Assessing the role of sexually dimorphic and prototypical shape characteristics in social judgments of unmanipulated face images

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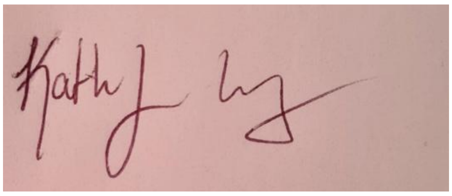

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Acknowledgments.

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I end by showing gratitude to my loved ones. I thank my husband for, I am sure at least occasionally, feigning interest in my incessant psychological babbling, for cooking and cleaning when I would work into nights and weekends, and for giving me foot rubs when deadlines loomed near. Without his unfailing support, the quality of this piece of work would have undoubtedly suffered, as would have my nerves. Finally, I must always give credit to my mother, who, a psychologist herself, raised me to be empathetic, curious, and passionate about the human mind. Hers is the guiding hand behind all that I do and all that I am, and I owe her my values, work ethic, and resolve to make the world a kinder place. Thank you, Mom.

Publications in peer-reviewed journals arising from this thesis

The empirical work reported in this thesis is adapted from the following publications in peer-reviewed journals, on which I am first author:

Leger, K., Dong, J., DeBruine, L. M., Jones, B. C., & Shiramizu, V. K. (2024). Assessing the roles of symmetry, prototypicality, and sexual dimorphism of face shape in health perceptions. Adaptive Human Behavior and Physiology, 10(1), 18-30. (Chapter 2)

Leger, K., Dong, J., DeBruine, L. M., Jones, B. C., & Shiramizu, V. K. (2023). Assessing the roles of shape prototypicality and sexual dimorphism in ratings of the trustworthiness of faces. Scientific Reports, 13(1), 15662. (Chapter 3)

Leger, K., Jones, B. C., & Shiramizu, V. K. (2025). Testing for individual differences in the effects of men’s physical attractiveness and perceived abusiveness on women’s hypothetical dating decisions. Scientific Reports, 15(1), 20667. (Chapter 5)

I confirm that I led the study design and conception, data analyses, and writing for these papers, with additional input from my co-authors.

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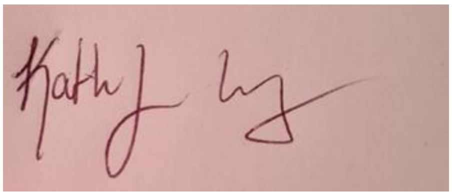

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Table of contents

General abstract. Social judgments of faces (e.g., perceptions of a person's trustworthiness, health, or attractiveness based on their facial appearance) play an important role in social interaction. While many previous studies have suggested that aspects of facial shape, such as sexual dimorphism and prototypicality, drive these social judgments, the methods used to assess social judgments in these studies (forced-choice paradigms using face images in which shape parameters were experimentally manipulated) have been criticised for lacking ecological validity. Consequently, the current work investigated whether shape parameters claimed to play a role in social judgments of faces (e.g., sexual dimorphism, prototypicality) predict social judgments of faces when natural (i.e., unmanipulated) faces were rated individually for health (Chapter 2) and trustworthiness (Chapter 3). Results suggest that measured shape distinctiveness (the converse of prototypicality) plays an important role in health and trustworthiness perceptions (Chapters 2 and 3) but is only weakly correlated with distinctiveness ratings of faces (Chapter 4). By contrast, evidence that measured sexual dimorphism is related to social judgments was limited, only occurring for health perceptions of female faces. Together these findings highlight the role prototypicality plays in social judgments of faces and the potential importance of distinguishing between perceived (i.e., rated) and measured distinctiveness when considering the literature on social judgments of faces. Building on this work, a final study (Chapter 5) found that women's responses on a hypothetical dating decisions task were strongly related to men's physical attractiveness, but not perceptions of men's physical abusiveness, suggesting perceptions of physical attractiveness may play a particularly important role in dating decisions.

Chapter 1. General introduction

Faces are one of the first visual stimuli we encounter when meeting new people. Consequently, evidence shows that faces are one of the first sources of information that people use to gather information about others, leading us to make quick social judgments of people that are based partly on their appearance (Langlois et al., 2000; Rhodes, 2006; Todorov et al., 2015). In fact, research has demonstrated that we not only use faces to gather broad categorical information about people (e.g., their age, gender, or ethnicity), but also to form more complex impressions of them (e.g., whether they seem competent, intelligent, or trustworthy), even though these first impressions are often spurious (Langlois et al., 2000; Rhodes, 2006; Olivola et al., 2014). In turn, these judgments have been shown to have impactful social consequences. For example, how someone's face is perceived appears to predict many important social outcomes, including their financial successes, fates in criminal courts, and how they fare on the dating market (Langlois et al., 2000; Olivola et al., 2014). In addition, individuals are not only impacted by how others perceive them but also by how they perceive others. For example, how an individual perceives others' faces influences how they interact with them, biasing their social behaviors from whom they choose to trust to whom they choose to elect as political leaders (Olivola et al., 2014; Todorov et al., 2015). Below, we will look more closely at how social judgments of faces influence various social outcomes, focusing on voting behaviour, career success, court sentencing, and romantic partner choice.

Social consequences of facial judgments

Facial judgments and political election outcomes

One of the important social outcomes that appear to be influenced by social judgments of faces is the outcome of political elections. While people typically assume that voting behaviour is guided by factors such as political party affiliation, ideology, or a campaigner's proposed policies, a large body of research suggests that a political candidate's appearance also influences voting behaviors (Carpinella & Johnson, 2016; Lowman et al., 2019). Indeed, multiple studies have found that participants accurately determined the party affiliation of politicians more often than by chance based solely on a facial photograph, suggesting that facial features provide information for candidate assessment (see Carpinella & Johnson, 2016 and Lowman et al., 2019 for reviews).

Multiple factors have been found to influence how a candidate is perceived, including a candidate's facial attractiveness. Research has demonstrated that candidates judged to be more attractive were also judged more favorably on other accounts (i.e., on impressions of intelligence and leadership) than their counterparts (Carpinella & Johnson, 2016). Furthermore, research also suggests that when individuals assess unfamiliar candidates' faces, they tend to over-ascribe their own ideologies to the more attractive candidates, thereby evaluating them more positively (Carpinella & Johnson, 2016). This bias is similar to "the attractiveness halo effect," whereby attractive individuals are often immediately perceived more favorably and assumed to possess more favorable personality traits, such as greater perceived intelligence, conscientiousness, sense of humor, and social skills (Langlois et al., 2000).

Another factor that has been shown to influence facial judgments of candidates is gender-related stereotypes. Studies demonstrate that perceivers often associate gender-stereotypically female qualities with the Liberal party and attribute to Liberal candidates gender-stereotypically female traits, such as compassion, trustworthiness, and nurturing (Carpinella & Johnson, 2016). In contrast, gender-stereotypically male qualities are often associated with the Conservative party. In turn, Conservative candidates are attributed gender-stereotypically male traits, such as assertiveness, dominance, maturity, and aggressiveness (Carpinella & Johnson, 2016). In addition, voters tend to seek these party-stereotypical traits in their party candidates, which they may infer from their appearance. Therefore, it appears that candidates can benefit from "looking the part" during their campaign by having a clear fit between how they are perceived and the policies they hold (Carpinella & Johnson, 2016).

Finally, a candidate's facial features may elicit other trait inferences that have been shown to influence voting behaviors (Carpinella & Johnson, 2016). For example, research shows that individuals use facial cues to judge whether a candidate seems intelligent, a strong leader, trustworthy, honest, caring, or experienced, especially when individuals value these traits in a political leader (Olivola & Todorov, 2010). However, competence judgments are repeatedly found to be the most important and predictive perceived trait for voting behaviors (Franklin & Zebrowitz, 2016; Olivola & Todorov, 2010). Competence judgments and related traits (i.e., experience, trustworthiness, and qualification) remain robust predictors of a candidate winning an election even after controlling for other variables (i.e., attractiveness, gender, ethnicity, and age, Olivola & Todorov, 2010). Studies have also demonstrated that the more attractive a political candidate is perceived to be, the higher their perceived competence (Olivola & Todorov, 2010; Carpinella & Johnson, 2016). Furthermore, men perceived as more competent are also perceived as more masculine. However, for women, looking neither too masculine nor too feminine increases their competence ratings, whereas being perceived as too much of either results in a decline in this perceived trait (Olivola & Todorov, 2010). Importantly, these factors also appear to “stack up”, so that the more a candidate is perceived as attractive, older, and more competent, the larger portion of the participants’ votes they tend to receive (Olivola & Todorov, 2010).

Notably, while the above findings suggest that voting intentions may be influenced by candidates’ facial features, results relating to the accuracy of individuals in predicting real-world voting behaviors from facial cues alone are mixed (for a review, see Olivola & Todorov, 2010). Some studies have found that when participants choose between two candidates who either ran in past, present, or simulated elections, based solely on candidates’ appearance, participants’ voting behaviors substantially predicted real election outcomes, and this across many countries and different political climates (e.g., Olivola & Todorov, 2010; Carpinella & Johnson, 2016). However, others have found that, when they looked at the individual level rather than the pooled results, participants were only accurate in predicting real-life election outcomes 53% of the time, which is barely above chance level (Todorov et al., 2005; see also Lin et al., 2018). In addition, while some research has reported that these in-lab appearance-based judgments explained up to 72% of the variance in participants’ hypothetical votes (Ballew & Todorov, 2007), other studies have reported that this influence on actual voting behaviors only translates into a few points advantage in actual electoral outcomes, suggesting that social judgments of faces are only one of many factors influencing votes and, potentially, relatively unimportant (Carpinella & Johnson, 2016).

Of course, although participants generally agree on which candidate looks most competent and can accurately predict election winners and losers, this does not necessarily mean that their chosen winner possesses their inferred traits or is the most competent for the job (Olivola & Todorov, 2010). Somewhat reassuringly, researchers have found that perceivers reduce their reliance on facial appearance when making voting decisions when given more information about candidates actual policies (Olivola & Todorov, 2010).

Facial judgments and financial and career successes

Another important area of life influenced by social judgments of faces is career and financial success. For example, research suggests that many of the same appearance-based biases that predict election outcomes and voting intentions also influence the appointment of business leaders and the hiring of employees. For instance, in business, the gender typicality of a business leader's appearance predicts their salary and the prestigiousness of their position in an organization (for a review, see Todorov et al., 2015). For instance, Chen et al.'s (2024) US study found that male and female audit partners whose faces were perceived to violate their respective gender stereotypes had fewer prestigious clients and were less likely to work at the top 4 audit firms in the country. More specifically, they found that men who seemed less competent, dominant, and professional (stereotypically masculine traits) and women who seemed less kind and warm (stereotypically feminine traits) experienced poorer career outcomes. Finally, they found that male and female audit partners scoring higher on stereotypical traits of the opposite gender had significantly smaller client portfolios.

Another common factor in selecting political and business leaders is the value attributed to perceived competence. When looking at the top 100 US law firms, Rule and Ambady's (2011a) study demonstrated that managing partners whose faces were perceived as more powerful (a combination of competence, dominance, and facial maturity traits) worked at the more profitable firms. These results held even after controlling for perceived attractiveness, photo quality, firm size, and managers' years of experience. In a follow-up study (Rule & Ambady, 2011b), the authors also had those same managing partners' undergraduate yearbook pictures rated for perceived power, testing for a relationship between ratings of the current and yearbook photographs. Interestingly, their study found a relationship wherein managing partners perceived as more powerful today were also perceived as more powerful in images taken up to 50 years ago. The authors suggested that these results could indicate that facial cues to work-place competence remain somewhat consistent over one's lifespan and are able to predict one's future success from a relatively young age. Once again, these results held even after controlling for variables such as perceived attractiveness, firm size, and managers' years of experience. However, perceptions of power only explained 14% of the variance in US managing partners' actual success, suggesting that the effects of appearance may be somewhat weak.

Little and Roberts (2012) have termed the biasing of job appointments by facial cues the "fit-for-task" effect. The underlying idea is that people seek to select individuals perceived to have the required qualities for the task. In other words, political and business leaders are chosen for their perceived competence because that is what people believe makes a good leader. Furthermore, the authors suggest that, as needs change (i.e., leading during a time of war vs. a time of peace), valued traits for the tasks should also shift (i.e., valuing a dominant leader vs. a leader with warmer qualities). Different tasks may also call for different traits in order to be performed well, explaining why perceived attractiveness has been positively associated with a salesperson's performance while perceived dominance tends to be more predictive of success within the military (see Todorov et al., 2015). Furthermore, needs may also change according to culture. For instance, while perceived power has been found to predict American CEOs' profits, it was not a trait found to predict Japanese CEOs' success (Rule et al., 2011). This may be because Japanese companies establish different business goals or seek different qualities in their leaders than US companies.

