, i.e., feminine traits in women and masculine traits in men. On the other hand, (2) when primed with cues of resource threat in a long-term context, both women and men would increase their preference for partners with greater indicators of direct investment, i.e., feminine men and women, respectively.

3.3.2 *Material and methods*

The current study consisted of three pretests and one experiment. The pretests were performed to create and test the facial, vocal, and behavioral stimuli and priming conditions, while the experiment examined the main hypotheses. Each volunteer participated in only one of the phases. No financial reward was given and the study was approved by the IRB of University of Sao Paulo, Brazil (Nr. 53719416.5.0000.5561).

3.3.2.1 Participants

The experiment was completed by 516 volunteers, but only participants aged between 18 and 35 years and exclusively or predominately heterosexuals (0-2 on Kinsey scale) were analyzed, because age (Lee & Zietsch, 2015) and sexual orientation (Glassenberg et al., 2010; Valentova et al., 2013) influence preferences for femininity-masculinity (FM). Our final sample comprised 206 women (M age = 25.02, SD = 3.89) and 164 men (M age = 25.01, SD = 4.47). The participants were students (undergraduates = 42.7%, graduates = 15.1%, postgraduates = 39.7%, postdocs = 2.5%) from universities across the state of Sao Paulo, Brazil. Finally, most participants (77%) reported to be white (13.8% reported to be of a mixed origin, called *pardo* in Brazilian Portuguese, 3.8% reported to be blacks, 3% Asians, and 2.4% others), and most of them (84.6%) earned one to ten Brazilian minimum salary per month (\$290.00 to \$2900.00 in 2017).

3.3.2.2. Stimuli

Stimuli comprised facial photographs, vocal recordings, and dance videos of 41 heterosexual women (M age = 24.0 SD = 5.05) and 38 heterosexual men (M age = 23.5, SD = 3.28). Participants were recruited at the University of Sao Paulo campus of Sao Paulo city, by a snowball method or an approach in the public places of the university. Stimuli from bisexual and homosexual individuals (3-6 on Kinsey scale) were excluded, because their faces, voices and behavior can differ from their heterosexual counterparts (e.g., Fasoli & Maass, 2018; Johnson et al., 2007; Valentova & Havlíček, 2013; Valentova et al., 2014; Valentova et al., 2011; Wang & Kosinski, 2018). The sample consisted of Brazilian students (mostly undergraduates = 76.%), who mostly self-reported as white (74.7%).

Stimuli were collected in a quiet room by the same researchers. Facial images consisted of frontal facial photographs with a neutral expression. Subsequently, each photograph was placed on a neutral grey background to be shown to the third-party raters. For vocal recordings, participants were instructed to repeat the following sentence in Portuguese: “Hi, my name is Ana/Pedro and I am from Belo Horizonte” – “Ana” for women, and “Pedro” for men. Details were published elsewhere (Valentova et al., 2017a).

Dance was recorded on a JVC Everio digital video camera placed on a Velbon Sherpa 600R tripod, which was located 2.5 meters away from participants. Volunteers were instructed to dance as naturally as possible according to a standard simple rhythm (130 beats per minute), which was generated by an automatic random rhythmic generator in Max/Msp. Volunteers wore white t-shirts and light grey trousers, and they danced for around 40 seconds in a 1 m² space and in front of a standardized grey background. Videos were cut and digitally edited using Videomux software. Any sound was removed, color was changed to black and white, and contrast was increased. Moreover, ten seconds of the middle part of the recordings were selected. Finally, participants’ faces were digitally covered using Adobe Premiere Pro CC. Part of pixelated layer (i.e. mask) with Mosaic effect was inserted on top of original video layer and by using mask tracking and frame-by-frame manual correction was carefully positioned, so that the whole face and a majority of hair was pixelated and indistinguishable. Mask feather (i.e. how strong is the effect presence) was set on value 16. By using this mosaic density, participants’ faces are blurred, but head movements and position are still recognizable.

To assess FM of the faces, voices and behavior, the stimuli were rated online on a 100-point slide scale (0 = very feminine; 100 = very masculine) via Qualtrics platform (version 2017, Provo, UT) by 43 heterosexual women (M age = 24.1, SD = 4.56) and 21 heterosexual

men (M age = 23.9, SD = 4.62), who were primarily undergraduate (57.8%), white (71.9%) students from the University of Sao Paulo, and mostly earned one to ten Brazilian minimum salaries per month (70.4%).

Stimuli were divided into three blocks (faces, voices, and dances, respectively). The blocks and stimuli inside each block were randomized. Men and women judged stimuli of both sexes. Ratings showed good internal consistency for the three categories of stimuli (Cronbach's alphas ≥ 0.78). Moreover, Spearman's tests showed strong positive correlations between males' and females' ratings for all rated stimuli (all ρ 's ≥ 0.85 , all p 's < 0.001) and thus ratings of both sexes were analyzed together. After calculating average ratings for each individual stimulus, we selected the five most masculine and the five most feminine male and female faces, voices, and dances (20 faces, 20 voices, and 20 videos in total). This method was used in previous research (DeBruine et al., 2010b; Jones et al., 2013).

3.3.2.3. Priming conditions

Priming conditions consisted of three newspaper-like articles that were tested in two pretests. This priming method was used in previous research (Hill et al., 2012).

3.3.2.3.1 Pretest of priming images

First, images depicting cues of pathogen threat (PT) and resource threat (RT) were chosen using Google search (see Supplementary Material) (McIntosh et al., 2017). For PT, 15 images were selected representing the 2015 *Aedes aegypti* epidemic in Brazil, including pictures of *Aedes aegypti* mosquito, its mosquito-borne diseases (e.g. muscle weakness, skin rash, bleeding, joint swelling, inflammation of the eye, and babies with microcephaly), and generalized spraying with insecticides. To pretest these stimuli, we recruited 14 female and 7 male students (M age = 31.2, SD = 4.20) from the University of Sao Paulo (postgraduates = 61.9%), mainly whites (76.2%), and heterosexuals (85.7%), who earned one to ten Brazilian minimum salary per month (76.2%). Participants judged, on 10-point scales (1 = not at all; 10 = very much), to what extent each photo made them feel insecure/anxious for themselves or

their important others about (a) contagious diseases, (b) health, and (c) their surroundings. For RT, 15 images were chosen about the 2015 Brazilian economic crisis, including photos of unemployment lines, commercial property for rent, stock market crash, poverty, and families worrying about bills. Participants rated on 10-point scales to what extent each picture made them feel concerned/anxious for themselves or their important others (a) to buy basic products, (b) to find/keep a job, and (c) about their salary. Participants rated both blocks of images randomly using Qualtrics platform.

For each photo, an average score was computed and analyzed. Ratings showed good internal consistency for both PT and RT (Cronbach's alphas ≥ 0.902), and there was no significant difference among images of PT ($\chi^2(14) = 19.6$, $p = 0.14$), or among images of RT ($\chi^2(14) = 15.6$, $p = 0.34$). We randomly selected three pictures from PT and RT, respectively, to compose the final priming material.

3.3.2.3.2 Pretest of priming texts

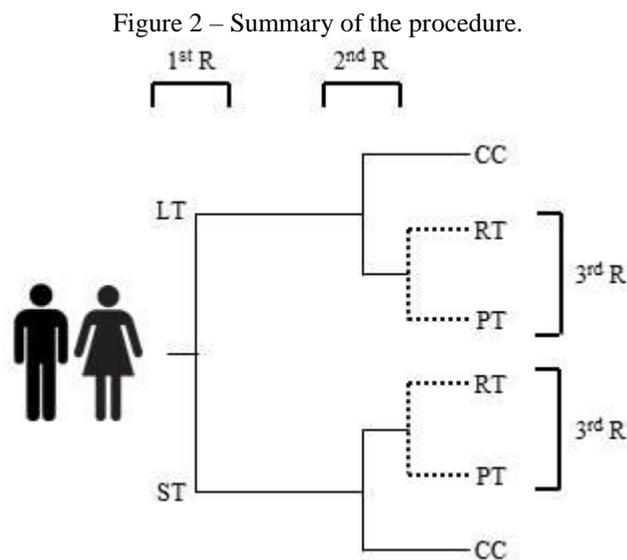
Second, three newspaper-like articles were written (see Supplementary Material). All of them included: (1) a headline (from eight to 11 words; font size 20), (2) a subheading (16 to 25 words; font size 12), (3) three pictures, (4) three figure captions (from eight to 17 words each; font size 9), and (5) a two columns-text (around 700 words each; font size 12).

One article described the 2015 *Aedes aegypti* epidemic in Brazil, and included information about *Aedes aegypti* mosquito, Dengue fever, Zika virus disease, and Chikungunya virus. The second article focused on the 2015 Brazilian economic crisis, and included data on increasing unemployment rates, industry and trade deficit, and decline in state educational investment. Finally, a third article was written as a control condition (CC) that contained information on an unrelated topic (lions poisoned in a Kenyan Reserve in 2015). A pretest was performed with 15 women and 10 men ($M = 29.7$, $SD = 4.65$) from the University of Sao Paulo. Participants consisted of Brazilian students (mostly postgraduates = 56%), who mostly self-reported as heterosexual (80%), white (64%), and earning one to ten Brazilian minimum salaries per month (92%).

Each article was followed by the same six questions used for the pretest of priming images (see Section 2.3.1. *Pretest of priming images*). Texts were divided into three blocks and presented randomly. For each article, two composite variables were computed by

averaging participants' answers of the questions about PT and RT, respectively. Ratings showed good internal consistency for the six variables (Cronbach's alphas ≥ 0.794). In the resource-scarcity condition, there was a significant difference between values of RT and PT ($Z = -4.14$, $p < 0.001$), indicating higher distress with resources. Similar results were found for the pathogen condition ($Z = 4.37$, $p < 0.001$), indicating higher distress with diseases. Finally, there was no significant difference between RT, PT and CC ($Z = 1.60$, $p = 0.11$). Furthermore, we compared the three newspaper-like articles. In RT ($\chi^2(2) = 44.7$, $p < 0.001$) and PT ($\chi^2(2) = 35.2$, $p < 0.001$), there was a significant difference between the articles, indicating that they led people to perceive both threats differently.