Much like the literature on voting intentions, the literature on the role of facial appearance in career success and appointments also highlights that the impressions driving effects like those described above are often inaccurate. For example, Chen et al. (2023) used real loan data to assess participants' accuracy in judging a subject's likelihood of repaying a loan based solely on a photograph. Their participants were only accurate 59.6% of the time, which is only slightly (albeit significantly) higher than chance level. They also found that participants extracted too much information from irrelevant facial cues (i.e., facial similarity, attractiveness, body weight, and wearing glasses), thereby further reducing accuracy. Furthermore, Pandey and Zayas (2021) conducted a study in which participants selected partners for a financial task across multiple trials. Their results demonstrated that participants consistently showed a preference for more attractive partners, even when they were disadvantageous and conferred financial losses compared to less attractive choices. Therefore, attractiveness can continue to bias our decision-making even as we receive performance feedback indicating that favouring attractive individuals is an ineffective or suboptimal strategy.

Facial judgments and criminal sentencing

Criminal sentencing is a third important area of life influenced by social perceptions of faces. Research demonstrates that individuals perceived as more criminal-looking are more likely to get selected in a police lineup (Flowe & Humphries, 2011) and that individuals whose appearance resembles the stereotype of their alleged crime are more likely to be found guilty (Dumas & Teste, 2006). Furthermore, research has found a relationship between facial features and criminal sentencing severity, to the point of predicting who does and does not receive the death penalty (Wilson & Rule, 2016).

Many researchers have argued that the facial characteristic that seems to hold the most sway in court decisions is perceived trustworthiness. For example, Porter et al. (2010) found that their participants required less evidence to confidently arrive at a guilty verdict when the accused was perceived as less trustworthy. In contrast, participants required more incriminating evidence and expressed less confidence in their verdicts when considering the culpability of more trustworthy-looking individuals accused of the same crime. Furthermore, Wilson and Rule (2015) reported that participants rated as looking more untrustworthy in third-party ratings of face images were more likely to be convicted and received longer sentences than those rated as trustworthy. Although this finding is widely cited in the literature on first impressions as evidence that facial appearance influences sentencing decisions, it should be noted that a more recent study by Kramer and Gardner (2020) did not replicate Wilson and Rule's (2015) findings. Using Wilson and Rule's (2015) study design and stimuli, but a larger sample of raters, Kramer and Gardener did not replicate Wilson and Rule's findings. They also did not replicate Wilson and Rule's results using a much larger sample of face images. These null results call into question the putative link between facial trustworthiness and court sentencing.

Another facial characteristic that has been found to predict criminal sentencing is, again, attractiveness. The literature highlights that attractiveness judgments correlate negatively with the perceived gravity of alleged crimes, resulting in more attractive individuals being perceived as less guilty of severe crimes (Sigall & Ostrove, 1975). Existing work also demonstrates that more attractive individuals pay lower bail sums (Little & Roberts, 2012). In addition, Blair et al.'s (2004) study on African facial features found that convicted criminals who had more African facial features were given longer criminal sentences, reporting that pronounced African facial features could result in up to 7 to 8 months of added prison time.

Facial judgments and romantic partner choice

The final area of life influenced by social judgments of faces that I will discuss here is romantic partner choice. With the increase in dating app use, individuals are triaging in an ever-larger pool of potential partners, with facial impressions placed front and centre in these decisions. Of course, people continue to look for partners with similar interests, values, age, and education, among other non-appearance-related factors (Montoya et al., 2008). However, facial appearance plays a considerable role when selecting a sexual or romantic partner.

Undeniably, attractiveness judgments have played a significant role in partner choice since long before the introduction of dating apps. Little et al. (2012) highlighted that attractive individuals get more dates than their less attractive peers, that individuals report being more satisfied after a date with a more attractive partner, and that attractiveness judgments were the main predictor of an individual's willingness to go on a second date with someone. Their review also highlighted that individuals are in high agreement about who is and is not attractive, both within and between cultures, suggesting that, while cultural differences in attractiveness judgments and standards of beauty certainly exist (e.g., Han et al., 2018; Scott et al., 2014), there is also a high degree of consensus in what faces people consider attractive.

Aside from attractiveness, individuals also seek certain personality traits in potential romantic or sexual partners, which they may infer, at least initially, from facial appearance. For instance, common personality traits women seek in male partners include appearing fun, extroverted, and open to new experiences. In contrast, men generally report a lower interest in women perceived as more serious, smart, and ambitious (Olivola & Todorov, 2010; Todorov et al., 2015). These perceived personality traits have been found to work independently from attractiveness ratings, suggesting that their effects are not simply a byproduct of the attractiveness halo effect (Todorov et al., 2015).

Of course, there may also be individual differences in the types faces people prefer in potential partners. For instance, faces will be considered more attractive if they are perceived to convey traits and qualities that the viewers subjectively value (Todorov et al., 2015). Therefore, while women generally prefer more feminine facial features in men because they convey more partnership-friendly traits such as commitment, kindness, and warmth, some women may prefer more masculine facial features if they are seeking more masculine traits such as dominance in their potential partners (Oh et al., 2020). Context also matters, such that women seem to prefer more stereotypically masculine and dominant traits in a short-term partner, presumably as concerns of fidelity and commitment do not matter as much in a short-term context (Snyder et al., 2008). In contrast, traits that suggest investment and commitment are preferred by women seeking a long-term partner (DeBruine et al., 2010; Little et al., 2012). Other factors that may drive individual differences in partner choice include ratings of one's own attractiveness and own personality traits (Little et al., 2012) among other factors (for a longer discussion of these individual differences, see Little et al., 2012 and Todorov et al., 2015).

That social judgments of faces appear to influence (or at least predict) a wide range of social outcomes raises the question of what facial characteristics drive social judgments and why. The next section of my General Introduction will address these issues, focusing on the putative roles of sexual dimorphism, symmetry, and averageness.

The role of face shape in facial judgments

Facial averageness

Averageness refers to the degree to which a face mathematically equates to or resembles most other faces within a population (Rhodes, 2006). The closer a face resembles most other faces in a population, the more average its facial features, whereas the further it is from that population average, the more extreme and distinctive its features are (Rhodes, 2006). Averageness has been found to influence various social judgments of faces. For example, some studies suggest that more average faces are perceived as more trustworthy (Kleisner et al., 2024b; Ryali et al., 2020; Todorov et al., 2015; but see also Zhao et al., 2023). Such results suggest the existence of an "anomalous-is-bad" stereotype whereby people may presumptuously attribute positive social traits to individuals with more average features and negative social traits to individuals with more distinctive ones (Workman et al., 2021).

Multiple theorists have suggested that averageness could be a signal to health as it might indicate developmental stability (Rhodes, 2006; Thornhill & Gangestad, 1999). These researchers suggest that averageness of features occurs when human development progresses relatively stress-free or has successfully been resistant to developmental stressors due to better gene quality (Rhodes, 2006; Thornhill & Gangestad, 1999). On the other hand, when human development is challenged, it potentially results in atypical, more distinctive features (Rhodes, 2006; Little et al., 2012). If this is the case, then averageness, as an honest signal of a strong immune system and greater genetic quality, may be desirable in potential partners because we have evolved to find this trait attractive (Little et al., 2012).

Multiple studies have indeed found a link between averageness and attractiveness for both male and female faces (Kocnar et al., 2019; Komori et al., 2009a; Rhodes et al., 2001b; Rhodes, 2006; Kleisner et al., 2024a; Trujillo et al., 2014). Studies have also found this relationship in multiple countries. For instance, Rhodes et al. (2001b) found that more average faces were considered attractive in both Chinese and Japanese cultures, and both Kleisner et al. (2024a) and Kocnar et al. (2019b) found this relationship in European and non-European countries alike. Some studies have found that individuals find average faces more attractive irrespective of face ethnicity (Rhodes et al., 2001b; Kleisner et al., 2024b), while others have found that people prefer averageness more in faces of their own ethnicity, potentially because these faces represent their true average experience (Apicella et al., 2007; Kocnar et al., 2019). Therefore, the relationship between averageness and attractiveness could be somewhat culture dependent. Some studies have reported limits on this effect of averageness on attractiveness, showing that highly attractive female faces possess some distinctive characteristics (DeBruine et al., 2007; Perrett et al., 1994).

Although many researchers have argued that facial averageness and measures of medical health are correlated (e.g., Rhodes et al., 2001a), multiple studies have reported null results for this putative relationship between averageness and health measures (Cai et al., 2019; Foo et al., 2017). Indeed, Lee et al. (2016) found that facial averageness had a relatively weak genetic component in both men and women and found no evidence for a genetic correlation between averageness and attractiveness, suggesting that facial averageness and attractiveness may derive from different genes. While there is little empirical support for a link between averageness and actual health, several studies have reported seemingly robust associations between facial averageness and health ratings of faces (e.g., Rhodes et al., 2001b, 2007).

Facial symmetry

No two sides of one face are perfectly symmetrical, as faces typically show some degree of fluctuating asymmetries (Skomina et al., 2020). The degree of the asymmetries is represented by how far the features are from perfect symmetry (Little et al., 2012). Faces higher in symmetry (closer to perfect symmetry) are attributed more positive personality traits, such as greater sociability, intelligence, liveliness, and self-confidence. In contrast, faces lower in symmetry are perceived as more anxious (Fink et al., 2006). Like averageness, greater symmetry is also theorized to advertise "good genes" and mate quality by signalling developmental stability and the ability to cope with environmental stressors during development (Rhodes, 2006). Therefore, according to this theory, symmetry should also be considered attractive in faces.

In their literature review, Little et al. (2011) noted that multiple studies showed a positive relationship between facial symmetry and attractiveness. Many subsequent studies have also reported this pattern of results (e.g., Vera Cruz, 2018; Quist et al., 2012, Tybur et al., 2022, Mogilski & Welling, 2017). While most studies have tested Western samples and/or used a sample of Western faces, research has also found this relationship in non-Western samples (Rhodes et al., 2001b). Furthermore, Quist et al. (2012) found that women's sociosexual attitude predicted their preferences for symmetry in male faces, yet it did not predict their preferences for symmetry in female faces. This suggests that attraction to symmetry is especially relevant in a short-term mating context, which is consistent with the "good genes" theory (see also Jones et al., 2001 and Little & Jones, 2003). However, Tybur et al. (2022) found that symmetry was preferred in both same-sex and opposite-sex faces, contradicting this partner-choice-specific finding. In addition, multiple studies have only found a relationship between symmetry and attractiveness in male faces and not in female faces (Foo et al., 2017; Komori et al., 2009b; Weeden & Sabini, 2005). Finally, more recent studies have found no effect of symmetry on attractiveness judgments at all (Kocnar et al., 2019; Jones & Jaeger, 2019; Kleisner et al., 2024a). Thus, while it is often claimed that symmetry plays an important role on attractiveness judgments of faces, the evidence for this claim is actually considerably more mixed.

Regarding health, studies demonstrate that faces high in symmetry are perceived to look healthier than less symmetrical faces (Jones et al., 2001; Rhodes et al., 2001a; Fink et al., 2006; Foo et al., 2017). In fact, in Rhodes et al.'s (2007) study, the appeal of facial symmetry almost disappeared when perceived health was controlled for, suggesting that health perceptions drove the relationship between symmetry and attractiveness (see also Jones et al., 2001). In terms of actual health, some studies find a relationship between facial symmetry and self-reported histories of respiratory diseases (Thornhill & Gangestad, 2006; Little et al., 2011), as well as the duration of illness and instances of antibiotic use (Thornhill & Gangestad, 2006). However, these findings have failed to replicate, with other studies finding no relationship between facial symmetry and health (e.g., Cai et al., 2019; Rhodes et al., 2001a).

This inconsistent evidence for relationships between symmetry and attractiveness, and between symmetry and health, cast doubt on symmetry's importance or validity as a cue to "good genes." The lack of consistency could be due to low-quality methods or a lack of consensus on which measures to use, among other things. Alternatively, it could be that, as faces are symmetrized, they become more average, which could be driving some of the positive results. For instance, while some studies have found that symmetry and averageness predict attractiveness independently (for a review, see Rhodes, 2006), others have found that when both characteristics were added into the same model, the influence of symmetry became either minimal or non-existent (Kleisner et al., 2024b). In sum, symmetry's importance in facial judgments may have been overstated by some researchers.

Sexual dimorphism

Sexual dimorphism refers to the characteristics that differ between the sexes due to different hormones influencing the development of these characteristics (Rhodes, 2006; Little et al., 2011). This can be seen in faces as male and female faces differ in face shape and facial characteristics. For instance, men tend to have longer and squarer faces, larger jawbones and brow ridges, thinner cheeks, and larger noses, whereas women tend to have smaller, rounder, and more symmetrical faces, larger lips, a smaller chin, and higher cheekbones (Little et al., 2012; Rhodes, 2006; Skomina et al., 2020; Velemínská et al., 2022). Sexual dimorphism also varies within the sexes, as some males and females have more masculinized or feminized characteristics than others do (Little et al., 2012). This trait has been linked with various social judgments. For instance, many studies have reported that faces with more masculine features are perceived as more dominant, assertive, and aggressive while also perceived as displaying lower commitment, lower cooperativeness, and lower emotionality (Boothroyd et al., 2007; Little et al., 2012; Perrett et al., 1998; Carpinella & Johnson, 2016; Chen et al., 2024). In contrast, feminine features are perceived as more compassionate, trustworthy, nurturing, kind, and warm (Carpinella & Johnson, 2016; Chen et al., 2024).

Like averageness and symmetry, a greater degree of sexual dimorphism (i.e., more masculine features in men and more feminine features in women) is theorized to signal "good genes" and heritable benefits (Little et al., 2012). This theory is largely based on the immunocompetence handicap hypothesis, which proposes that the development of more sexually dimorphic features requires greater energy and that the sex hormones that drive the development of sexually dimorphic features tax the immune system (Foo et al., 2020; Rhodes et al., 2003a).

As a potential cue to different aspects of mate quality, sexually dimorphic traits are expected to be perceived as attractive. Indeed, the literature on female facial attractiveness has consistently reported positive relationships between attractiveness and femininity (Zhao et al., 2023; Foo et al., 2017; Perrett et al., 1998; Mogilski & Welling, 2017; Kleisner et al., 2024a; Kocnar et al., 2019; Jones & Jaeger, 2019). For male faces, however, the relationship appears much less straightforward. While some studies have found that masculinity increased male facial attractiveness (Zhao et al., 2023; McIntosh et al., 2017; Foo et al., 2017), others have found that masculinity decreased attractiveness (Kocnar et al., 2019; Mogilski & Welling, 2017) or had no effect on attractiveness (Lidborg et al., 2022; Kleisner et al., 2024a). Some researchers have argued that this lack of consistency is due to women exercising a trade-off between "good genes" and perceived partnership-friendly traits, such as kindness and parental investment, traits commonly attributed to more feminine features (Rhodes, 2006; Kocnar et al., 2019). In support of this, DeBruine et al. (2010) found that women's preferences for masculinity varied depending on health levels within their population. They found that women from countries with lower health levels (i.e., greater mortality rates and lower life expectancies) had increased preferences for masculinity in men, presumably because they valued strong and healthy genes for their offsprings to a greater extent than women living in communities with greater health (however, see also Marcinkowska et al., 2021 and Scott et al., 2014 for examples of studies that did not replicate these results). Other studies suggest that violence-related factors (Tureček et al., 2025), degree of industrialisation (Scott et al., 2014), and individual differences in attractiveness and/or fertility (Penton-Voak et al., 1999; Little et al., 2001) cause these mixed results. The causes of mixed findings for male facial masculinity and attractiveness remain controversial (for a review, see Jones et al., 2019 and Lidborg et al., 2022).

Although some studies have reported that more feminine female faces and more masculine male faces are perceived to look healthier (e.g., Rhodes et al., 2007), results for actual health are less clear. For example, Foo et al. (2020) found that exaggerated sex-typical face shapes were positively linked to measures of antibacterial immunity and allergic responses in an Australian longitudinal public health dataset but found null results for another 14 health measures. Similarly, Thornhill and Gangestad (2006) found that exaggerated sex-typical face shapes were correlated positively with self-reported respiratory disease frequency and duration, but not other health measures. Rhodes et al. (2003a) found that in teenage males, rated facial masculinity was modestly correlated with actual health, but that facial masculinity did not predict health at other ages. Boothroyd et al. (2013) found a positive relationship between facial masculinity and men's past respiratory health, but found a negative relationship between masculinity and future men's health. Indeed, many other studies have found no relationship between actual health and facial femininity in women (Rhodes et al., 2003a; Cai et al., 2019; Foo et al., 2017) and a meta-analysis by Lidborg et al. (2022) found no clear evidence of links between facial masculinity and mating success or fertility.

Evidence for good genes theories of facial attractiveness appears, at best, weak (Jones et al., 2021b). A prominent alternative theory is the perceptual bias account.

The perceptual bias theory

"Perceptual bias" theory proposes that characteristics such as symmetry, averageness, and sexual dimorphism may be attractive because faces possessing these traits are easier to process (Kleisner et al., 2024b; Young et al., 2011; Freeman & Johnson, 2014). Effects of these characteristics on social judgments of faces may then simply be a consequence of the attractiveness halo effect (Rhodes, 2006).

In the case of averageness, the theory argues that if this trait is, in fact, attractive, it may simply be because individuals have been exposed to average features more often within their population compared to less average ones, leading to greater efficiency in cognitively processing such average, more familiar faces (Trujillo et al., 2014). To test this, Trujillo et al. (2014) conducted an analysis of participants' reaction times during a categorization task of human and chimpanzee faces. They found that participants categorized average and attractive faces as being human faster than unattractive faces due to the engagement of fewer neural resources, confirming that more average and attractive faces are processed more fluently than unattractive ones. Similarly, Renoult et al. (2016) found that more efficient neural coding positively correlated with attractiveness in female faces as rated by men and explained up to 17% of the variance in attractiveness. In addition, Halberstadt & Winkielman (2014) found that morphs of faces were considered more attractive than the individual faces composing them, presumably because of the “beauty-in-averageness effect.” However, the authors found that this effect could be reduced or eliminated if paired with a difficult categorizing task, such as classifying bi-racial faces in terms of their racial identity. In other words, previously-rated attractive faces were rated as less attractive if they were difficult to categorize in terms of race. Other studies have also found that white individuals with lower interracial exposure displayed greater negative evaluations of mixed-race individuals who seemed racially ambiguous (Freeman & Johnson, 2016).

Welling et al. (2017) found this same categorizing effect with sexual dimorphism, wherein faces that were less sexually dimorphic were more difficult to categorize in terms of biological sex, thereby leading to negative evaluations. Research has found that this may also partly explain prejudice against sexual minorities as gender-atypical faces are stereotypically categorized as gay, and the effect of gay categorization on negative evaluations is mediated by greater difficulty in perceiving the gender of the face (Freeman & Johnson, 2014).

Finally, similar arguments have been made for symmetry as symmetry has been linked to attractiveness judgments in non-human animals and objects alike (Rhodes, 2006; Young et al., 2011), contesting the idea that symmetry is solely attractive because it is a cue to mate quality. For example, Lewis (2017) and Lewis (2020) argued that processing biases (as indicated by discrimination abilities) drive preferences for symmetric and masculine male faces, respectively.

Other facial characteristics and social judgments

Although much of the work on social judgments of faces has focused on the roles of symmetry, averageness, and sexual dimorphism of face shape, faces convey information via many sources other than averageness, symmetry, and sexual dimorphism. For example, facial adiposity (perceived weight in the face) also negatively influences judgments of health and attractiveness (Jager et al., 2018). Skin tone also affects attractiveness judgments, such that lighter facial features are considered more attractive than darker features (Vera Cruz, 2018), and skin redness increases perceived attractiveness in female faces (Pazda et al., 2016). In terms of face shape, facial elongation has been associated with perceived height and actual height (Skomina et al., 2020), influencing perceived leadership ability (Re et al., 2013). Furthermore, emotional expressions also influence trait perceptions such that angry faces are perceived as more dominant, whereas smiling faces are perceived as more trustworthy (Todorov et al., 2015). Even peripheral cues, such as hairstyle and jewellery (Carpinella & Johnson, 2016) and facial tattoos (Funk & Todorov, 2013), can influence social perceptions of faces. For instance, facial tattoos have been found to influence judgments of guilt and trustworthiness, as well as perceived criminality (Funk & Todorov, 2013). In sum, these represent just a few examples among many facial features that influence social judgments, demonstrating that facial judgments are dynamic and multifaceted.

Limitations in the literature

Despite a substantial amount of research exploring social judgments of faces, the specific facial characteristics that reliably drive these judgments remain unclear.

Many recent studies have suggested that this may be because of fundamental issues with the most commonly used method in this literature, which is the "forced-choice" method (Jones et al., 2022; Jones & Jaeger, 2019; Lee et al., 2021; Dong et al., 2023; Scott et al., 2010, 2013; Lewis et al., 2020). This method consists of using computer-graphic methods to manipulate face images on a single dimension by either enhancing or reducing the presence of an individual characteristic (i.e., symmetry) while every other facial characteristic remains constant. Then, participants are typically asked to choose one of two face images that vary on this one dimension according to which they perceive as possessing more of a given trait (e.g., trustworthiness, Jones et al., 2022).

While this method has enabled researchers to isolate specific facial characteristics in order to measure their effects on social judgments of faces, researchers have criticised this method for lacking ecological validity (see, e.g., Scott et al., 2013; Jones & Jaeger, 2019; Lee et al., 2021) and recent research suggests that results obtained using this method generalize poorly to perceptions of natural face images. For instance, recent work has found that the large effects of sexual dimorphism on attractiveness judgments detected in the forced-choice task are not found in studies using natural (i.e., unmanipulated) face images that vary naturally on multiple dimensions and when sexual dimorphism of face shape is objectively measured from face images (Scott et al., 2013; Jones & Jaeger, 2019). Moreover, similar patterns of results have been reported for facial symmetry and attractiveness (Lee et al., 2021). Indeed, studies have recently reported that the large effects of masculinity on dominance perceptions obtained using the forced-choice methods do not occur when natural face images are used as stimuli (Dong et al., 2023). These findings raise the possibility that the forced-choice method shows what facial characteristics participants *can* use to inform first impressions under controlled conditions (i.e., when faces differ on only a single dimension), but not what information they *do* use when faces vary simultaneously on multiple dimensions, as is the case during social interaction (Jones et al., 2022; Satchell et al., 2023). Additionally, the forced-choice method cannot easily take into account the potential effects of intercorrelations among facial characteristics (Jones et al., 2022). For example, symmetrical faces tend to be more average (Lee et al., 2016) making it difficult to fully disentangle the effects of these two facial characteristics using manipulated face stimuli.

A second potentially important limitation of much of the work on social judgments of faces is the tendency for these studies to aggregate responses across either face images or across raters (DeBruine et al., 2022). Aggregating responses in this way can be problematic because it means that variance in responses across either trials (i.e., faces) or raters are then not considered in the analytical models (DeBruine et al., 2022). This issue can, in turn, compromise generalizability of results and increase false positive rates (DeBruine et al., 2022). Linear mixed effects models (LMEMs) address this issue by allowing variance across both stimuli and raters to be considered in analyses (Barr et al., 2013).

The current studies

The studies reported in this thesis were undertaken to investigate the role of shape information in social judgments of natural (i.e., unmanipulated) face images while addressing the limitations of much of the previous work on this topic that were described above.

The first empirical chapter of my thesis (Chapter 2) investigated possible relationships between health ratings of natural (i.e., unmanipulated) faces and shape symmetry, averageness, and sexual dimorphism. Crucially, this study also specifically investigated how conclusions might differ depending on whether relationships were tested for using bivariate ('simple') correlations or multiple regression analyses.

The second empirical chapter (Chapter 3) built on Chapter 2, this time investigating whether trustworthiness ratings of natural (i.e., unmanipulated) faces were best predicted by shape sexual dimorphism or averageness. The third empirical chapter addressed a limitation of previous work on the role of averageness in assessments of faces whereby objective and subjective measures of distinctiveness are often treated interchangeably. Specifically, Chapter 4 assessed the extent to which measured face-shape distinctiveness and rated distinctiveness are correlated.

Finally, while Chapters 2, 3 and 4 investigated the effects of facial characteristics (symmetry, averageness, and sexual dimorphism) on social perceptions (health, trustworthiness, distinctiveness), our fourth empirical chapter (Chapter 5) took a different approach, investigating whether women's hypothetical dating decisions based on judgments of unstandardised male face images were best predicted by perceptions of the men's physical attractiveness, perceptions of the men's likelihood of engaging in abusive behaviour, or the interaction between these two types of perceptions. This chapter also considered the possible role of individual differences in women's dating intentions, examining the possible roles of factors such as sensation seeking, self-perceived attractiveness, and sociosexuality (openness to short-term uncommitted relationships).

In all four empirical chapters, LMEMs were used to analyse rating data, addressing the potential problems associated with aggregating ratings across either stimuli or raters.