3.3.2.4 Procedure



Note: 1st R = first randomization; 2nd R = second randomization; 3rd R = third randomization; LT = long-term relationship context; ST = short-term relationship context; CC = control condition; RT = resource threat; PT = pathogen threat. First randomization refers to participants being exposed to either mating strategy (LT or ST). In the second randomization, volunteers saw the control and the threat-prime conditions randomly. Finally, the flat dashes indicate the third randomization, in which raters were exposed to either environmental threat (RT or PT).

In total, 370 individuals (206 women and 164 men) were recruited online and they were directed to Qualtrics platform. We carried out the research online, because previous studies have shown that online and laboratory studies on visual, and vocal preferences produce equivalent results (e.g., Feinberg et al., 2008a; Fraccaro et al., 2010; Jones et al., 2010; Little et al., 2007b). Moreover, research showed a high accuracy in FM online ratings (Feinberg et al., 2008b; Welling et al., 2007).

Participants were randomly divided according to: (a) mating strategy, and (b) environmental threat. For the former, participants judged either stimuli of a short-term (ST) (e.g., one-night stand, uncommitted relationship) or long-term (LT) (e.g., dating, engagement, or marriage) relationship context. For the latter, participants were exposed in a randomized order to the control-priming condition (control article), and to one of the threat-priming conditions (PT or RT) (Watkins et al., 2012). For example, a female participant would rate FM of all the randomized male stimuli (faces, voices and dances) for a long-term mating context in the control-priming condition, and then in the resource-scarcity condition. Figure 2 shows a summary of the procedure.

Table 6. Distribution of participants according to mating strategy and environmental threat.

| | Pathogen-threat condition | Resource-scarcity condition |
|-------------------------|---------------------------|-----------------------------|
| Long-term relationship | 58 women 45 men | 46 women 43 men |
| Short-term relationship | 51 women 33 men | 51 women 43 men |

After reading a newspaper-like article (control or experimental), participants judged stimuli of the preferred sex on a 100-point scale ranging from zero (not at all attractive) to 100 (very attractive) (Abend, Pflüger, Koppensteiner, Coquerelle, & Grammer, 2015; Lee & Zietsch, 2015). Volunteers were instructed to answer according to their first perception. The stimuli comprised randomly presented masculine and feminine facial images, vocal recordings, and dance videos selected previously. They were judged twice: after volunteers were exposed to (1) CC, and (2) the threat-priming condition. In both conditions, raters examined the same stimuli within the same mating strategy. One hundred two women and 76 men judged the faces, voices, and dance videos for the short-term relationship, while 104 women and 88 men assessed the stimuli for the long-term relationship (more details in Table 6).

3.3.2.5. Analysis

Data were analyzed with SPSS (version 21.0). An average score of attractiveness for each stimulus was calculated and Shapiro-Wilks showed that many items departed from normality. However, parametric tests were still used, since the central limit theorem indicates

that the average of infinite samples of a population tends towards a normal distribution, and each experimental group had at least more than 30 participants (Ghasemi & Zahediasl, 2012).

Table 7 – Mean values for the subtraction of environmental conditions from control condition.

| | RS | ET | FM | Faces | | Voices | | Dances | |
|------------|-------|----|-----|-------|-------|--------|-------|--------|-------|
| | | | | Ms | SDs | Ms | SDs | Ms | SDs |
| Short-Term | Men | PT | Fem | -0.42 | 13.24 | -0.15 | 13.36 | 0.13 | 15.13 |
| | | | Mas | -0.33 | 9.17 | -1.08 | 13.65 | 2.03 | 11.97 |
| | | RT | Fem | -2.51 | 12.72 | -1.25 | 15.83 | -1.32 | 15.99 |
| | | | Mas | -2.33 | 11.31 | -1.26 | 16.39 | -0.24 | 15.54 |
| | Women | PT | Fem | -0.57 | 12.42 | 1.27 | 19.28 | -0.31 | 15.80 |
| | | | Mas | 0.90 | 12.41 | 1.33 | 16.95 | 1.67 | 15.87 |
| | | RT | Fem | 1.30 | 13.57 | -0.02 | 19.37 | -0.01 | 16.78 |
| | | | Mas | -0.25 | 11.27 | 1.43 | 16.11 | -0.24 | 16.96 |
| Long-Term | Men | PT | Fem | 1.05 | 16.54 | 0.31 | 16.69 | 0.92 | 16.88 |
| | | | Mas | -0.30 | 11.15 | 1.73 | 15.52 | 2.83 | 16.31 |
| | | RT | Fem | -0.25 | 13.72 | 1.15 | 16.46 | -1.81 | 16.19 |
| | | | Mas | 1.31 | 9.07 | -0.86 | 14.44 | 1.19 | 12.49 |
| | Women | PT | Fem | -0.92 | 12.25 | -2.30 | 19.05 | -0.46 | 16.95 |
| | | | Mas | -1.27 | 12.31 | -2.46 | 18.68 | -1.79 | 17.83 |
| | | RT | Fem | 1.46 | 12.11 | -1.04 | 20.28 | -1.82 | 17.50 |
| | | | Mas | -0.42 | 10.00 | 1.14 | 22.75 | -0.30 | 16.82 |

Note. RS = raters' sex. ET = environmental threat. PT = pathogen threat. RT = resource threat. FM = femininity-masculinity. Fem = feminine. Mas = masculine.

Analyses were conducted separately according to mating strategies (LT vs. ST). For each participant, the score of the environmental threat was subtracted from the control condition (i.e., the score of CC minus the score of environmental threat). The results were considered as the independent variable. The dependent variables were FM (feminine or masculine), environmental threat (pathogen or resource), and raters' sex (female or male). Since participants assessed attractiveness on a 100-point scale on each stimulus, a Linear Estimation Equations Model was performed. The model used the Wald χ^2 Test, and the covariance matrix for repeated measures was defined by the smallest QIC.

Table 7 shows the mean values for the subtraction of the environmental threat from CC, and their standard deviations. Women and men had similar scores in both conditions, despite the mating strategy; i.e. the averages were small, considering the scales varied from zero to 100. Negative scores indicate that raters gave higher scores to the stimuli in the environmental threat (PT or RT) compared to CC, while positive means show that participants assessed the stimuli in CC as more attractive than in the environmental threat. The Wald χ^2 Test was then carried out to investigate whether FM, environmental threat, and raters' sex

influenced the attractiveness of facial, vocal, and behavioral stimuli of women and men. Table 8 presents the results.

Table 8 – Results of Wald χ^2 Test for facial, vocal, and behavioral stimuli (dfs = 1).

| Model | Faces | | Voices | | Dances | |
|--------------|-----------------|--------------|-----------------|-------|-----------------|-------|
| | Wald χ^2 s | ps | Wald χ^2 s | ps | Wald χ^2 s | ps |
| Intercept | 0.291 | 0.590 | 0.251 | 0.617 | 0.101 | 0.751 |
| RS | 1.632 | 0.201 | 2.261 | 0.133 | 3.673 | 0.055 |
| ET | 0.148 | 0.700 | 0.451 | 0.502 | 1.180 | 0.277 |
| FM | 0.764 | 0.382 | 0.187 | 0.666 | 2.313 | 0.128 |
| RS * ET | 1.603 | 0.205 | 2.024 | 0.155 | 1.334 | 0.248 |
| RS * FM | 0.066 | 0.797 | 0.605 | 0.437 | 1.967 | 0.161 |
| ET * FM | 0.438 | 0.508 | 0.106 | 0.745 | 1.383 | 0.240 |
| RS * ET * FM | 4.194 | 0.041 | 2.976 | 0.084 | 0.275 | 0.600 |
| Intercept | 1.920 | 0.166 | 0.004 | 0.947 | 0.184 | 0.668 |
| RS | 5.234 | 0.022 | 3.692 | 0.055 | 0.017 | 0.898 |
| ET | 1.236 | 0.266 | 0.377 | 0.539 | 1.802 | 0.179 |
| FM | 0.006 | 0.937 | 0.032 | 0.859 | 2.514 | 0.113 |
| RS * ET | 2.500 | 0.114 | 0.000 | 0.984 | 0.283 | 0.595 |
| RS * FM | 0.021 | 0.884 | 0.595 | 0.440 | 0.168 | 0.682 |
| ET * FM | 1.572 | 0.210 | 0.535 | 0.464 | 1.032 | 0.310 |
| RS * ET * FM | 1.750 | 0.186 | 0.021 | 0.886 | 0.216 | 0.642 |

Note. RS = raters' sex. ET = environmental threat. FM = femininity-masculinity.

3.3.3 Results

3.3.3.1 Long-term relationship context

The analysis revealed a significant interaction among raters' sex, environmental threat, and FM for faces (see Table 8). To parse the interaction, we examined the 95% confidence intervals (CIs). The 95% CIs showed differences in women's assessments for resource threat (RT). Female raters found masculine male faces more attractive after being primed with RT compared to the control condition (CC), while women perceived more feminine male faces as more attractive after being primed with CC (see Table 9).

For voices, the equivalent analysis indicated a close-to-significant effect among raters' sex, environmental threat, and femininity-masculinity (see Table 8). The 95% CIs indicated that both sexes presented distinct results for RT (see Table 9). Men assessed masculine female voices as more attractive after being primed with RT in comparison to CC, while feminine voices were judged as more attractive after being primed with CC compared to RT. In

contrast, women preferred feminine male voices after being primed with RT, and masculine male voices after being primed with CC.