Role of secondary data analyses in the current studies

Many researchers have highlighted the utility of analyses of existing data sets, which is commonly known as secondary data analyses (e.g., van den Akker et al., 2021; Weston et al., 2019), including in research on social judgments of faces (e.g., Batres & Shiramizu, 2023; Durkee & Ayers, 2021; Hester et al., 2021). The main *advantage* of secondary data analyses is the reduction in costs (both financial and time) associated with data collection, making research production more efficient and cost effective (e.g., van den Akker et al., 2021; Weston et al., 2019). The main *disadvantages* of secondary data analyses are that available open-access data may not be ideally suited to testing the research hypotheses and/or the quality of the data may be unclear or unknown (e.g., van den Akker et al., 2021; Weston et al., 2019). Both of these advantages and disadvantages apply to research to on social judgments of faces.

The first three empirical chapters of this thesis (Chapters 2, 3 and 4) analyse face ratings (health, trustworthiness, and distinctiveness) and images from an open-access image set (DeBruine & Jones, 2022). Further information on the data and images analysed is given in the Methods sections of these chapters. The specific open-access dataset used was chosen for four reasons. First, in the chosen dataset, Cronbach's alphas for each trait are extremely high (all > 0.90), far exceeding recommendations for data-quality checks in registered reports (e.g., Jones et al., 2021). Second, the number of raters per trait is higher than in most other open-access datasets (and considerably higher than recommendations for number of raters per trait in studies of social judgments of faces, N = ~30; Hehman et al., 2025), with one hundred male and one hundred female raters providing ratings for each combination of trait and sex of face. Third, all data required to address the relevant research questions was available in the dataset or (in the cases of shape characteristics) could be calculated from the face images. Fourth, none of the ratings from this dataset that were analysed in this thesis have been analysed in other studies. In other words, in this case, the quality of the data can be shown to be very high, the data are ideally suited to answering the research questions posed, and the analyses entirely novel to this dataset.

In Chapter 5, face stimuli from a different open-access image set (Nightingale & Farid, 2022) were used, but new ratings were collected and analysed. The open-access images employed in Chapter 5 were AI-generated images, avoiding potential ethical issues associated with having images of real individuals rated for traits relating to propensity for abuse within relationships. Given Nightingale and Farid (2022) have shown that their participants were unable to correctly distinguish between these AI-generated images and images of real individuals (indeed, this issue was the focus of their study), it can be argued that using AI-generated images in this case does not undermine the quality of the research conducted.

Chapter 2. Assessing the roles of symmetry, prototypicality, and sexual dimorphism of face shape in health perceptions

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Abstract

Health perceptions are thought to play an important role in human mate preferences. Although many studies have investigated potential relationships between health ratings of faces and facial symmetry, prototypicality, and sexual dimorphism, findings have been mixed across studies. Consequently, we tested for potential relationships between health ratings of faces and the symmetry, prototypicality, and sexual dimorphism of those faces' shapes. When these three shape characteristics were considered in separate regression models, we observed significant positive relationships between health ratings and both shape symmetry and prototypicality. By contrast, health ratings and sexual dimorphism were not significantly correlated in these analyses. However, in analyses in which symmetry, prototypicality, and sexual dimorphism were entered simultaneously as predictors in a single model, prototypicality, but not symmetry, was significantly correlated with health ratings. Moreover, sexual dimorphism predicted health ratings of female, but not male, faces in these analyses. Collectively, these results suggest that the relationship between symmetry and health ratings is, at least partly, driven by the effect of prototypicality on health perceptions and highlight the importance of considering multiple aspects of face shape when investigating factors that predict perceived health.

Introduction

Many researchers have hypothesized that facial-attractiveness judgments reflect evolved behaviors that function, at least in part, to identify healthy potential mates (Rhodes, 2006; Thornhill & Gangestad, 1999; Little et al., 2011). Although evidence that individuals with more attractive faces are actually healthier is mixed (for a recent review see Jones et al., 2021b), facial-attractiveness judgments of faces and health ratings (i.e., perceptual ratings of how healthy a person appears to be) are highly correlated and health perceptions are thought to play an important role in human mate preferences (Rhodes, 2006; Thornhill & Gangestad, 1999; Little et al., 2011). Indeed, Rhodes et al. (2007) demonstrated that health perceptions contribute to the attractiveness of putative health cues in faces (see also Jones et al., 2001). Consequently, there is now a relatively large literature investigating the shape characteristics in faces that predict health ratings (e.g., Boothroyd et al., 2013; Fink et al., 2006; Grammar & Thornhill, 1994; Gray & Boothroyd, 2012; Jones et al., 2001; Penton-Voak et al., 2001; Rhodes et al., 2001a, 2003, 2007). Although explicit perceptions may not necessarily guide behaviour in other species, it is well established that explicit perceptions influence behaviour in modern humans (e.g., third-party ratings of the trustworthiness of face images influence trusting behaviour in economic games, Van't Wout & Sanfey, 2008).

Because symmetry, prototypicality, and sexual dimorphism are theorized to function as cues of physical condition in many species, much of the research on predictors of health perceptions of faces has investigated the role these specific characteristics might play in health perceptions. Indeed, several studies have reported that faces perceived to be healthier have more symmetric (Fink et al., 2006; Grammar &

Thornhill, 1994; Jones et al., 2001; Penton-Voak et al., 2001; Rhodes et al., 2001a, 2007) or more prototypical (Grammar & Thornhill, 1994; Jones, 2018; Rhodes et al., 2001b, 2007) shapes. Other studies have reported that more masculine male faces (Boothroyd et al., 2013; Rhodes et al., 2003a) and more feminine female faces (Gray & Boothroyd, 2012; Jones, 2018; Rhodes et al., 2003a) are perceived to be healthier. However, there are several potential problems with this literature on the possible roles of symmetry, prototypicality, and sexual dimorphism in health ratings of faces.

First, although many studies have reported evidence for links between health perceptions and either facial symmetry, prototypicality, or sexual dimorphism, other studies have reported mixed evidence for these links. For example, Foo et al. (2017) reported that healthier-looking male faces were more symmetric and prototypical, but not more masculine, while healthier-looking female faces were more feminine, but not more symmetric or prototypical. Similarly, Rhodes et al. (2007) reported that healthier-looking female faces were more feminine but observed no evidence that healthier-looking male faces were more masculine (see also Alharbi et al., 2020 and Boothroyd et al., 2007). Results such as these raise the possibility that reported links between health perceptions of faces and symmetry, prototypicality, and sexual dimorphism may not necessarily be as robust as other work suggested.

Second, many studies have assessed symmetry, prototypicality, and sexual dimorphism of faces using perceptual ratings, rather than objective measures of these characteristics (i.e., employed ratings of symmetry, prototypicality, or sexual dimorphism, rather than facial-metric assessments of these characteristics, e.g., Gray & Boothroyd, 2012; Foo et al., 2017; Rhodes et al., 2003a). Using perceptual ratings to assess physical characteristics of faces in this way may be somewhat problematic, since such ratings can be influenced by factors other than the physical characteristic researchers wish to assess (see, e.g., Bartlome & Lee, 2023; Dong et al., 2023; Scott et al., 2010). However, evidence that this issue necessarily has a material effect on the conclusions made from studies employing both approaches (i.e., studies that assessed face shape using both perceptual ratings and objective measures and analysed these two types of assessment separately) is somewhat mixed. For example, on one hand, Rhodes et al. (2001) found that health ratings of faces were correlated with rated symmetry, but not an objective measure of symmetry, suggesting these two approaches can produce different patterns of results. On the other hand, Boothroyd et al. (2013) found that neither rated masculinity nor an objective measure of masculinity were correlated with health ratings of male faces, suggesting these approaches can produce similar patterns of results.

Third, many studies have tested for possible links between health perceptions of faces and symmetry, prototypicality, or sexual dimorphism using face stimuli in which these physical characteristics were experimentally manipulated using computer graphics methods (e.g., Alharbi et al., 2020; Jones et al., 2001; Penton-Voak et al., 2001). However, several recent studies have reported that findings for social judgments of faces that were obtained using this method are often not observed (or, if observed, have considerably smaller effect sizes) in studies using natural face images and objective assessments of physical characteristics of faces (Dong et al., 2023; Jones & Jaeger, 2019; Jones et al., 2022; Lee et al., 2021; Scott et al., 2010).

Given such results, many researchers have expressed concerns about the appropriateness of experimentally manipulated face images for studying social judgments of faces (Dong et al., 2023; Jones & Jaeger, 2019; Jones et al., 2022; Lee et al., 2021; Scott et al., 2010). Nonetheless, Boothroyd et al. (2007) reported that experimentally manipulated masculinity did not influence the perceived health of male faces and also reported that masculinity and health ratings of natural male faces were not significantly correlated. Rhodes et al. (2001) also presented evidence that facial symmetry and prototypicality have similar effects on health perceptions using these two types of method.

Fourth, studies assessing health perceptions of natural (i.e., unmanipulated) face stimuli have typically considered individual predictors, rather than entering multiple predictors simultaneously into regression models (but see Foo et al., 2017). This approach may not be ideal, however, since there is some evidence for interrelationships among symmetry, prototypicality, and sexual dimorphism. For example, several studies have reported that more masculine male and more feminine female faces tend to be more symmetric (Gangestad & Thornhill, 2003; Little et al., 2008; but see also Van Dongen et al., 2020) and other work has demonstrated that faces with more distinctive (i.e., the converse of prototypical) face shapes tend to be more asymmetric (Jones et al., 2007; Lee et al., 2016). Such results suggest that it may be useful to compare findings for health ratings and symmetry, prototypicality, and sexual dimorphism when these physical characteristics are analysed individually and when these physical characteristics are entered simultaneously as predictors of health ratings.

In light of the above, we tested for possible relationships between health ratings of male and female face images and symmetry, prototypicality, and sexual dimorphism. Rather than assessing these physical characteristics via perceptual ratings, we used established image-analysis methods (Holzleitner et al., 2019) to objectively measure symmetry, distinctiveness (the converse of prototypicality), and sexual dimorphism of shape information in natural (i.e., unmanipulated) face images.

Methods

Stimuli. Fifty male and 50 female face images were taken from an open-access face-image database (DeBruine & Jones, 2022). Male and female face images depicted young adult white men (mean age = 24.2 years, SD = 3.99 years) and young adult white women (mean age = 24.3 years, SD = 4.01 years), respectively. Images had been standardised on pupil position and clothing masked prior to rating. The individuals photographed posed with neutral expressions, front-on to the camera, and with direct gaze. Images are publicly available at https://osf.io/a3947/. DeBruine and Jones (2022) obtained these images from 3d.sk, a company that collates and provides images for artist references and avatar generation. The depicted individuals are Slovakian members of the public recruited by the 3d.sk company through adverts on social media and in the Slovakian press. These stimuli have been used in several previous studies (e.g., DeBruine et al., 2019; Jones et al., 2018). Example images are shown in Figure 1.

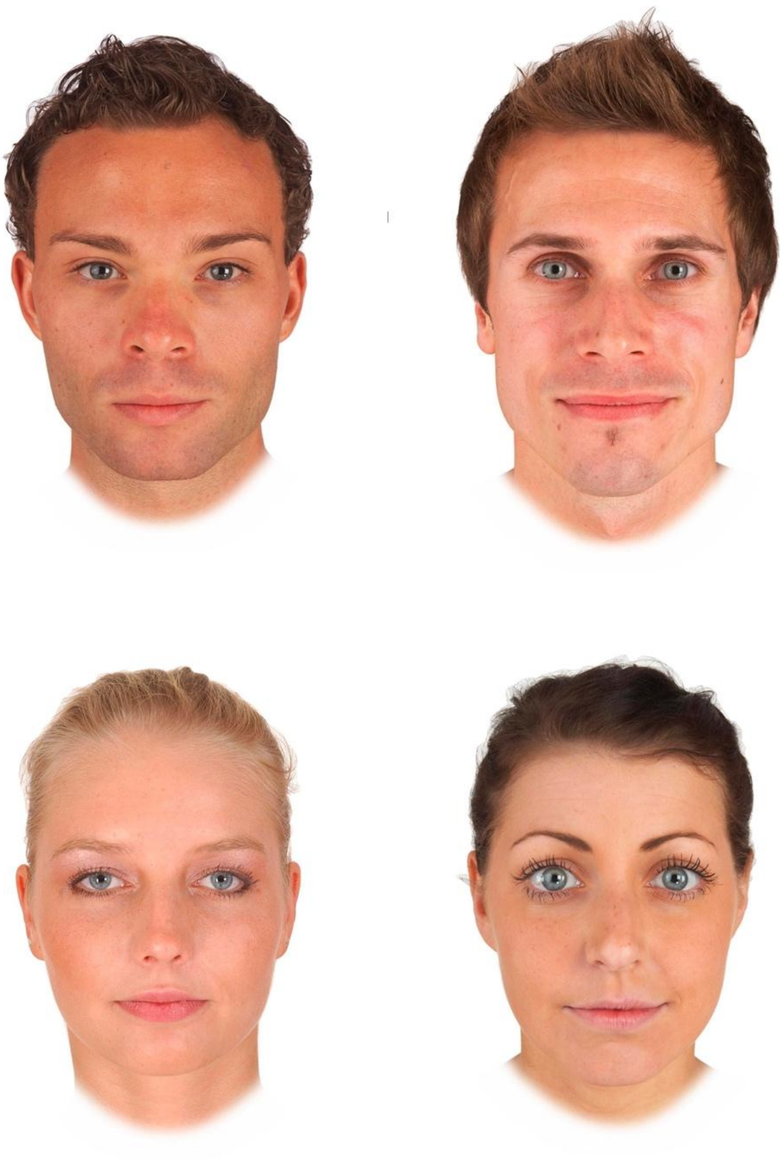

Figure 1. Examples of male (top row) and female (bottom row) face images used in the study.

Health ratings. Health ratings were also taken from the same open-access face-image database (DeBruine & Jones, 2022). Two hundred men and 200 women (mean age = 25.15 years, SD = 5.62 years) were randomly allocated to rate either the 50 male face images or the 50 female face images for health using a 1 (much less healthy than average) to 7 (much more healthy than average) scale. Trial order was fully randomised. Ratings were collected using the Experimentum data-collection platform (DeBruine et al., 2020). Inter-rater agreement for health ratings was high for both male and female faces (both Cronbach's alphas > .90). Although these ratings were obtained from an open-access image set (DeBruine & Jones, 2022) they had not been analysed for *any* previous studies. Raters were members of the public recruited through social media links (e.g., stumbleupon.com) and ratings were collected using the Experimentum platform (DeBruine et al., 2020). Although no attention checks were employed when collecting these ratings, the quality (and therefore suitability) of the collected ratings is evidenced by the high Cronbach's alphas, which exceed cutoffs given for data quality checks in Registered Reports (e.g., Jones et al., 2021).

Sexual dimorphism of face shape

Sexual dimorphism of face shape was objectively measured for each of the 50 male and 50 female face images using the facefuns package (Holzleitner & DeBruine, 2021) in R (R Core Team, 2021), which implements shape analysis of images that have been delineated with standard landmarks. This method has been used in many previous studies to assess sexual dimorphism of face shape (e.g., Cai et al., 2019; Dong et al., 2023; Holzleitner et al., 2019; Komori et al., 2011). Shape components were first derived from Principal Component Analysis (PCA) of 132 Procrustes-aligned landmark points (see Holzleitner et al., 2019 for a diagram showing these facial landmarks) on each of the 50 male and 50 female face images. Delineation (placement of face landmarks) was done by Lisa DeBruine. Previous work has shown that measures of face shape derived from manually placed and automatically generated image landmarks are highly correlated (Jones et al., 2021a). Scores representing sexual dimorphism of face shape were then calculated from each photograph using a vector analysis method (e.g., Cai et al., 2019; Dong et al., 2023;

Holzleitner et al., 2019; Komori et al., 2011). This method uses the shape principal components to locate each face on a female-male continuum. The female-male continuum was defined by calculating the average shape information of the 50 female faces and the average shape information of the 50 male faces. Sexual dimorphism scores were then derived by projecting each image onto this female-male vector. Higher scores indicated more masculine face shapes. No scores were more than three standard deviations from the mean (i.e., there were no extreme values). The templates (i.e., landmark points) used to calculate these shape scores (and also distinctiveness and asymmetry shape scores) are publicly available (DeBruine & Jones, 2022).

Distinctiveness of face shape

Distinctiveness scores were also calculated from each photograph using the facefuns package (Holzleitner & DeBruine, 2021) in R (R Core Team, 2021). This technique has been used to measure face-shape distinctiveness in many previous studies (e.g., Cai et al., 2019; Holzleitner et al., 2019). This method uses the shape principal components described in the previous section of our methods to measure the distance each face lies from the mathematical average shape for the sample of faces of the same sex. That is, the average shape values for the same-sex sample were calculated and, for each image, the Euclidean distance from the average was derived. Higher scores indicate that the face lies a further distance away from the average (i.e., had a more distinctive shape). We measured distinctiveness scores for male and female faces separately, in light of evidence that faces are primarily processed relative to sex-specific prototypes (e.g., Little et al., 2005; Rhodes et al., 2011). No scores were more than three standard deviations from the mean (i.e., there were no extreme values).

Asymmetry of face shape

Asymmetry scores were also calculated from each photograph using the facefuns package (Holzleitner & DeBruine, 2021) in R (R Core Team, 2021). This technique has been used to measure face-shape asymmetry in many previous studies (e.g., Cai et al., 2019; Holzleitner et al., 2019). For each image, the landmark template was mirrored, and shape asymmetry measured as the Euclidean distance between original and mirrored templates. Higher scores indicate that the face has greater asymmetry. One extreme value (i.e., one score more than three standard deviations from the mean) was adjusted (i.e., winsorized) to be three standard deviations from the mean prior to further analyses.

Analyses

All statistical analyses were carried out using R (R Core Team, 2021), with the packages lme4 (Bates et al., 2015a), lmerTest 3.1-3 (Kuznetsova et al., 2017), jtools 2.2.3 (Long, 2022), and robustHD 0.7.3 (Alfons, 2022). Data processing and display used kableExtra 1.3.4 (Zhu, 2021) and tidyverse 1.3.1 (Wickham, 2021). All data, full outputs, and analysis code are publicly available on the Open Science Framework (https://osf.io/vrmxd/).

We first tested for correlations among the three measures of face shape (asymmetry, distinctiveness, and sexual dimorphism). Next, we analysed health ratings in three linear mixed effects models, each model testing for an effect of an individual face-shape parameter (distinctiveness, asymmetry, or sexual dimorphism). In each of these models, health ratings served as the dependent variable. The models included main effects of face-shape scores (distinctiveness, asymmetry, or sexual dimorphism, depending on the model), rater sex (effect coded so that -0.5 corresponded to male raters and 0.5 corresponded to female raters), and face sex (effect coded so that -0.5 corresponded to male faces and 0.5 corresponded to female faces) as predictors, as well as all possible two- and three-way interactions. The models also included by-rater and by-stimulus random intercepts, by-rater random slopes for face-shape scores (face sex varied between raters), and by-stimulus random slopes for rater sex. Face shape scores were standardised prior to analyses by converting them to z scores (separately for each face sex). Higher face-shape scores for both male and female faces indicate more distinctive, asymmetric, or masculine shapes, respectively. Finally, we analysed health ratings in a fourth linear mixed effects model that was identical to the three previous ones, except that all three face-shape parameters (distinctiveness, asymmetry, sexual dimorphism), as well as the interactions involving them, were included as predictors in a single model.

Results

Intercorrelations among sexual dimorphism, distinctiveness, and asymmetry scores

Sexual dimorphism scores were not significantly correlated with distinctiveness scores ($r = .04$, $N = 100$, $p = .70$) or asymmetry scores ($r = -.08$, $N = 100$, $p = .44$). Distinctiveness and asymmetry scores were significantly positively correlated ($r = .41$, $N = 100$, $p < .001$). This same pattern of results was seen for both male and female faces when they were analysed separately. For female faces, distinctiveness and asymmetry scores were significantly positively correlated (r = .39, N = 50, p = .005) and sexual dimorphism scores were not significantly correlated with distinctiveness scores (r = -.07, N = 50, p = .63) or asymmetry scores (r = -.15, N = 50, p = .31). Similarly, for male faces, distinctiveness and asymmetry scores were significantly positively correlated (r = .43, N = 50, p = .002) and sexual dimorphism scores were not significantly correlated with distinctiveness scores (r = .15, N = 50, p = .31) or asymmetry scores (r = -.01, N = 50, p = .95).

Linear mixed effects model testing for possible effects of distinctiveness

This analysis revealed a significant negative effect of distinctiveness on health ratings that was not qualified by any significant higher order interactions. Full results of this analysis are summarised in Table 1.

Table 1. Summary of results from our analysis of the effect of distinctiveness on health ratings.

	Estimate	SE	t	df	p
Intercept	3.567	0.075	47.351	222.749	< 0.001
Distinctiveness	-0.206	0.061	-3.355	101.867	0.001
Rater sex	-0.126	0.092	-1.371	400.606	0.171
Face sex	-0.054	0.151	-0.356	222.749	0.722
Distinctiveness x rater sex	-0.006	0.022	-0.247	144.238	0.805
Distinctiveness x face sex	0.075	0.123	0.609	101.867	0.544
Rater sex x face sex	0.524	0.184	2.853	400.606	0.005

Distinctiveness x rater sex x face sex	-0.013	0.045	-0.289	144.238	0.773

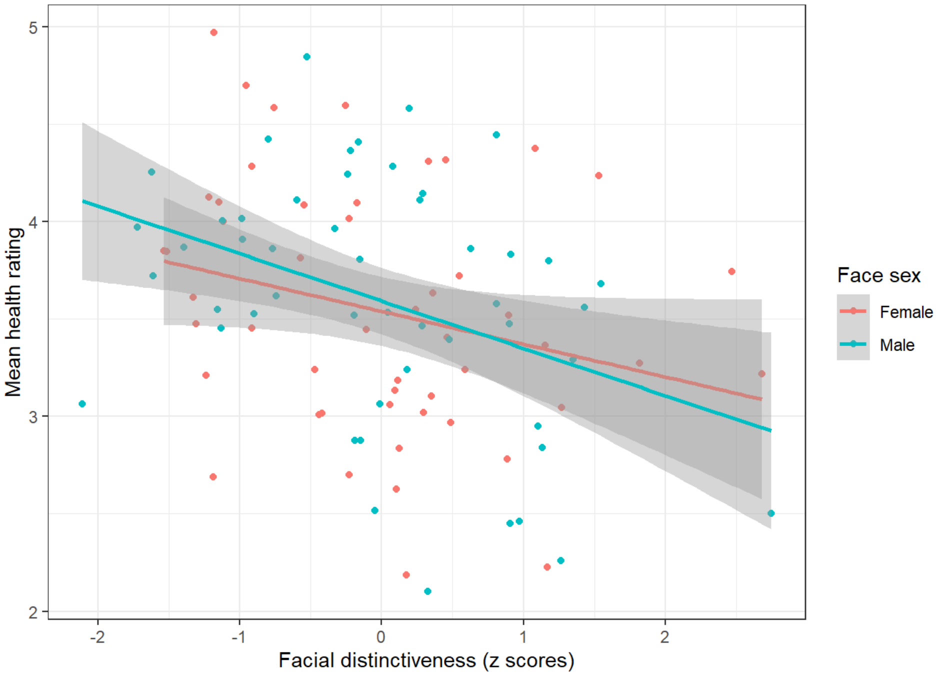

Figure 2: Visualization of the relationship between mean health ratings and facial distinctiveness by face sex

Linear mixed effects model testing for possible effects of asymmetry

This analysis revealed a significant negative effect of asymmetry on health ratings that was not qualified by any significant higher order interactions. Full results of this analysis are summarised in Table 2.

Table 2. Summary of results from our analysis of the effect of asymmetry on health ratings.

	Estimate	SE	t	df	p
Intercept	3.566	0.077	46.549	216.403	< 0.001

Asymmetry	-0.157	0.064	-2.457	101.013	0.016
Rater sex	-0.126	0.092	-1.371	400.391	0.171
Face sex	-0.052	0.153	-0.34	216.403	0.734
Asymmetry x rater sex	0.006	0.021	0.268	120.948	0.789
Asymmetry x face sex	0.029	0.127	0.224	101.013	0.823
Rater sex x face sex	0.524	0.184	2.853	400.391	0.005
Asymmetry x rater sex x face sex	-0.007	0.043	-0.175	120.948	0.861

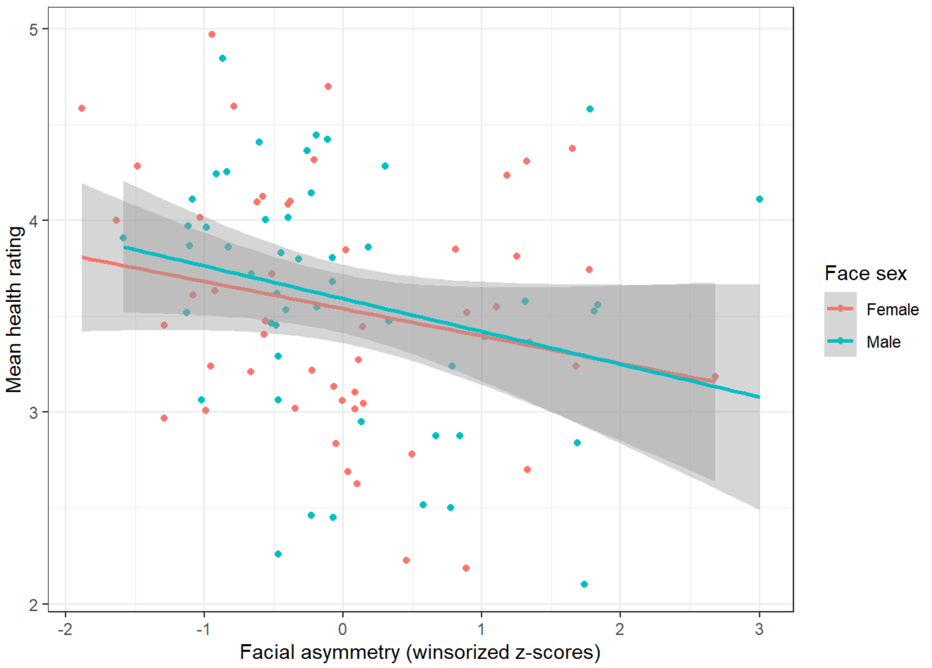

Figure 3: Visualization of the relationship between mean health ratings and facial asymmetry by face sex

Linear mixed effects model testing for possible effects of sexual dimorphism

The main effect of sexual dimorphism was not significant, nor were any of the interactions including sexual dimorphism. Full results of this analysis are summarised in Table 3.