Table 9 – Significant results of the 95% confidence intervals for long-term relationship.

| Stimuli | RS | ET | FM | Ms | SEs | 95% CIs | |
|---------|-------|----|-----|--------|-------|---------|--------|
| | | | | | | Lower | Upper |
| Faces | Men | PT | Fem | 2.773 | 2.848 | -2.809 | 8.356 |
| | | | Mas | 0.298 | 1.224 | -2.101 | 2.697 |
| | | RT | Fem | -0.247 | 1.246 | -2.689 | 2.196 |
| | | | Mas | 1.312 | 0.612 | 0.112 | 2.512 |
| | Women | PT | Fem | -1.455 | 1.033 | -3.479 | 0.568 |
| | | | Mas | -1.266 | 0.855 | -2.941 | 0.410 |
| | | RT | Fem | 1.457 | 1.021 | -0.545 | 3.458 |
| | | | Mas | -0.417 | 0.650 | -1.692 | 0.857 |
| Voices | Men | PT | Fem | 0.307 | 1.425 | -2.487 | 3.100 |
| | | | Mas | 1.733 | 1.232 | -0.680 | 4.147 |
| | | RT | Fem | 1.149 | 1.245 | -1.292 | 3.590 |
| | | | Mas | -0.856 | 0.873 | -2.568 | 0.856 |
| | Women | PT | Fem | -2.303 | 1.221 | -4.696 | 0.089 |
| | | | Mas | -2.462 | 1.242 | -4.897 | -0.027 |
| | | RT | Fem | -1.039 | 1.523 | -4.024 | 1.945 |
| | | | Mas | 1.144 | 2.281 | -3.326 | 5.613 |
| Dances | Men | | | 0.782 | 0.688 | -0.566 | 2.130 |
| | Women | | | -1.092 | 0.695 | -2.455 | 0.270 |

Note. RS = raters' sex. ET = environmental threat. PT = pathogen threat. RT = resource threat. FM = femininity-masculinity. Fem = feminine. Mas = masculine.

Dance behavior was influenced marginally by raters' sex (see Table 8). The 95% CIs showed that men perceived women's behavior as more attractive in CC compared to the environmental threat, while women judged men as more attractive in RT compared to CC (see Table 9).

3.3.3.2 Short-term relationship context

Both facial and vocal preferences were only influenced by raters' sex, with no significant effect of FM or interaction (see Table 8); however vocal stimuli reached a marginal significance. CIs showed that men assessed women's faces and voices as more attractive in the pathogen threat (PT) compared to CC. In contrast, women perceived men's faces and voices as more attractive after being primed with CC compared to the environmental threat (see Table 10). Finally, no main effects or interaction were significant for dance behavior.

Table 10 – Significant results of the 95% confidence intervals for short-term relationship.

| Stimuli | RS | Ms | SEs | 95% CIs | |
|---------|-------|--------|-------|---------|--------|
| | | | | Lower | Upper |
| Faces | Men | -1.397 | 0.601 | -2.576 | -0.218 |
| | Women | 0.343 | 0.466 | -0.569 | 1.256 |
| Voices | Men | -0.934 | 0.687 | -2.281 | 0.412 |
| | Women | 1.001 | 0.737 | -0.443 | 2.445 |

Note. RS = raters' sex.

3.3.4 Discussion

The current study examined the influence of pathogen threat and resource threat on preferences for femininity-masculinity (FM) in the opposite-sex faces, voices, and behavior (dances). Women and men rated attractiveness of the stimuli either for a short-term (ST) or long-term (LT) relationship context but the priming conditions only influenced preferences in LT context. In particular, in the resource-scarcity condition, women preferred masculine male faces and feminine male voices, while men preferred masculine female voices.

3.3.4.1 Long-term (LT) relationship context

In the LT relationship context, women preferred sex atypical (feminine) male voices, and similarly men preferred sex atypical (masculine) female voices, when primed with resource threat. On a South American population, we thus replicated the preference for feminine male voices under a resource-scarcity condition (Pisanski & Feinberg, 2013; Puts, 2005), and showed that similar preferences can work in men. Nevertheless, in our study women simultaneously preferred masculine male faces, contrary to the previous findings (Lee et al., 2013; Little et al., 2007a).

Male masculinity can present some advantages not only for ST but also for LT relationships. First, masculine faces provide cues to higher immunocompetence (Folstad & Karter, 1992; Foo et al., 2017), which increases indirect benefits to offspring (Kokko et al., 2003; Li et al., 2011). Second, Buss (2006) argues that women have a similar desire for resource acquisition, and physical protection in long-term and short-term partners. Both aspects are cued by faces (Little et al., 2011a). Therefore, masculinity is preferred in

circumstances like poorer health (DeBruine et al., 2010a), higher threat (Reeve et al., 2018), and extrapair sex (Lyons et al., 2016).

However, women face a trade-off since masculine facial traits are judged as less warm, caring, having less interest in long-term relationships, and providing lower paternal investment (Dixson et al., 2016). Therefore, in order to secure both indirect (e.g., genetic) and direct (e.g., parental) qualities, women prefer a mosaic of masculine and feminine traits in a potential partner (Buss & Shackelford, 2008; Varella et al., 2014).

It has been suggested that testosterone synthesis and mechanisms of tissue response in different parts of the body and behavior might have evolved independently, and be independent to some degree (Hau, 2007). Intrasexual variation in the distribution of androgen receptors and timing of masculinization and/or defeminization could explain such results (Bastir, 2008; Bastir et al., 2013; Bastir & Rosas, 2009). These arguments are supported by the lack of association between male faces' and voices' attractiveness (Hill et al., 2013; Valentova et al., 2017; Wells et al., 2013). Moreover, Rezlescu et al. (2015) argue that preference for men's feminine faces and masculine voices is expected, because masculine voices are associated with intra-sexual dominance, while feminine faces relate to pro-social characteristics in men. As we showed, such preferences were not replicated in the resource-scarcity condition,

Finally, men primed with resource threat preferred more masculine female voices for LT relationships. Similarly, previous studies found that men preferred more masculine female faces in harsh environments, when examining ST versus LT relationship (Little et al., 2007a; Pettijohn & Tesser, 2005). Furthermore, lower access to resources (e.g. running water) and pessimistic social and economic conditions predicted preference for masculine female faces in El Salvador (Batres & Perrett, 2014), and in American movie actresses (Pettijohn & Tesser, 1999).

Men's preferences for masculine women can be adaptive. Firstly, more masculine women can have advantages in terms of resource competition and acquisition, which may benefit both parents when raising offspring, particularly under stressful and difficult circumstances. In accordance, Cashdan (2003) showed that more masculine women were more likely to express competition through verbal aggression. Previous studies also found that traditionally feminine women have rather poor adjustment (e.g., low self-esteem, high anxiety, low education and lower socioeconomic status), while more masculine women have

higher education, socioeconomic status and income (e.g., Hoffman & Fidell, 1979), which are characteristics advantageous particularly in conditions with resource scarcity. Moreover, masculine women report higher number of sexual partners (Mikach & Bailey), and can thus secure resources from more than one male partner. In line with this, polyandry is more common in harsh environmental and resource-scarcity conditions (reviewed in Kenrick & Griskevicius, 2015), and according to life history theory (Hill, 1993), women who are exposed to harsh environments in their childhood adjust their reproductive strategies to a more short-term oriented strategy (Belsky, Steinberg, & Draper, 1991). In summary, some masculine features in women and some feminine traits in men can contain qualities that, under specific conditions, can increase social, economic and reproductive success.

3.3.4.2 Short-term (ST) relationship context

Contrary to our hypotheses, the environmental conditions did not influence preferences for FM in the ST relationship context. Previous studies reported that women and men preferred higher sexual dimorphism after primed with ST context (Dixson et al., 2016; Lee and Zietsch, 2011; Little et al., 2011a; Little et al. 2002), or after cues of pathogen threat (DeBruine et al., 2010b; Jones et al., 2013; Lee et al., 2013; Watkins et al., 2012).

However, a growing number of studies showed no significant preference for sexual dimorphism after primed with pathogen threat (Dixson et al., 2017; Holzleitner & Perrett, 2017; Lee & Zietsch, 2015, Study 3; McIntosh et al., 2017; Zietsch et al., 2015). For example, Lee and Zietsch (2015, Study 3) found no interaction between pathogen threat and women's preference for facial masculinity. Therefore, we have expanded their findings for voices, dance movements, and men's preferences.

The study design can explain such differences. Previous research used a forced-choice design, in which participants had to choose between a more masculine and a more feminine version of the same stimulus. Contrarily, the current study and those who could not replicate the influence of pathogen threat on mating preferences (e.g., Lee et al., 2013; Lee & Zietsch, 2015) pursue a standalone-rating design. Lee and Zietsch (2015) argued that the forced-choice design may convey a different aspect of preferences for FM (e.g., conscious awareness) and thus be more powerful in such circumstances.

In accordance, Zietsch et al. (2015) found that among identical and non-identical twins, genetic variation explained 38% of the variance in women's facial FM preferences, while sociosexuality, fertility, and pathogen disgust explained less than 1% of the variance. Accordingly, participants from non-WEIRD (Western, Educated, Industrialized, Rich, and Democratic) societies showed low or null association between pathogen threat and preference for sexually dimorphic faces, despite potentially higher exposure rates to pathogen burden (Dixson et al., 2017; Scott et al., 2014). Finally, previous results found that preferences for facial FM increased with the level of urbanization and thus human preferences for sexual dimorphism may be a recent manifestation for the context of large, urban societies to increase sensitivity to minor variations (Buss & Schmitt, 2019; Scott et al., 2014). In this scenario, forced-choice studies could access the influence of pathogen threat more easily. Therefore, our study reinforces that the influence of pathogen condition on preference for FM in short-term relationships is rather small and specific to study design.