Table 3. Summary of results from our analysis of the effect of sexual dimorphism on health ratings.

	Estimate	SE	t	df	p
Intercept	3.567	0.077	46.304	214.404	< 0.001
Sexual dimorphism	-0.087	0.063	-1.381	100.166	0.170
Rater sex	-0.126	0.092	-1.372	399.525	0.171
Face sex	-0.054	0.154	-0.348	214.404	0.728
Sexual dimorphism x rater sex	-0.025	0.019	-1.328	93.917	0.187
Sexual dimorphism x face sex	-0.197	0.126	-1.555	100.166	0.123
Rater sex x face sex	0.524	0.184	2.855	399.525	0.005
Sexual dimorphism x rater sex x face sex	-0.03	0.038	-0.783	93.917	0.435

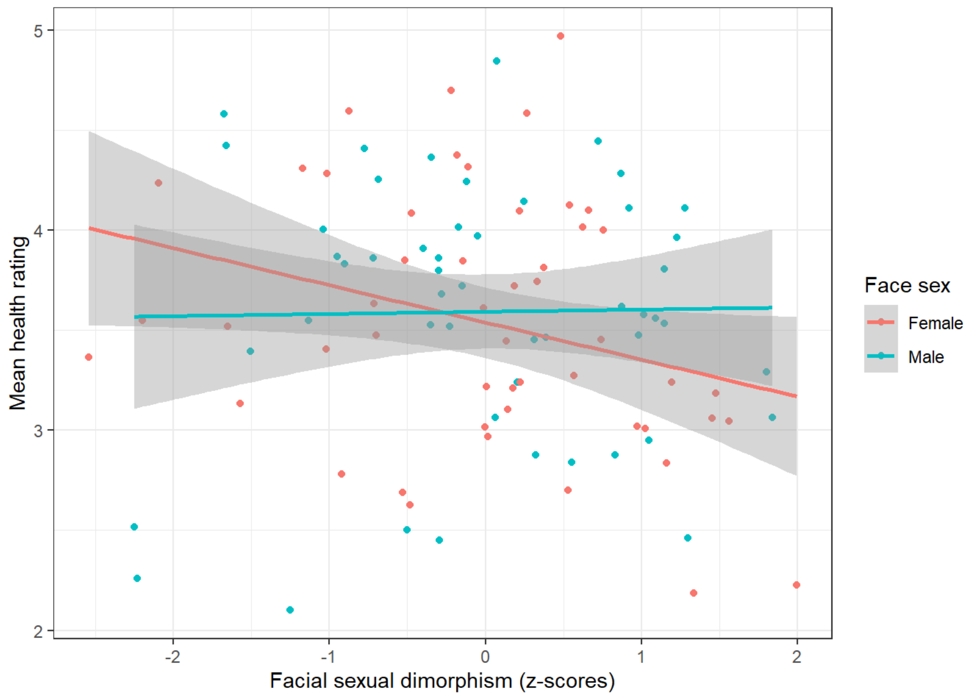

Figure 4: Visualization of the relationship between mean health ratings and facial sexual dimorphism by face sex

Linear mixed effects model testing for possible effects of distinctiveness, asymmetry, and sexual dimorphism

This analysis revealed a significant negative main effect of distinctiveness on health ratings and a significant interaction between sexual dimorphism and sex of face. Full results of this analysis are summarised in Table 4.

Table 4. Summary of results from our analysis of the effects of distinctiveness, asymmetry, and sexual dimorphism on health ratings when all three shape parameters were entered as predictors simultaneously.

	Estimate	SE	t	df	p
Intercept	3.566	0.073	48.568	233.152	< 0.001

Sexual dimorphism	-0.085	0.059	-1.43	100.252	0.156
Rater sex	-0.126	0.092	-1.371	400.116	0.171
Face sex	-0.053	0.147	-0.361	233.152	0.719
Asymmetry	-0.097	0.066	-1.476	100.543	0.143
Distinctiveness	-0.177	0.065	-2.727	101.415	0.008
Sexual dimorphism x rater sex	-0.026	0.02	-1.314	96.266	0.192
Sexual dimorphism x face sex	-0.255	0.119	-2.147	100.252	0.034
Face sex x rater sex	0.524	0.184	2.854	400.116	0.005
Rater sex x asymmetry	0.006	0.022	0.276	108.326	0.783
Face sex x asymmetry	-0.046	0.132	-0.352	100.543	0.725
Rater sex x distinctiveness	-0.009	0.023	-0.372	135.159	0.711
Face sex x distinctiveness	0.083	0.13	0.635	101.415	0.527
Sexual dimorphism x rater sex x face sex	-0.031	0.039	-0.797	96.266	0.427
Asymmetry x rater sex x face sex	-0.008	0.044	-0.182	108.326	0.856
Distinctiveness x rater sex x face sex	-0.014	0.047	-0.295	135.159	0.769

Repeating this analysis for male and female faces separately (and with face sex removed from the model) to interpret the interaction between sexual dimorphism and sex of face showed a significant negative effect of sexual dimorphism on health ratings of female faces (estimate = -0.21, SE = 0.08, t = -2.57, df = 50.39, p = .013). By contrast, the corresponding effect for health ratings of male faces was not significant (estimate = 0.04, SE = 0.09, t = 0.50, df = 49.91, p = .62). Full results for these two models are given on the Open Science Framework (https://osf.io/vrmxd/).

Discussion

We tested for possible relationships between health ratings of faces and three aspects of their face shape (symmetry, prototypicality, sexual dimorphism) in two types of regression model (when shape characteristics were tested individually in separate regression models and when all three shape characteristics were entered simultaneously as predictors in a single model). Results from models in which each shape characteristic was investigated individually suggested that healthy-looking faces had symmetric and prototypical face shapes. These results are consistent with previous studies reporting that faces perceived to be healthier have more symmetric (Fink et al., 2006; Grammar & Thornhill, 1994; Jones et al., 2001; Penton-Voak et al., 2001; Rhodes et al., 2001a, 2007) or more prototypical (Grammar & Thornhill, 1994; Jones, 2018; Rhodes et al., 2001b, 2007) face shapes. By contrast with previous studies reporting correlations between health ratings and sexual dimorphism (Boothroyd et al., 2013; Gray & Boothroyd, 2012; Rhodes et al., 2003a), results from models in which each shape characteristic was investigated individually showed no significant relationships between health ratings and sexual dimorphism.

Results when all three shape characteristics were entered simultaneously as predictors in a single model showed a different pattern of results to those described above. Here, a significant relationship between prototypicality and health ratings was also observed, but the relationship between symmetry and health ratings was not significant. These two results suggest that the association between symmetry and health ratings may be at least partly driven by the positive effect of prototypicality on health perceptions. Consistent with this interpretation, symmetry and prototypicality were positively correlated in this sample of faces (see also Lee et al., 2016). Thus, it would appear that prototypicality partially mediates the effect of symmetry on health ratings. Indeed, a mediation analysis showed that prototypicality significantly contributed to the link between symmetry and health ratings and indicated that prototypicality mediated this link by ~46% (see https://osf.io/vrmxd/ for full results of this analysis).

Results when all three shape characteristics were entered simultaneously as predictors in a single model also suggested that healthier-looking female faces have more feminine face shapes, but that healthier looking male faces do not have more masculine face shapes. Although this effect of sexual dimorphism for female faces was significant only when we controlled for effects of symmetry and averageness, a difference in the effects of sexual dimorphism for health ratings of male and female faces has been reported in some previous studies (Foo et al., 2017; Rhodes et al., 2007). That the association between femininity and health ratings of women's faces was only significant when we controlled for other aspects of face shape (prototypicality and symmetry) suggests femininity is unlikely to function as a cue to women's perceived health during social interactions (i.e., the functional significance of the observed effect of femininity is likely to be limited).

Some researchers have previously reported that facial symmetry and sexual dimorphism are positively correlated and suggested that this correlation occurs because both characteristics reflect a common underlying quality (i.e., good physical health or immune function, Gangestad & Thornhill, 2003; Little et al., 2008). By contrast with these findings, facial symmetry and sexual dimorphism were not significantly correlated in our study (see also Van Dongen et al., 2020). These null results are consistent with other recent work suggesting that neither facial symmetry nor sexual dimorphism are reliably correlated with measures of physical health or immune function (e.g., Cai et al., 2019; Jones, 2018).

Although we found that prototypicality predicted health ratings in both of our models, and found some evidence for significant relationships between health ratings of faces and both symmetry and sexual dimorphism, these relationships were relatively weak (i.e., none of our models explained >4% of the variance in health ratings, see https://osf.io/vrmxd/). In other words, despite the focus on these shape characteristics in studies of health perceptions of faces, our data suggest that these characteristics explain only a relatively small proportion of the variance in health ratings. This finding raises the question of what facial characteristics drive health perceptions. One possibility is that health perceptions are driven by skin, rather than shape, characteristics. Indeed, previous work has reported associations between health ratings and aspects of skin coloration (e.g., Jones, 2018; Henderson et al., 2016; Stephen et al., 2009). Another possibility is that health perceptions are driven by shape characteristics other than those considered in our study. For example, it is well-established that face shape contains information about individual differences in adiposity and that these cues predict health perceptions (e.g., Coetzee et al., 2009; Henderson et al., 2016). Of course, these two possible explanations are not necessarily mutually exclusive. Further work considering a wider range of shape and surface characteristics would be needed to clarify this issue.

Although we observed evidence that prototypicality and perceived health are positively correlated, our data do not speak to the reasons why this association occurs. One possibility is that the association occurs because individuals with prototypical face shapes are actually healthier than individuals with distinctive face shapes. However, empirical tests of this potential explanation have produced mixed results. Some studies have reported evidence that measures of actual health and facial prototypicality are positively correlated (e.g., Jones, 2018), while other work has reported null results for links between measures of prototypicality and actual health (e.g., Cai et al., 2019). Another possibility is that prototypical faces are generally perceived positively because of the tendency for people to ascribe negative traits to individuals with distinctive physical characteristics (the 'anomalous-is-bad' stereotype, Workman et al., 2021). Further work is needed to explore these (and other) potential explanations for the observed associations between perceived health and facial prototypicality.

A limitation of the current study is that we investigated health ratings of white faces only that were made by participants living in highly developed, western cultures. Consequently, our results may not generalise to ratings of other ethnicities and/or image sets that are more heterogeneous in terms of ethnicity, and also may not generalise to health ratings made by individuals from other types of cultures or societies. Further work is needed to explore these issues.

In conclusion, we found that prototypicality and health ratings of faces were positively and significantly correlated both when prototypicality was the only shape predictor included in our model and when it was entered simultaneously along with other shape predictors (symmetry, sexual dimorphism). By contrast, the relationship between health ratings and symmetry was only significant when no other shape characteristics were included as predictors. This pattern of results for symmetry may be particularly noteworthy, since it suggests that effects of symmetry on health ratings are, at least partly, driven by the positive effect of prototypicality on health perceptions. Additionally, relationships between sexual dimorphism and health ratings of faces were only significant when the other shape characteristics were included as predictors (and then only for female faces). Collectively, these results highlight the utility of considering multiple predictors when investigating the role shape characteristics play in health perceptions of faces.

The current study highlighted the role of face-shape averageness in health perceptions and the potential importance of considering multiple shape predictors simultaneously when investigating putative links between social judgments of faces and shape characteristics. While Chapter 2 investigated this issue in the context of health ratings, Chapter 3 sought to extend this approach to ratings of the trustworthiness of faces.