3.3.4.3 Dance behavior

Dance is defined as an universal set of body movements (Niemitz, 2010), which are composed of patterned sequences with rhythm, intention, and purpose and plays a role in courtship practices of many cultures (Hanna, 1988, 2010; Kaepler, 1978; Kurath, 1960; Wade et al., 2015). Dance is argued to be a sexually selected mechanism that display an individual's qualities (Hanna, 1988, 2010). In fact, dance movements can reveal person's sex (Saunders et al., 2010), and it was shown that FM of dance movements influences attractiveness ratings (Weege et al., 2012). Therefore, we hypothesized that pathogen threat and resource threat would influence raters' preference for FM of dance movements. However, results did not confirm our hypotheses. Women preferred men's dance in general after primed with environmental threat, suggesting that other variables not studied in the current experiment are influencing raters' responses.

Despite the influence of hormones on behavior (Hines, 2011; Puts et al., 2012), dance is largely influenced by social aspects. For example, Weege et al. (2012) found that women assessed good male dancers as more masculine, while other studies showed that male dancers were perceived as more feminine (Risner, 2002; Spence & Buckner, 2000). Therefore, the stereotype of dance behavior as a feminine activity can influence the assessment of a potential

partner, at least in westernized populations with recent style of living (Crawford, 1994; Lueptow et al., 1995; Risner, 2002; Spence & Buckner, 2000).

Thus, our results indicate that dance is not perceived in the mating context through the dimension of masculine and feminine characteristics. Nevertheless, dance movements might cue other important aspects to mate choice, such as synchrony of the movement, symmetry, and rhythmicity. Indeed, Bläsing et al. (2012) argued that professional dancers exhibit limb coordination, strength, flexibility, and aesthetic qualities. They can also learn complex sequences of movements, and synchronize their actions to changing musical speed and rhythm. Moreover, Fink et al. (2014) argued that professional dancers have higher physical and cognitive abilities. These characteristics may be associated with indirect qualities and socio-cultural functions, like coalition and social bonding (Hanna, 1988). Perception of femininity-masculinity through dance movements needs more research.

The current study showed some limitations. First of all, participants were recruited mainly among the middle-class university student population across the richest state of Brazil. Therefore, studies possessing a more diverse Brazilian population are needed to examine the generalizability of the current findings. Finally, future studies should also examine the influence of other factors that can influence FM preferences in specific environmental conditions, like self-perceived and rated attractiveness (Little et al., 2001; Kandrik & DeBruine, 2012; O'Connor et al., 2012), partnership status (Lyons et al., 2016), menstrual cycle (Gildersleeve et al., 2014), and self-perceptions of health (Feinberg et al., 2012).

3.3.5 Conclusion

In summary, we found that women preferred a mosaic of masculine male faces and feminine male voices when primed with the resource-scarcity condition in long-term relationship context. In the same condition, men preferred women's masculine voices. In the short-term relationship context, we found no influence on participants' preferences for femininity-masculinity. Finally, no association was found for dance videos in either mating context.

Firstly, we partly corroborated the research using an experimental design with unmanipulated stimuli in a standalone-rating. Secondly, previous results were drawn primarily from data collected among participants living in North American, Australian and

West European countries. Here we showed that, in the long-term relationship context, Brazilian women preferred a mosaic of FM in men to acquire direct and indirect benefits, while men preferred masculine female voices to improve resource acquisition. Our results can differ from previous studies because Brazilian population has some peculiarities. In particular, the disease (Barreto et al., 2011; Murray & Schaller, 2010) and homicide (Murray et al., 2013) rates are relatively high in Brazil, as well as socioeconomic differences within the population which together with the current economic crisis show the instability of the resource availability. Our sample is thus daily exposed to very specific environmental threats, and can show different reactions during laboratory experiments.

Furthermore, despite the multimodal nature of FM in humans, most of the current research still focused on isolated cues, especially facial photographs (Lee & Zietsch, 2015; Little et al., 2011b; McIntosh et al., 2017; Watkins et al., 2012). The current study is the first to examine faces, voices and especially dance movements with such study design. Finally, we examined the influence of pathogen threat and resource scarcity not only on women's preferences for femininity-masculinity in men (Lee & Zietsch, 2015; McIntosh et al., 2017), but also on men's mate preferences.

3.3.6 *Supplementary material*

A – Images of pathogen threat selected on Google Images for the ‘pretest of priming images’



P1



P2



P3



P4

P5



P6



P7





P8



P9

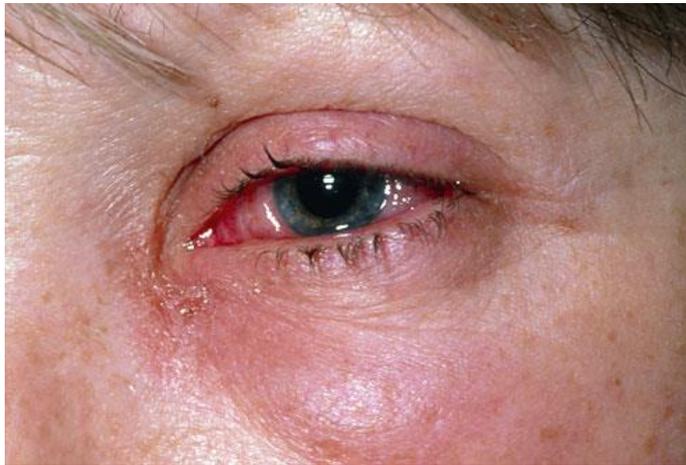


P10

P11



P12



P13





P14



P15

B – Images of resource scarcity selected on Google Images for the ‘pretest of priming images’



R1

R2



R3



R4



R5





R6



R7



R8



R9



R10



R11



R12



R13



R14



R15

C – Newspaper-like article on pathogen threat

Brasil enfrenta epidemia de dengue, zika e chikungunya

Região de transmissão da dengue quadruplicou e aponta riscos para a disseminação do zika vírus e da febre chikungunya.



Mosquito *Aedes aegypti* se prolifera em ambiente urbano e transmite doenças, como dengue, zika e chikungunya.

O mosquito é o animal mais perigoso para o homem atualmente. Para Frances Hawkes da Universidade de Greenwich, “metade da população global corre risco de contrair uma doença transmitida por mosquitos”. O foco do momento é o *Aedes aegypti*, mais conhecido no Brasil como mosquito da dengue – e agora também como transmissor do zika vírus e da febre chikungunya.

A eficiência do *Aedes aegypti* se baseia na sua capacidade de adaptação e sua proximidade com o homem. Se prolifera em ambiente urbano e possui hábito diurno (alimenta-se preferencialmente pela manhã ou fim da tarde); entretanto pode picar à noite se necessário. Além disso, geralmente utiliza água limpa para pôr seus ovos; mas em sua falta, utiliza outras variantes.

Seu oportunismo não é visto apenas nos adultos. A fêmea coloca em média cem ovos, que são distribuídos em diversos locais. Na falta de água, os ovos podem permanecer em locais secos por até um ano e, assim que

possível, desenvolvem-se num curto período de sete dias em média.

DENGUE

Os números epidemiológicos também assustam. No ano de 2015, o país bateu o recorde de casos de dengue: foram 1,6 milhão. Apenas no estado de São Paulo, foram registrados 649 mil casos. No mesmo período, o número de mortes também é o maior, com 761 óbitos até o início de outubro.

Os sintomas já são bem conhecidos pelos brasileiros: febre, dores no corpo e manchas na pele. Em casos mais graves, a dengue pode causar hemorragias que podem levar à morte.

Dados alarmantes apontam que, em uma década, a área de transmissão da doença no Brasil quadruplicou, de 1,5 milhão de km² para 6,9 milhões de km². Fato semelhante é visto no Estado de São Paulo, onde 612 dos 645 municípios apresentaram transmissão do

vírus – em 1995, apenas 107 cidades apresentavam casos.

ZIKA VÍRUS



Organização Mundial de Saúde declara emergência mundial para o zika vírus.

A área de transmissão da dengue pode apontar regiões nas quais a zika e a chikungunya também podem se disseminar. Como novo problema gerado pelo mosquito, a zika já contabiliza três casos de mortes no país.

Os sintomas são febre, erupções cutâneas, coceira, dor muscular e vermelhidão nos olhos. Eles normalmente desaparecem em um período de 3 a 7 dias, porém em média 80% das pessoas não os apresentam.

A zika está gerando grande alarde mundial pelos indícios de sua relação com o repentino aumento nos casos de bebês com microcefalia. Em 2015, foram 270 casos confirmados e 3.449 em estudo. Tal coincidência não foi confirmada, mas as evidências colocam as grávidas e as mulheres que planejam ter filhos no grupo de risco. Alguns países e a União Europeia recomendaram que grávidas adiassem viagens a países expostos ao zika, como o Brasil.

A Organização Mundial de Saúde (OMS) relatou em fevereiro que a zika havia se propagado em mais de 30 países das Américas e fez a estimativa de que haverá entre 3 e 4 milhões de casos no continente em 2016 - desses, 1,5 milhão ocorrerão no Brasil. Tais dados fizeram a OMS declarar emergência mundial de saúde pública.

Evidências apontam que, todavia, a zika pode ser um fator de risco para todos em geral. A doença aumentou a incidência de casos da síndrome de Guillain-Barré em 19% no Brasil e em mais quatro países da região. Os sintomas são fraqueza muscular e paralisia dos músculos, variando de leve à paralisia total dos membros. Ela não apresenta cura e os tratamentos são voltados a reduzir a gravidade dos sintomas.

CHIKUNGUNYA

A chikungunya também pode se privilegiar da ampla área de ocorrência do *Aedes aegypti*. Os sintomas são febre e dores, principalmente nas articulações, durando em média duas semanas. Entretanto as dores articulares podem permanecer por vários meses, afetando a qualidade de vida do paciente.