Chapter 3. Prototypicality, but not sexual dimorphism, of face shape predicts perceptions of trustworthiness

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Abstract

Perceptions of the trustworthiness of faces predict important social outcomes, including economic exchange and criminal sentencing decisions. However, the specific facial characteristics that drive trustworthiness perceptions remain poorly understood. Here we investigated this issue by exploring possible relationships between ratings of the trustworthiness of face images and objective assessments of two aspects of face shape that researchers have previously suggested are important for perceptions of trustworthiness: distinctiveness and sexual dimorphism. We found that faces with more distinctive shapes were rated as less trustworthy. By contrast, sexual dimorphism of face shape was not significantly correlated with trustworthiness ratings. These results suggest that distinctiveness of face shape plays a more important role in trustworthiness perceptions than does sexual dimorphism and suggest that perceptions of trustworthiness may stem, at least in part, from the 'anomalous-is-bad' stereotype.

Introduction

Perceptions of trustworthiness based on facial appearance predict important social outcomes. For example, in an economic game assessing trusting behaviour, people were more likely to trust individuals whose faces were judged more trustworthy by third-party raters (Van't Wout & Sanfey, 2008). Moreover, convicted murderers in a US state with the death penalty (Florida) were more likely to receive death sentences if their faces were judged less trustworthy by third-party raters (Wilson & Rule, 2015). Despite this evidence that trustworthiness ratings of faces predict social outcomes, the specific physical characteristics that predict perceptions of trustworthiness are unclear.

Sexually dimorphic shape information is one facial characteristic that researchers have suggested may play an important role in perceptions of trustworthiness. Several studies have reported that versions of face images in which shape characteristics had been feminised using computer-graphic methods (i.e., versions in which female sex-typical shape characteristics had been increased) were perceived to be more trustworthy than masculinised versions (e.g., Buckingham et al., 2006; Perrett et al., 1998; Smith et al., 2009; but see also Alharbi et al., 2020). However, this method for investigating possible links between physical characteristics and social judgments of faces has recently been criticised (Jones & Jaeger, 2019; Lee et al., 2021). Indeed, studies of facial-attractiveness judgments have shown that, although studies using experimentally manipulated face images often show large effects of shape manipulations on perceptions, effects are considerably smaller (and often not significant) when natural (i.e., unmanipulated) face images are rated for attractiveness and the shape characteristics being investigated are objectively assessed from the images (Jones & Jaeger, 2019; Lee et al., 2021; Scott et al., 2010). This pattern of results suggests that findings for perceptions of face stimuli manipulated on a single dimension do not necessarily generalise to ratings of natural face images (Jones et al., 2022; Jones & Jaeger, 2019; Lee et al., 2021; Scott et al., 2010). Furthermore, although some studies have reported that trustworthiness ratings of face images are positively correlated with ratings of their femininity and negatively correlated with ratings of their masculinity (e.g., Hester et al., 2020), other studies suggest that masculinity and femininity ratings of faces are influenced by characteristics that are not sexually dimorphic (e.g., Scott et al., 2010). For these reasons, we suggest that the role that sexually dimorphic shape information plays in perceptions of the trustworthiness of face images is currently unclear.

An alternative, but not necessarily mutually exclusive, explanation for perceptions of trustworthiness stems from the 'anomalous-is-bad' stereotype (Workman et al., 2021). This stereotype refers to the tendency for perceivers to erroneously ascribe negative personality traits to individuals with atypical physical appearances (Workman et al., 2021). Although tests for the existence of such a stereotype have generally focused on the effects of prominent facial anomalies (Jamrozik et al., 2019; Workman et al., 2022, 2021), it is possible that this stereotype also extends to the effects of more subtle deviations from prototypical face shapes on perceptions of trustworthiness. Consistent with this possibility, Ryali et al. (2020) recently reported that the statistical typicality of face images was positively correlated with ratings of their trustworthiness (see also Sofer et al., 2015).

In light of the above, we investigated possible relationships between ratings of the trustworthiness of natural (i.e., unmanipulated) face images and objective assessments of both the atypicality (i.e., distinctiveness) and sexual dimorphism of their face shapes. Trustworthiness ratings and face stimuli were taken from an open-access face-image database (DeBruine & Jones, 2022) and sexual dimorphism and distinctiveness of face shape were assessed using image-analysis methods widely used in face-perception research (see, e.g., Cai et al., 2019; Holzleitner et al., 2019; Komori et al., 2011).

Methods

Ethics

All procedures were approved by the School of Psychological Sciences and Health (University of Strathclyde) Ethics Commitee, all work was undertaken in accordance with the Declaration of Helsinki, and all participants provided informed consent.

Trustworthiness ratings

Ratings of trustworthiness were taken from an open-access face-image database (DeBruine & Jones, 2022). Two hundred men and 200 women (mean age = 25.11 years, SD = 6.00 years) were randomly allocated to rate either 50 male face images or 50 female face images for trustworthiness using a 1 (much less trustworthy than average) to 7 (much more trustworthy than average) scale (Cronbach's alphas: male faces = .97, female faces = .98). Trial order was fully randomised. Images had been standardised on pupil position and clothing masked prior to rating and the individuals photographed posed with neutral expressions, front-on to the camera, and with direct gaze. Male and female face images depicted young adult white men (mean age =

24.2 years, SD = 3.99 years) and young adult white women (mean age = 24.3 years, SD = 4.01 years), respectively. Ratings were collected using the Experimentum data-collection platform (DeBruine et al., 2020). As mentioned in Chapter 2, DeBruine and Jones (2022) had obtained these images from 3d.sk (a company that collates and provides images for artist references and avatar generation), the depicted individuals are Slovakian members of the public recruited by the 3d.sk company through adverts on social media and in the Slovakian press, and the stimuli have been used in several previous studies (e.g., DeBruine et al., 2019; Jones et al., 2018). Although the trustworthiness ratings were obtained from an open-access image set (DeBruine & Jones, 2022), they had not been analysed for any previous studies. Raters were members of the public recruited through social media links (e.g., stumbleupon.com) and ratings were collected using the Experimentum platform (DeBruine et al., 2020). Although no attention checks were employed when collecting these ratings, the quality (and therefore suitability) of the collected ratings is evidenced by the high Cronbach’s alphas, which exceed cutoffs given for data quality checks in Registered Reports (e.g., Jones et al., 2021). Example images are shown in Chapter 2’s Figure 1.

Sexual dimorphism of face shape

Sexual dimorphism of face shape was objectively measured for each of the 50 male and 50 female face images using the facefuns package (Holzleitner & DeBruine, 2021) in R (R Core Team, 2021). This method that has been used in many previous studies to assess sexual dimorphism of face shape (e.g., Cai et al., 2019; Holzleitner et al., 2019; Komori et al., 2011; see also Chapter 2). Shape components were first derived from Principal Component Analysis (PCA) of 132 Procrustes-aligned landmark points (see Holzleitner et al., 2019 for a diagram showing these facial landmarks) on each of the 50 male and 50 female face images. Scores representing sexual dimorphism of face shape were then calculated from each photograph using a vector analysis method (e.g., Cai et al., 2019; Holzleitner et al., 2019; Komori et al., 2011). This method uses the shape principal components to locate each face on a female-male continuum. The female-male continuum was defined by calculating the average shape information of the 50 female faces and the average shape information of the 50 male faces. Sexual dimorphism scores were then derived by projecting each image onto this female-male vector. Higher scores indicated more masculine face shapes.

Distinctiveness of face shape

Distinctiveness scores were also calculated from each photograph using the facefuns package (Holzleitner & DeBruine, 2021) in R (R Core Team, 2021). This technique has been used to measure face-shape distinctiveness in many previous studies (e.g., Cai et al., 2019; Holzleitner et al., 2019; see also Chapter 2). This method uses the shape principal components described in the previous section of our methods to measure the distance each face lies from the mathematical average shape for the sample of faces of the same sex. That is, the average shape values for the same-sex sample were calculated and, for each image, the Euclidean distance from the average was derived. Higher scores indicate that the face lies a further distance away from the average (i.e., had a more distinctive shape). We measured distinctiveness scores for male and female faces separately in light of evidence that faces are primarily processed relative to sex-specific prototypes (e.g., Little et al., 2005; Rhodes et al., 2011).

Correlation between sexual dimorphism and distinctiveness scores

Sexual dimorphism and distinctiveness scores were not significantly correlated for the whole sample of 100 faces (r = .03, N = 100, p = .70), the sample of 50 male faces (r = .15, N = 50, p = .31), or the sample of 50 female faces (r = - .07, N = 50, p = .63).

Results

All analyses were carried out using R (R Core Team, 2021), with the packages kableExtra 1.3.4 (Zhu, 2021), lme4 (Bates et al., 2015a), lmerTest 3.1-3 (Kuznetsova et al., 2017), jtools 2.2.3 (Long, 2022), psych 2.2.5 (Revelle, 2022), robustHD 0.7.3 (Alfons, 2022), and tidyverse 1.3.1 (Wickham, 2021). All data, full outputs, and analysis code are publicly available on the Open Science Framework (https://osf.io/htbjv/).

We tested for possible relationships between trustworthiness ratings and both sexual dimorphism and distinctiveness scores using a linear mixed effects model. Trustworthiness ratings served as the dependent variable. The model included main effects of sexual dimorphism scores, distinctiveness scores, rater sex (effect coded so that 0.5 corresponded to male raters and -0.5 corresponded to female raters), and face sex (effect coded so that 0.5 corresponded to male faces and -0.5 corresponded to female faces) as predictors, as well as all possible two- and three-way interactions, excluding those involving both of the continuous predictors (i.e. no interactions including both sexual dimorphism and distinctiveness scores were included in the model). The model also included, by-rater and by-stimulus random intercepts, by-rater random slopes for sexual dimorphism and distinctiveness (face sex varied between raters), and by-stimulus random slopes for rater sex. Sexual dimorphism and distinctiveness scores were standardised prior to analyses by converting them to z scores. Results are summarised in Table 1.

Table 1. Summary of results from our analysis of trustworthiness ratings.

	Estimate	SE	t	df	p
Sexual dimorphism	0.018	0.052	0.343	100.435	0.732
Distinctiveness	-0.142	0.052	-2.732	101.134	0.007
Face sex	-0.007	0.128	-0.053	227.701	0.958
Rater sex	0.157	0.080	1.958	403.924	0.051
Sexual dimorphism x Rater sex	-0.002	0.021	-0.103	98.694	0.918
Sexual dimorphism x Face sex	0.145	0.104	1.395	100.435	0.166
Distinctiveness x Rater sex	0.014	0.022	0.616	112.017	0.539
Distinctiveness x Face sex	-0.100	0.104	-0.959	101.134	0.340
Face sex x Rater sex	0.298	0.160	1.858	403.924	0.064
Sexual dimorphism x Rater sex x Face sex	0.011	0.042	0.252	98.694	0.801
Distinctiveness x Rater sex x Face sex	-0.035	0.044	-0.788	112.017	0.432

Our analysis revealed a significant negative main effect of distinctiveness, indicating that faces with less distinctive face shapes were rated more trustworthy. By contrast, the main effect of sexual dimorphism was not significant. Neither the main effects of rater sex or face sex, nor any of the two- or three-way interactions were significant. Figure 1 shows the relationships between trustworthiness ratings and both sexual dimorphism and distinctiveness.