Em 2015, foram registrados 17.146 casos suspeitos até novembro, sendo 6.726 confirmados. O país também registrou o primeiro caso de miosite aguda - doença que acomete os músculos e pode causar fortes dores, convulsões e paralisia de partes do corpo, podendo ocorrer em qualquer pessoa.



Aumento no número de casos mostra fragilidade do país para lidar com o *Aedes aegypti*.

BRASIL

Com o advento da zika e do chikungunya, os brasileiros têm novos motivos para temer o *Aedes aegypti*. Os dados apontam que o país se mantém refém do mosquito em períodos de chuvas e calor.

D – Newspaper-like article on resource scarcity

Crise econômica atinge diversos setores e a renda do trabalhador brasileiro

“Dados seguem surpreendendo negativamente e não há sinais de recuperação” aponta relatório do banco suíço UBS.



Desemprego atingiu taxa de 6,9% em dezembro de 2015, segundo o IBGE.

O ano de 2015 se mostrou difícil para a economia nacional e para os brasileiros. O fim do ano apresentou taxa de desemprego de 6,9%, segundo o Instituto Brasileiro de Geografia e Estatística (IBGE). Essa é a taxa mais alta para o mês de dezembro desde 2007, quando chegou a 7,4%.

O IBGE também indicou recuo na renda média dos trabalhadores entre 2014 e 2015, passando de R\$ 2.373 para R\$ 2.235. Por segmento, empregados com carteira de trabalho assinada no setor privado tiveram queda de -3,3%, empregados sem carteira no setor privado, -5,1%, militares ou funcionários públicos estatutários, -1,8%, trabalhadores por conta própria, -4,1%, e empregadores, -6,2%. Além disso, aumentou a inadimplência da população que atingiu a casa dos 5,8% no ano passado.

INDÚSTRIA E COMÉRCIO

Parte desses efeitos negativos se deve aos resultados na indústria e no comércio. De acordo com o IBGE, a produção industrial encolheu 8,3% em 2015. Este é o pior resultado de toda a série da Pesquisa Industrial Mensal – Produção Física (PIM-PF), que traz dados anuais desde 2003.

Alguns setores chamam mais a atenção. A indústria de bens de capital (produção de máquinas e equipamentos) mostrou queda de 25,5%. Em conformação, o setor de veículos automotores mostrou retração de 25,9%, enquanto a área de equipamentos de informática, produtos eletrônicos e ópticos, 30%. Os analistas preveem a continuidade no cenário negativo para 2016. A previsão é que a produção industrial tenha retração de 3,8%.

Da mesma forma, o comércio registrou prejuízos. No Natal de 2015, as vendas do varejo caíram 6,4% em comparação com a mesma época do ano passado, segundo a

Serasa Experian. Foi o pior desempenho para o período desde a criação do indicador, em 2003. Porém, a Federação do Comércio do Estado de São Paulo (FecomercioSP) estima uma diminuição ainda maior, chegando a 15%.

EDUCAÇÃO

Esses resultados negativos estão produzindo queda na arrecadação de impostos, afetando assim a distribuição de recursos para a educação. Em 2015, os ajustes fiscais geraram redução do orçamento do Ministério da Ciência, Tecnologia e Inovação (MCTI) em 25% e do Ministério da Educação (MEC) em 9%. De acordo com a presidente da Sociedade Brasileira para o Progresso da Ciência (SBPC), o cenário é o “pior dos últimos 20 anos”.



Indústria e comércio registram prejuízo, afetando positivamente a taxa de desemprego.

A principal fonte de recursos para pesquisa no País é o Fundo Nacional de Desenvolvimento Científico e Tecnológico (FNDCT). O valor total arrecadado pelo FNDCT em 2014 caiu 28%: indo de R\$ 4,5 bilhões para R\$3,2 bilhões. Por falta de dinheiro, em 2015 houve atraso no pagamento de editais aprovados e cancelamento na abertura de novas chamadas.

Na esfera acadêmica, quem mais vem sofrendo são os programas de pós-graduação – principal base da produção científica nacional. A Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) cortou 100% dos recursos para capital – destinados a equipamentos e gastos em infraestrutura – e 75% das verbas de custeio – usadas com materiais, organização de eventos e outras rotinas da pós-graduação.

BRASIL

Relatório do banco suíço UBS afirma que para 2016 os “dados seguem surpreendendo negativamente e não há sinais de recuperação”. O Produto Interno Bruto (PIB) – soma de todos os bens e serviços produzidos no país – terá uma retração de 3,8%, com estimativas de recuo de 14% nos investimentos e de 4,4% no consumo privado. A inflação será de 6,8%, enquanto a cotação do dólar pode atingir R\$ 4,35.

Seguindo as estimativas negativas, a receita líquida do governo central sofreu queda de 6,4% em relação a 2014 – correspondendo a 1,03 trilhão de reais, enquanto a Receita Federal divulgou recuo de 5,62% na arrecadação. Em contrapartida, as despesas totais subiram 2,1% - os gastos totais somaram 1,15 trilhão de reais em 2015.

Para suplantar os prejuízos, a equipe econômica aposta no aumento da carga tributária e na recriação da CPMF. Para 2016, a taxa básica de juros (14,25%) pode aumentar 0,5 ponto percentual. O aumento nos tributos também atinge os combustíveis, o Imposto sobre Operações Financeiras (IOF) sobre crédito e os tributos sobre bebidas e eletrônicos.



Inadimplência dos brasileiros atingiu a casa dos 5,8% em 2015.

Dessa forma, o ano de 2016 será uma continuidade da crise econômica para grande parte dos setores nacionais – desde Indústria até Educação, assim como para a população em geral.

E – Newspaper-like article on control condition

Estrelas de documentários da BBC, leões são envenenados no Quênia

Os leões foram encontrados tendo espasmos e com dificuldades para se levantar. Apresentadora de TV se declarou “horrorizada ao pensar na dor que eles sofreram”.



Leão do bando de Marsh com dificuldades de respirar e ficar em pé, após comer carcaça envenenada.

Oito leões, conhecidos por uma série de documentários da BBC foram envenenados na Reserva Nacional de Masai Mara no Quênia. O relato foi feito pelos próprios produtores do programa.

O caso aconteceu em dezembro. A equipe de filmagens da BBC encontrou os leões se comportando de forma estranha, tendo espasmos e com dificuldades para se levantar. Três leões foram confirmados como mortos. Um dos animais falecidos era Bibi, uma fêmea de 17 anos e estrela nos documentários da BBC. Segundo a equipe da rede britânica, Bibi foi encontrada “caída de lado, com espuma na boca e ofegando”, e pouco depois morreu. Um dos apresentadores do programa, Jonathan Scott, lamentou o “fim de uma era”.

Uma segunda leoa foi encontrada morta. Por ser comida por hienas, sua identificação foi impossível – mas é provável que seja a leoa

Siena. Seu filhote, que tem dois anos, está sendo tratado por veterinários.

A terceira e última vítima foi Alan, um jovem leão. Ele estava sendo tratado, porém, após se separar do grupo, foi pisoteado por uma manada de búfalos. Alan foi encontrado debaixo de um carro com graves ferimentos, após conseguir rastejar e fugir de uma hiena que tentou atacá-lo. Devido à gravidade, o animal foi sacrificado.

Os demais leões doentes foram mantidos em observação. Todos fazem parte do bando de Marsh (*Marsh Pride* em inglês) e foram envenenados após comerem uma carcaça de vaca. Dois pastores de gado foram detidos em Narok, no sudoeste do Quênia, pelo envenenamento do grupo de leões segundo a BBC. Saba Douglas-Hamilton, uma conservacionista e apresentadora de TV, declarou-se profundamente triste e

“horrorizada ao pensar na dor que eles sofreram”.



Leão Alan após ser sacrificado na Reserva Nacional de Masai Mara no Quênia.

Este bando de leões se tornou famoso pela aparição na série “Big Cat Diary”, transmitida pela BBC entre 1996 e 2008. O grupo inclusive possui uma página no Facebook, onde o envenenamento foi confirmado.

Segundo correspondente da BBC em Nairóbi, Alastair Leithead, há um conflito entre os felinos e os pastores Maasai. No passado, alguns aldeões envenenavam os leões para prevenir ataques contra seu gado. Mas recentemente o problema tem aumentado pelo fato de alguns pastores levarem seus animais para dentro das terras do parque. “Tornou-se a norma que dezenas de milhares de gado entrem na reserva durante a noite, onde, no passado, isso só acontecia sob condições de seca extrema”, disse Jonathan Scott.

Para Anne Kent Taylor, uma conservacionista na Reserva Nacional Masai Mara, ocorre um ciclo vicioso. Em troca de um salário, os pastores Maasai vendem ou reservam parte de suas terras para a conservação da vida selvagem e turismo, onde pastoreio não é permitido. Com o dinheiro, eles compram mais gado, mesmo tendo menos terra. Dessa forma, durante o dia, milhares de cabeças de gado pastoreiam perto da reserva. Ao cair da noite, quando os turistas vão embora, os animais são levados para a reserva, onde a pastagem é melhor - o período coincide com o horário de caça dos predadores noturnos,

como os leões. Quando o gado é morto, os fazendeiros fazem a “retaliação” com veneno.

Um estudo de 2009 descobriu que, desde 1977, a entrada de gado na reserva aumentou mais de 1.100%. De acordo com Scott, “não há nada de surpreendente a respeito do que está acontecendo no Masai Mara”. Scott também aponta um segundo problema causado pelo gado ilegal pastoreando dentro da reserva – o gado diminui a vegetação local, afastando os herbívoros, o que significa maior dificuldade de caça para os leões.



Dos oito leões envenenados, três foram confirmados mortos.

O autor do livro “The Marsh Lions” que inspirou a série da BBC, Brian Jackman, disse estar devastado com a notícia. “Elas eram leões tão bonitas e maduras. Bibi era uma das grandes matriarcas dos Marsh. Elas eram tão conhecidas que se podia reconhecê-las como fazemos com o cão ou gato da nossa família.” disse ao The Telegraph. Jackman acrescenta que essas mortes são uma tragédia aos leões de toda a África. O número de leões caiu 50% desde 2003 e estudo recente indica que essas somas devem diminuir pela metade nos próximos 20 anos se não houver esforços na conservação. As estimativas apontam que existam apenas 2.000 leões livres remanescentes no Quênia e 20.000 por todo o continente, de acordo com a Iniciativa Grande Felinos da National Geographic.

4 CONCLUSION

The current thesis aimed to investigate the subjective perception of intrasexual variations in femininity-masculinity and how third-party's perception is influenced by environmental threats (i.e. pathogen threat and resource scarcity) in distinct sexual strategies (i.e. short-term and long-term relationship contexts). Since femininity-masculinity associates with distinct mate qualities, women and men have faced trade-offs between preferences for feminine and masculine traits in a potential partner of the opposite sex. The trade-offs suggest recurring sexual problems faced by our ancestor throughout evolution. Therefore, psychological mechanisms have been selected because they have helped individuals to reply adaptively to significant environmental information (Buss, 2006; Buss & Schmitt, 1993, 2019; Giudice, Gangestad, & Kaplan, 2015; Tooby & Cosmides, 2015).

Femininity-masculinity is firstly developed because of the intersexual difference in the level of sex hormones, which produces a differentiation between women and men in faces, voices, and behavior (e.g. Grammer et al., 2003; Puts, 2010; Saunders et al., 2010), for instance. However, individuals are differently influenced by the processes of masculinization/defeminization and feminization and thus creating intrasexual variation in femininity-masculinity in both sexes. Since both women's and men's femininity and masculinity are linked with direct (parental care) (e.g. Vukovic et al., 2011; Cashdan, 2003) and indirect (genetic quality) (e.g. Foo et al., 2017; O'Connor et al., 2013) investments into reproduction, respectively, feminine and masculine traits indicate mate qualities.

Previous studies suggest that men's masculinity seems advantageous in circumstances of short-term relationships and environments with high levels of pathogen prevalence (Buss & Schmitt, 1993, 2019; Gangestad & Simpson, 2000; Li & Kenrick, 2006). In contrast, male femininity seems important in the context of long-term relationships and resource scarcity (e.g. Buss & Schmitt, 1993, 2019; Gangestad & Simpson, 2000; Lee & Zietsch, 2011). On the other hand, research indicates that women's femininity is advantageous for the context of short-term relationships and pathogen threat (Buss & Schmitt, 1993, 2019; Gangestad & Simpson, 2000). However, mixed results are found for women's traits in the context of long-term relationship and resource scarcity context (e.g. Cashdan, 2003, 2008; Law Smith et al., 2012; Nelson & Morrison, 2005; Swami & Tovée, 2006).

Since women and men can show high levels of biparental care, it is expected that an accurate assessment of a potential mate's quality and one's self-perceived mate value have been selected to avoid wasting resources on inadequate mates (Regan, 1998a, 1998b).

However, previous studies have mainly focused on the subjective perception of attractiveness (e.g. Muñoz-Reyes et al., 2015), neglecting. Therefore, we examined the association between self-reports and third-party ratings of femininity-masculinity and attractiveness. Moreover, we assessed the correlation between such subjective perceptions and objective measures of femininity-masculinity.

A second concern addressed in the current thesis was the multiple channels to inform third-party raters on cues of femininity-masculinity. Previous research indicated that female faces and voices seemed to carry concordant information (e.g. Collins & Missing, 2003; Fraccaro et al., 2010; Wheatley et al., 2014); however, mixed results were found for the male stimuli (Feinberg et al., 2008a; Little et al., 2011a; Valentova et al., 2017a). Further, most studies neglected other channels of information, such as body movements. Therefore, we addressed the correlation between facial, vocal, and behavioral (dance) femininity-masculinity in both sexes.

Finally, we also investigated the influence of environmental threats on third-party's perceptions of femininity-masculinity. Previous studies have examined the influence of prime conditions on the participants' preferences for femininity-masculinity, i.e. researchers have presented stimuli simulating environments containing high levels of pathogen load and/or issues with resource acquisition to test whether such circumstances change women's and men's preferences for feminine and masculine traits in a potential partner of the opposite sex. Results indicated that prime conditions were able to change volunteers' assessment in the context of pathogen threat (e.g. Lee & Zietsch, 2011; Little et al., 2007a; Little et al., 2011a; Watkins et al., 2012) and resource scarcity (e.g. Lee et al., 2013; Lee & Zietsch, 2011; Little et al., 2011a).

However, these studies showed some limitations. Firstly, they emphasized the investigation of women's sexual strategies and the context of pathogen threat (Lee et al., 2013; Lee and Zietsch, 2011; Little et al., 2007a; Watkins et al., 2012). Then, they used manipulated faces as primary stimulus, especially with studies containing forced-choice designs between feminine and masculine traits (Lee et al., 2013; Little et al., 2007a; Watkins et al., 2012). Finally, they performed most experiments among Americans, Canadians, Australians and Western Europeans (e.g., Feinberg et al., 2012; Jones et al., 2013; Lee et al., 2013; Lee and Zietsch, 2011; Little et al., 2007a; Lyons et al., 2016; Watkins et al., 2012). Therefore, the current study aimed to examine whether pathogen-prime and resource-prime conditions influence women's and men's preferences for feminine and masculine facial photographs, voices, and dance movements of potential partners of the opposite sex.

Participants were Brazilians, who assessed unmanipulated stimuli on a standalone-rating design.

To achieve such goals, three pretests and one experiment were performed. The first pretest aimed to select six photographs related to pathogen threat and resource scarcity to compose later the newspaper-like articles. The ‘pretest 2’ examined if the articles about the *Aedes aegypti* epidemic and the economic crisis were effective as pathogen-prime and resource-prime conditions, respectively. Then, ‘pretest 3’ were conducted to select the five most feminine and the five most masculine stimuli among a sample of facial photographs, vocal recordings, and dance videos of both sexes. Lastly, the experiment was carried out to examine the influence of the prime conditions on participants’ preferences for femininity-masculinity.

From this methodology, three scientific articles were written and submitted to international journals. A summary of them can be found in Table 11 and Table 12.

Table 11 – Summary of aims and procedures.

| | Aims | Procedures |
|------------------|--|--|
| Chapter 1 | Humans have faced a trade-off between feminine and masculine characteristics, since they cue to distinct parental investments. Nevertheless, previous studies lack to examine the association between subjective perceptions and objective measures of femininity-masculinity and how they are linked to attractiveness across facial, vocal, and behavioral stimuli. | Forty-one women and 38 men had their faces photographed and their voices and dance movements recorded. Subjective perceptions comprised self-reports and third-party ratings on femininity-masculinity and attractiveness. Sixty-four (43 women) and 51 (28 women) participants independently rated facial, vocal and behavioral femininity-masculinity and attractiveness, respectively. Both assessments consisted of two 7-point scales, varying from '1' (very feminine/not at all attractive) to '7' (very masculine/very attractive). Finally, objective measures consisted of facial sexual shape dimorphism, vocal fundamental frequency, and an ethogram of shoulders and hip movements. |
| Chapter 2 | Previous research showed that men prefer and rate women's feminine traits as more attractive. However, studies are inconsistent about men's masculine traits. Thus, it was tested whether third-party raters perceived femininity-masculinity concordantly in women's and men's faces, voices, and dance behaviors. | Standardized facial photographs, vocal recordings and dance videos of 41 women and 38 men were rated by 43 female and 21 male female students on 100-point scale (0 = very feminine; 100 = very masculine). Participants were Brazilian undergraduates from the University of Sao Paulo, aged 18-35 years, and mostly identified as white. The third-party raters assessed the stimuli of both sexes in three randomized blocks. |
| Chapter 3 | Studies indicated that women's femininity and men's masculinity are linked to indirect benefits (e.g. genes, health, fertility). Thus, they might be preferred in conditions of pathogen threat and short-term relationships. However, male masculinity is linked to undesired behaviors to long-term mates and therefore male femininity/direct benefits (e.g. parental care) are preferred by women in conditions of resource scarcity and long-term relationships. But there is a lack of studies and inconsistent results about men's preferences for female femininity in such conditions. Thus, it was examined whether environmental threats (i.e. pathogen threat and resource scarcity) influenced women's and men's preferences for femininity-masculinity in faces, voices, and dances of the opposite sex. The pathogen-prime condition was presented in the short-term relationship context, while the resource-prime condition was showed in the long-term relationship context. | Stimuli: after the procedure of 'Chapter 2', the five most masculine and the five most feminine male faces, voices, and dances were selected for both sexes. Prime conditions: firstly, 14 women and seven men analyzed 15 images of pathogen threat and 15 images of resource scarcity. Then, three images of the former and three images of the latter were selected. They were then included on priming texts. Three newspaper-like articles were written on pathogen threat, resource scarcity, and control condition. They were pretested with 15 women and ten men. All participants were students from the University of Sao Paulo, aged 18-35 years, who mostly reported as white and heterosexual. Experiment: 206 female and 164 male students from universities across the state of Sao Paulo, evaluated the stimuli of the preferred sex on a 100-point scale (0 = not at all attractive; 100 = very attractive). Volunteers were heterosexual and mostly white. The ratings occurred in either a short-term or long-term relationship context. Stimuli were rated twice: after participants were primed with the control condition and with the environmental threat (either pathogen threat or resource scarcity). The conditions were presented randomly. |

Results of '3.1 Chapter one' showed that there was a discrepancy between women's self-reports and third-party raters on assessing women's facial and vocal femininity and attractiveness. These results reinforce previous studies (Feingold, 1992; Muñoz-Reyes et al., 2015) showing that women's self-perceived and third-party measures of attractiveness are

independent variables. We suggest that our female sample had their self-concepts on femininity influenced by social context (Little & Mannion, 2006; Ben Hamida et al., 1998) more than objective measures. According Ben Hamida et al. (1998), women's mate value is more related to less controllable variables, like youth and reproductive potential. Such scenario has selected women who are more aware of their social performance and are more influenced by it (Kavanagh & Scrutton, 2015). This is corroborated by the lack of association between facial shape and vocal fundamental frequency and women's self-reports on femininity and attractiveness.

In contrast, third-party raters assessed women's facial and vocal femininity according to their feminine facial shape and vocal frequency. Further, other-rated femininity also correlated with third-party ratings on attractiveness. Therefore, we replicated the association between female femininity and attractiveness (Rhodes, 2006). Since female femininity is related to fertility and genetic quality (e.g. Wheatley et al., 2014), our results suggest that men were selected to perceive such traits in a potential female partner, while women was selected to perceive potential female competitors.

Women's results in '3.1 Chapter one' are corroborated by the positive association between feminine female faces and feminine female voices in '3.2 Chapter two'. Such results suggest that women's faces and voices are providing concordant cues to third-party raters regarding female femininity. Nevertheless, we found no correlation between facial and vocal objective measures and female attractiveness. This indicates that social factors are also influencing in some extent third-party ratings of attractiveness.

Table 12 – Summary of hypotheses and results.

| | Hypotheses | Results |
|------------------|---|---|
| Chapter 1 | Firstly, we assumed that self-reports and third-party ratings of femininity-masculinity and attractiveness would be associated. Secondly, we hypothesized that subjective perceptions and objective measures of femininity-masculinity and attractiveness would be related. | Men's self-reports on femininity-masculinity and attractiveness were associated with third-party ratings. Masculine male voice pitch correlated with subjective perceptions of femininity-masculinity. In women, there was no association between self- and other-rated femininity and attractiveness, or between subjective perceptions and objective measures. For behavioral stimuli only men's subjective perceptions on attractiveness correlated. |
| Chapter 2 | We hypothesized that women's faces, voices, and dances would be perceived concordantly as cues to femininity-masculinity, but men's traits would not. | As predicted, a positive correlation between women's faces and voices was found. In men, faces and voices showed no concordance. No correlation was found among dance behavior and the previous traits in both sexes. |
| Chapter 3 | We predicted that both women and men would increase preference for faces, voices, and dances with indicators of indirect investment (i.e. feminine female and masculine male traits) when primed with cues of pathogen threat in a short-term context. When primed with cues of resource threat in a long-term context, both women and men would increase preference for faces, voices, and dances with indicators of direct investment (i.e. feminine female and male traits). | Results partially confirmed the hypotheses for the long-term relationship context: women found men's masculine faces and feminine voices more attractive, while men rated masculine female voices as more attractive. For the short-term relationship context, pathogen-prime condition and femininity-masculinity however did not influence the results of both sexes. No effect was found for dance behavior in both contexts. |

In the case of masculine male perception, men's self-perception and third-party ratings on facial and vocal masculinity associated. However, men's self-perception and third-party ratings on facial masculinity were not influenced by the objective measures studied, i.e. facial sexual shape dimorphism. Moreover, subjective perceptions did not associate with self-perception and third-party ratings on facial attractiveness. Previous studies show that facial perception is influenced by other aspects (e.g. Valentova et al., 2017b) besides masculinity and thus other traits influenced both perceptions on facial masculinity and attractiveness.

For men's voice, we found that masculine vocal pitch associated with the self-perception and third-party ratings on male masculinity, suggesting that voice could be a better indicator of male masculinity than faces and dance movements. In fact, previous studies suggest that vocal masculinity cue to dominance (Rezlescu et al., 2015), which is relevant since men's mate value is more associated with status-relevant characteristics (Ben Hamida et al., 1998). Nevertheless, only subjective perceptions of vocal masculinity associated with subjective perception of vocal attractiveness, while vocal pitch did not correlate with vocal attractiveness. Those results suggest that other factors are influencing third-party raters on

assessing men's vocal attractiveness, such as the trade-offs faced by women between men's indirect and direct investments (reviewed in Buss & Schmitt, 2019).

Moreover, the different results found between men's faces and voices in '3.1 Chapter one' were corroborated by the lack of association between masculine male faces and voices in '3.2 Chapter two'. Our results thus reinforce a growing number of studies indicating that male faces and voices cue distinct characteristics (Rezlescu et al., 2015; Varella et al., 2014; Wells et al., 2013).

For dance movements, we only found that other-rated femininity of women's dance movements correlated with other-rated attractiveness, and men's self-reports on attractiveness associated with third-party ratings on attractiveness. Therefore, we partially replicated the association between body movements and attractiveness (Fink et al., 2015), but we did not replicate the link between body movements and the perception of FM (Troje, 2003). This result is corroborated by the fact that dance movements did not associate with feminine female faces or voices in '3.2 Chapter two'.

Moreover, we found an association between women's youth and higher levels of hip movements. The reason might be related to the influence of sex hormones in the body composition (Jasińska et al., 2004). Women develops permanent stores of fat around the buttocks, and thighs (Puts, 2010), i.e., wider hips compared to the waists. In addition, feminine bodies were associated with reproductive maturity, and fecundability (Jasińska et al., 2004). Therefore, our results suggest that dance behavior develops by distinct processes than faces and voices, and that women's dance movements might be related to other objective measures, like waist-to-hip ratios (Röder et al., 2015).

Finally, we examined the influence of pathogen threat and resource scarcity on third-party perceptions of femininity-masculinity. In the long-term relationship context, we reinforced the female preference for a mosaic of men's masculine and feminine traits after the resource-prime condition (Buss & Shackelford, 2008; Varella et al., 2014). Women, thus, ensure the access to male indirect and direct investments. In the case of men's preferences, we showed that they preferred masculine female voices. Previous studies suggest that masculine women could have better access to resources through competition (Cashdan, 2003). Moreover, feminine women were assessed as more likely to be unfaithful and pursue short-term relationships (Boothroyd et al., 2008), and to have rather poor adjustment to long-term relationship context (Hoffman & Fidell, 1979). Therefore, our results suggest that men might also face a trade-off between masculine and feminine female traits.

For the short-term relationship context, we found no influence of pathogen threat in women's and men's preferences for femininity-masculinity in a potential partner of the opposite sex. Our results replicate some studies that did not find any association when using a standalone-rating design (e.g. Lee et al., 2013; Lee and Zietsch, 2015), because human preferences for sexual dimorphism may be a recent manifestation (Scott et al., 2014). For further discussion see '3.3 Chapter three'.

The current study showed some limitations. Firstly, our sample consisted of only university students across Sao Paulo State. Further, dance videos were recorded in a scientific laboratory, which might have influenced participants'. Moreover, we only analyzed results of heterosexual women and men. Therefore, future studies should examine the influence of a more diverse Brazilian sample, regarding ethnics, social class, education, and sexual orientation. Moreover, it is necessary to further investigate how femininity-masculinity influences dance behavior. Finally, future research should further examine the influence of study design and unmanipulated stimuli on results.

Despite the limitations, the current study advanced the discussion concerning the subjective perception of femininity-masculinity and how human preferences for such traits vary according to environmental threats. We have also introduced the dance movements in such experimental design. Finally, our samples were collected among Brazilian, increasing the discussion about the influence of culture in such topic.

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ANNEX A – Ethics Committee Approval

INSTITUTO DE PSICOLOGIA
DA UNIVERSIDADE DE SÃO



PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Influência de patógenos e recursos nas preferências por parceiros sexuais

Pesquisador: Kamila Janaina Pereira

Área Temática:

Versão: 2

CAAE: 53719416.5.0000.5561

Instituição Proponente: UNIVERSIDADE DE SAO PAULO

Patrocinador Principal: MINISTERIO DA CIENCIA, TECNOLOGIA E INOVACAO

DADOS DO PARECER

Número do Parecer: 1.506.897

Apresentação do Projeto:

O presente projeto de pesquisa irá investigar as possíveis variáveis biológicas e evolutivas relacionadas às escolhas e à preferência por pares amorosos, principalmente no tocante a possíveis influências de duas variáveis - patógenos e recursos – nas preferências por parceiros amorosos ideais em homens e mulheres. Parte de na hipótese que ambos buscam traços de 'bom provedor' e/ou capacidades de 'bons genes' em seus futuros/as parceiros/as. Para tal, busca examinar como a apresentação de sinais de prevalência de patógenos e de escassez de recursos irá afetar as preferências de homens e mulheres para traços de masculinidade e feminilidade em fotos faciais, gravações de vozes e vídeos de dança. Será utilizado um método complexo multifásico, nas quais se incluem experimentos com exibição e avaliação de fotos faciais, gravações vocais e vídeos de dança, seguido de escala Likert para avaliar feminilidade-masculinidade, questionário sócio-demográfico, e a seguir novo experimento para avaliação de fotos masculinas e femininas, seguido de novo experimento para avaliação de estímulos para parceiros/as para curtos ou longos relacionamentos, seguido de novo experimento para identificar parceiros/as que exibam patógenos e/ou recursos, e por fim, nova avaliação de fotos faciais e resposta de questionário sobre relacionamentos amorosos. Apresenta TCLE; se mostra relevante dentro do campo da Psicologia; e toma os cuidados éticos necessários.

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Continuação do Parecer: 1.506.897

Objetivo da Pesquisa:

O objetivo da pesquisa é relevante e claramente explicitado e busca investigar as possíveis variáveis biológicas e evolutivas relacionadas às escolhas e à preferência por pares amorosos, principalmente no tocante as possíveis influências de duas variáveis - patógenos e recursos – nas preferências por parceiros amorosos ideais em homens e mulheres com base na hipótese que ambos buscam traços de 'bom provedor' e/ou capacidades de 'bons genes' em seus futuros/as parceiros/as.

Avaliação dos Riscos e Benefícios:

O projeto de pesquisa apresenta claramente descrito os benefícios e os riscos aos participantes.

Comentários e Considerações sobre a Pesquisa:

O presente projeto de pesquisa apresenta referencial teórico pertinente, metodologia experimental adequada, apresenta o TCLE, mostra-se relevante dentro do campo da Psicologia e toma os cuidados éticos necessários, inclusive com a caracterização dos participantes da pesquisa e a descrição da forma de recrutamento dos mesmos.

Considerações sobre os Termos de apresentação obrigatória:

O TCLE deixa claro os objetivos e procedimentos que serão adotados; oferece um contato da pesquisadora e do Comitê de Ética para eventuais dúvidas e esclarecimentos adicionais; explicita que os participantes poderão pedir os esclarecimentos que desejarem e/ou deixar a pesquisa a qualquer momento, retirando seu consentimento, sem quaisquer consequências, penalizações ou prejuízos; deixa claro que haverá anonimato e a garantia do sigilo dos participantes, apontando a possibilidade de publicação da pesquisa e da garantia de sigilo neste caso; além de indicar onde as respostas dos participantes ficarão armazenadas. Além disso, será apresentado aos participantes um documento com esclarecimentos adicionais.

Recomendações:

Sem recomendações.

Conclusões ou Pendências e Lista de Inadequações:

Sem pendências ou inadequações.

Considerações Finais a critério do CEP:

Se o projeto prevê aplicação de TCLE, todas as páginas do documento deverão ser rubricadas pelo pesquisador e pelo voluntário e a última página assinada por ambos, conforme Carta Circular no 003/2011 da CONEP/CNS.

Salientamos que o pesquisador deve desenvolver a pesquisa conforme delineada no protocolo

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Continuação do Parecer: 1.506.897

aprovado.

Eventuais modificações ou emendas ao protocolo devem ser apresentadas ao CEPH de forma clara e sucinta, identificando a parte do protocolo a ser modificada e suas justificativas. Lembramos que esta modificação necessitará de aprovação ética do CEPH antes de ser implementada. De acordo com a Res. CNS 466/12, o pesquisador deve apresentar a este CEP/SMS o relatório final do projeto desenvolvido, conforme preenchimento de Protocolo disponível na página do Comitê de Ética em Pesquisa com Seres Humanos do IPUSP, do site do IPUSP. Em seguida, o protocolo preenchido deverá ser enviado ao CEPH pela Plataforma Brasil, ícone Notificação, logo que o mesmo estiver concluído.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

| Tipo Documento | Arquivo | Postagem | Autor | Situação |
|---|--|------------------------|------------------------|----------|
| Informações Básicas do Projeto | PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_641698.pdf | 31/03/2016 12:32:31 | | Aceito |
| TCLE / Termos de Assentimento / Justificativa de Ausência | ANEXO_TCLE_alterado.docx | 31/03/2016 12:31:51 | Kamila Janaina Pereira | Aceito |
| Projeto Detalhado / Brochura Investigador | Projeto_KamilaJP_Alterado.docx | 31/03/2016 12:31:42 | Kamila Janaina Pereira | Aceito |
| Outros | Carta_ao_CEP.docx | 31/03/2016 12:31:31 | Kamila Janaina Pereira | Aceito |
| Declaração de Pesquisadores | Pesquisadora.pdf | 29/02/2016 08:43:10 | Kamila Janaina Pereira | Aceito |
| Declaração de Instituição e Infraestrutura | Demonstrativo_de_infraestrutura.pdf | 29/02/2016 08:37:32 | Kamila Janaina Pereira | Aceito |
| Folha de Rosto | Folha_de_Rosto.pdf | 29/02/2016 08:36:28 | Kamila Janaina Pereira | Aceito |

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

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Continuação do Parecer: 1.506.897

SAO PAULO, 19 de Abril de 2016

Assinado por:
Helena Rinaldi Rosa
(Coordenador)

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ANNEX B – Details of Submission to *Personality and Individual Differences*

Elsevier Editorial System(tm) for
Personality and Individual Differences
Manuscript Draft

Manuscript Number:

Title: Femininity-masculinity and attractiveness - associations between self-ratings, third-party ratings and objective measures

Article Type: Full Length Article

Section/Category: Research Paper (<5000 words)

Keywords: Femininity/masculinity; Attractiveness; Subjective perception; Objective measures; Dance; Voice; Face; Mate preferences

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Corresponding Author's Institution:

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Abstract: Femininity-masculinity affects perceived attractiveness and indicates biosocial qualities. Physiological and morphological femininity-masculinity is primarily influenced by reproductive hormones; however, its perception is mediated biopsychosocially, and it is not clear if self- and other-rated femininity-masculinity are associated. We examined possible associations between self-rated, other-rated, and measured femininity-masculinity and attractiveness of faces, voices, and behavior in a target sample of 41 women and 38 men, aged 18-35 years, from Brazil. We took their facial photos, recorded voices and dancing behavior, and we measured sexual dimorphism of facial shape, vocal fundamental frequency, and performed behavioral analysis of the videos. These participants self-rated their facial, vocal, and behavioral femininity-masculinity and attractiveness. Sixty-four (43 women) and 51 (28 women) Brazilian students, aged 18-35 years, independently rated facial, vocal and behavioral femininity-masculinity and attractiveness, respectively, of the target sample. In general, men's self-rated femininity-masculinity and attractiveness correlated with third-party ratings. Male voice pitch correlated with self- and other-rated femininity-masculinity. In women, there was no association between self-ratings and ratings by others, or between self-ratings and objective measures of femininity-masculinity. Women's subjective perceptions thus do not reflect perceptions of others or objective measures. Studies using different measures of attractiveness or femininity-masculinity should thus reflect upon this discrepancy.

ANNEX C – Details of Submission to *Behavioural Processes***Manuscript Details**

| | |
|--------------------------|--|
| Manuscript number | BEPROC_2018_123 |
| Title | Positive association between facial and vocal femininity/masculinity in women but not in men |
| Article type | Short Communication |

Abstract

Multicomponent stimuli improve information reception. In women, perceived facial and vocal femininity-masculinity (FM) are concordant; however, mixed results are found for men. Some feminine and masculine traits are related to sex hormone action and can indicate reproductive qualities. However, most of the current research about human mate choice focuses on isolated indicators, especially visual assessment of faces. We therefore examined the cross-modal concordance hypothesis by testing correlations between perceptions of FM based on facial, vocal, and behavioral stimuli. Standardized facial pictures, vocal recordings and dance videos of 38 men and 41 women, aged 18-35 years, were rated by 21 male and 43 female students, aged 18-35 years, on 100-point scale (0 = very feminine; 100 = very masculine). All participants were Brazilian students from University of Sao Paulo. In women, facial and vocal FM correlated positively, suggesting concordant information about mate quality. Such results were not found in men, indicating multiple messages, which agree with women's multifaceted preference for male FM. In both sexes, FM of dance did not correlate with voices or faces, indicating different information and distinct process of development. We thus partially supported the cross-modal concordance hypothesis.

| | |
|---|---|
| Keywords | Acoustic trait; Femininity; Masculinity; Multimodal perception; Sexual selection; Visual trait |
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| Order of Authors | Kamila Janaina Pereira, Marco Antonio Varella, Karel Kleisner, Ondřej Pavlovič, Jaroslava Varella Valentova |
| Suggested reviewers | David Puts, Karl Grammer, Bernhard Fink, Ben Jones |

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Highlights.docx [Highlights]

Abstract.docx [Abstract]

Manuscript_Pereira et al..doc [Manuscript File]

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ANNEX D – Details of Submission to *Evolution and Human Behavior***Manuscript Details**

| | |
|--------------------------|---|
| Manuscript number | EVOLHUMBEHAV_2019_40 |
| Title | The influence of resource scarcity on multimodal preference in long-term, but not pathogen threat in short-term relationships |
| Article type | Research paper |

Abstract

During evolution, humans faced the trade-off between preferences for feminine and masculine traits which are connected to direct (parental care) and indirect (genetic quality) investments into reproduction, respectively. Recent research has shown that environmental factors influence preferences for femininity/masculinity (FM) in potential mates. However, studies mainly focus on women's preferences for isolated cues in men. We therefore examined the influence of pathogen threat (PT) and resource threat (RT) on women's and men's preference for FM in opposite sex unmanipulated faces, voices, and dances. Three hundred seventy (206 women) students, aged 18-35 years, from universities across the state of Sao Paulo, Brazil, were primed with newspaper-like articles on either PT (*Aedes aegypti*, and its mosquito-borne diseases) or RT (Brazilian economic crisis), and compared to a control condition (lions poisoned in a Kenyan Reserve). Each participant was randomly assigned to rate attractiveness of the stimuli either for a short-term or a long-term relationship. After each priming article, participants rated attractiveness of pre-rated masculine and feminine stimuli of the opposite sex in a standalone-rating design. For the long-term relationship context, women preferred men's masculine faces and feminine voices after being primed with the RT condition, suggesting a preference for men with a mosaic of FM traits. Men, however, preferred masculine female voices, which might indicate preference for partners with easier access to resources. There was no association for the short-term relationship context, and no effect was found for the PT condition. Finally, no effect was found for dances, indicating that behavior develops independently and conveys different messages than faces and voices.

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|---|---|
| Keywords | Femininity/masculinity; Individual differences; Dance; Voice; Face; Environmental cues |
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| Suggested reviewers | Lisa Welling, Lisa DeBruine, Bernhard Fink, Brendan Zietsch, Rob Brooks |

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| Declaration of Interest.docx | [Cover Letter] |
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