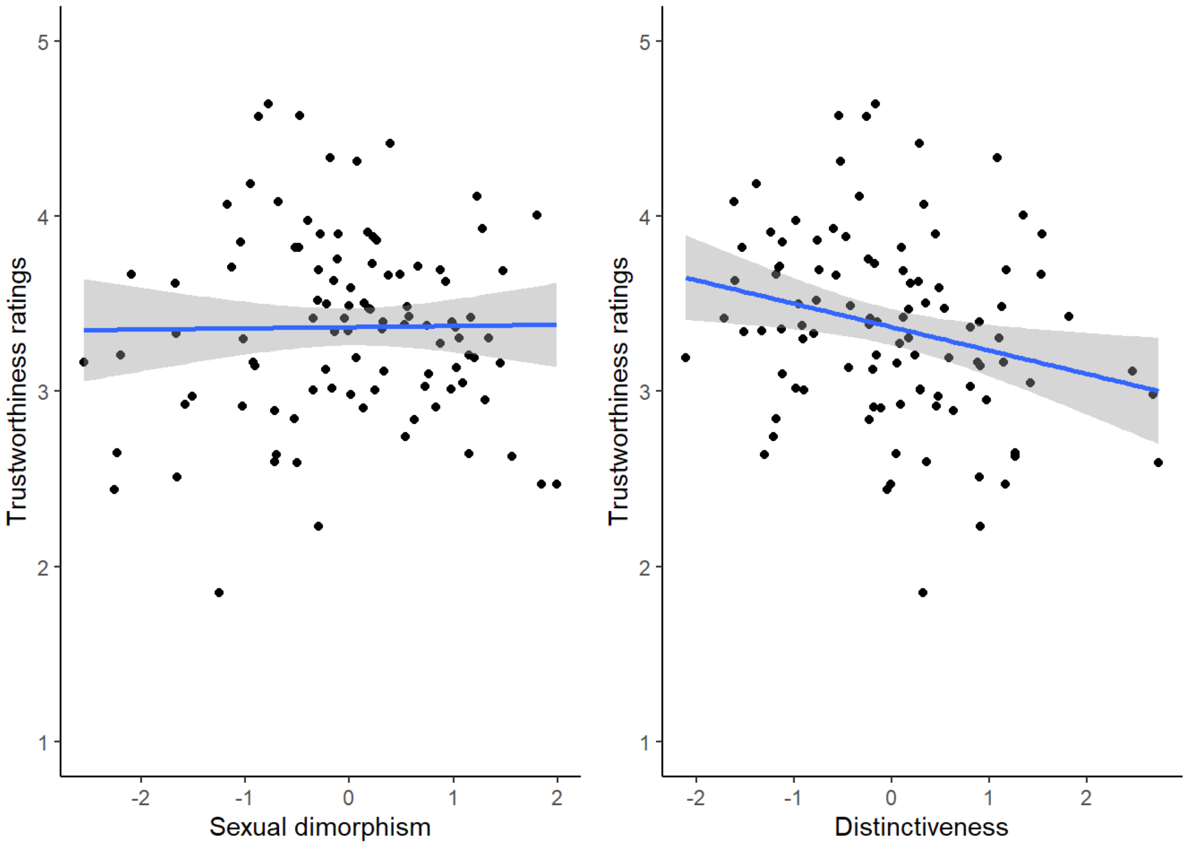

Figure 1. The non-significant relationship between sexual dimorphism and trustworthiness ratings (left) and the significant relationship between distinctiveness and trustworthiness ratings (right). The shaded areas show 95% confidence intervals. Because face-shape parameters (distinctiveness and sexual dimorphism) were converted to z scores within each sex prior to analyses, for both sexual dimorphism and distinctiveness, zero represents the midpoint of the measure within each sex.

Exploratory analyses testing for linear and quadratic effects of sexual dimorphism on trustworthiness when distinctiveness was not included in the model showed (1) no significant linear effect of sexual dimorphism on trustworthiness and (2) a significant quadratic effect of sexual dimorphism on trustworthiness whereby faces with average levels of sexual dimorphism (with face-sex) were perceived to be more trustworthy than those with high level of masculinity or femininity. This latter result is consistent with the finding that faces with more average face shapes are perceived to be more trustworthy. Consistent with this interpretation, there was also a significant quadratic relationship between shape distinctiveness and sexual dimorphism, whereby faces with average levels of sexual dimorphism within each sex had the least distinctive (i.e., most average) face shapes. Full results of these exploratory analyses are given on the Open Science Framework (https://osf.io/htbjv/).

Discussion

We investigated possible relationships between ratings of the trustworthiness of natural (i.e., unmanipulated) face images and objective assessments of both the distinctiveness (i.e., atypicality) and sexual dimorphism of their face shapes. There was a significant negative relationship between distinctiveness of face shape and trustworthiness (see Figure 1), indicating that more trustworthy-looking faces had less distinctive (i.e., more prototypical) face shapes (see Figure 1). By contrast, the relationship between sexual dimorphism of face shape and trustworthiness ratings was not significant (see Figure 1).

The significant negative relationship between trustworthiness ratings and shape distinctiveness is consistent with previous research reporting that trustworthy-looking faces tend be more typical (Ryali et al., 2020; see also Sofer et al., 2015). It is also consistent with the 'anomalous-is-bad' stereotype (Workman et al., 2021), which refers to the tendency for perceivers to ascribe negative personality traits to individuals with atypical physical appearances (Workman et al., 2021). While most previous research on the 'anomalous-is-bad' stereotype has examined the effects of prominent anomalies (e.g., Jamrozik et al., 2019; Workman et al., 2022, 2021), our results suggest that this stereotype also extends to the effects of more subtle deviations from prototypical face shapes. More fundamentally, our results suggest that distinctiveness of face shape contributes significantly to trustworthiness perceptions, even when stimuli are natural (i.e., unmanipulated) faces that vary simultaneously on other dimensions.

Our null result for sexual dimorphism of face shape and trustworthiness ratings contrasts with previous studies reporting that versions of face images in which female sex-typical shape characteristics had been increased were perceived as more trustworthy than versions of face images in which male sex-typical shape characteristics had been increased (e.g., Buckingham et al., 2006; Perrett et al., 1998; Smith et al., 2009; but see also Alharbi et al., 2020). However, recent work on facial-attractiveness judgments has found that the large effects typically observed when sexually dimorphic face-shape characteristics are manipulated in face images are not observed when individual, unmanipulated faces were rated for attractiveness and sexually dimorphic face-shape measured objectively from face images (Jones & Jaeger, 2019; Lee et al., 2021). Our null result for trustworthiness ratings and sexual dimorphism suggests that the extent to which sexually dimorphic aspects of face-shape influence perceptions of trustworthiness is also determined by study design and that the large effects observed for manipulated shape characteristics do not generalise to ratings of natural (i.e., unmanipulated) face images. Perhaps more importantly, our null result for sexual dimorphism does not support the proposal that sexually dimorphic face-shape is an important cue for perceptions of trustworthiness. That there was a significant quadratic effect of sexual dimorphism in the exploratory analyses we conducted, whereby faces with average levels of sexual dimorphism were judged most trustworthy, provides further evidence for the role of averagness in perceptions of trustworthiness.

Many previous studies have compared the effects of manipulated shape characteristics on social judgments of faces across world regions. For example, Perrett et al. (1998) found that experimentally manipulating sexually dimorphic shape information in face images had similar effects on social judgments of faces made by UK and Japanese participants (e.g., feminising shape characteristics made faces appear more trustworthy to both UK and Japanese participants). By contrast, using similar methods, Scott et al. (2014) found that the size and even direction of the effects of sexual dimorphism on social judgments of faces could differ markedly across world regions, with some regions showing the opposite pattern of results to those observed in western regions. Results from studies investigating effects of other face-shape characteristics (e.g., distinctiveness) in different cultures are similarly mixed (reviewed in Apicella & Barrett, 2016). A limitation of these studies is that they typically employed experimentally manipulated face images as stimuli and assessed perceptions using forced-choice methods. Establishing whether the relationships between ratings of individual faces and objectively measured face-shape parameters are similar or different across world regions may provide a clearer picture of cultural differences and similarities in the cues that drive social judgments of faces.

To summarize, we investigated possible relationships between ratings of the trustworthiness of natural face images and objective assessments of the distinctiveness and sexual dimorphism of their face shapes. By contrast with previous research that used experimentally manipulated face stimuli (e.g., Buckingham et al., 2006; Perrett et al., 1998; Smith et al., 2009), we found no evidence that sexual dimorphism of face shape plays an important role in perceptions of trustworthiness. However, our results suggest that distinctiveness of face shape contributes significantly to perceptions of trustworthiness and appears to play a more important role in trustworthiness perceptions than does sexual dimorphism. Collectively, these results underline the importance of establishing whether findings for experimentally manipulated face stimuli generalise to judgments of natural (i.e., unmanipulated) face images.

Chapters 2 and 3 highlighted the role of face-shape averageness in perceptions of health and trustworthiness, consistent with other recent work suggesting averageness may be an important predictor of facial attractiveness (see Lee et al., 2025 for a recent review). A challenge when assessing work that has investigated links between unmanipulated (i.e., natural) face images and averageness/distinctiveness is that some studies have measured distinctiveness objectively using facial metric methods, other studies have measured distinctiveness via perceptual ratings of distinctiveness, and the extent to which these two measures of distinctiveness are correlated is unclear. Consequently, Chapter 4 addressed this issue by examining the correlation between rated and measured distinctiveness.

Chapter 4. Distinctiveness ratings of faces and shape distinctiveness measured from face images are positively correlated, but only weakly

Abstract

Many previous studies have reported that more distinctive (i.e., less average) faces are generally perceived to be unattractive. However, studies that have reported correlations between distinctiveness and facial attractiveness have used two different methods to assess distinctiveness. While some studies have assessed distinctiveness via distinctiveness ratings of faces made by participants, other studies assessed distinctiveness by objectively measuring shape distinctiveness from face images using computer graphics methods. However, a lack of clarity regarding how well correlated these two different measures of distinctiveness are creates a challenge for researchers wishing to interpret the distinctiveness literature. Consequently, here we tested for possible correlations between distinctiveness ratings of faces made by participants and an objective measure of shape distinctiveness from face images. Distinctiveness ratings of faces made by participants and the objective measure of shape distinctiveness were significantly and positively correlated and this relationship was not significantly moderated by sex of face. However, because the correlation was weak ($r = .24$), we suggest that researchers should carefully consider the method that studies used to assess distinctiveness when interpreting the large literature on the role of distinctiveness in social judgments of faces.

Introduction

Many studies have reported that more distinctive faces are judged to be less attractive (DeBruine et al., 2007; Jones et al., 2007; Kleisner et al., 2024a; Komori et al., 2009a, 2009b; Lee et al., 2025; Perrett et al., 1994; Rhodes et al., 1999, 2021a, 2021b). Two potential explanations for this negative association between facial distinctiveness and attractiveness have been outlined in the attractiveness literature. Some researchers have proposed that attractiveness judgments reflect psychological adaptations for identifying individuals with strong immune systems and that distinctiveness is a facial characteristic associated with susceptibility to infectious illnesses (see Rhodes, 2006 for discussion). A different (but not necessarily mutually exclusive) explanation is that distinctive faces are processed less efficiently by the perceptual system and that this negative association between distinctiveness and facial attractiveness is simply a by-product of this difference in processing efficiency (see Rhodes, 2006 for discussion). Negative associations between distinctiveness and social judgments of faces do not appear to be limited to attractiveness judgments and have been reported for judgments of other traits that are thought to be important for social interactions. For example, more distinctive faces are perceived to be untrustworthy and unhealthy (e.g., Kleisner et al., 2024b; Rhodes et al., 2021b; Sofer et al., 2015; see also Chapters 2 and 3).

Although some studies have demonstrated effects of distinctiveness on social judgments of faces by experimentally *manipulating* distinctiveness using computer graphics methods (e.g., DeBruine et al., 2007; Jones et al., 2007; Perrett et al., 1994; Rhodes et al., 1999, 2001a, 2001b), other studies have tested for potential *correlations* between social judgments of faces and assessments of distinctiveness

(Kleisner et al., 2024a, 2004b; Komori et al., 2009a, 2009b; Lee et al., 2025; Rhodes et al., 2021a, 2021b; Sofer et al., 2015). However, some of these latter studies have assessed facial distinctiveness using perceptual measures (i.e., participants' distinctiveness ratings of faces, Rhodes et al., 2021b, 2021b), while others have assessed distinctiveness more objectively (i.e., have used computer-graphics methods to objectively measure the distinctiveness of 2D face shape from images, Kleisner et al., 2024a, Komori et al., 2009a, 2009b; Lee et al., 2025). Consequently, a challenge when considering the literature on distinctiveness and social judgments of faces is that the extent to which these two measures of distinctiveness are correlated is unclear. Kleisner et al. (2024b) reported that shape distinctiveness measured from face images and typicality ratings were significantly and negatively correlated, but that the relationship was weak. Given this finding, a weak positive relationship between distinctiveness ratings of faces and measured shape distinctiveness might also be expected, given that typicality and distinctiveness ratings of faces are strongly and negatively correlated (e.g., Dewhurst et al., 2005).

Given the apparent importance of averageness for social judgments of faces (e.g., the positive effects of averageness on perceptions of health, trustworthiness, and attractiveness) and the weak correlations between typicality ratings and measured distinctiveness reported by Kleisner et al. (2024b), the current study sought to quantify the strength of the relationship between shape distinctiveness measured from face images and distinctiveness ratings. A strong correlation between these two measures would suggest it is appropriate to treat them as equivalent when assessing the literature on distinctiveness and social judgments of faces. However, a weak or non-significant correlation between distinctiveness ratings and the objective measure of face-shape distinctiveness would suggest that it may be important to distinguish between studies using these two methods when assessing the literature on distinctiveness and social judgments of faces.

Methods

Ethics

All procedures were approved by the School of Psychological Sciences and Health (University of Strathclyde) Ethics Committee, all work was undertaken in accordance with the Declaration of Helsinki, and all participants provided informed consent.

Distinctiveness ratings

Ratings of distinctiveness were taken from an open-access face-image database (DeBruine & Jones, 2022). Two hundred men and 200 women (mean age = 24.03 years, SD = 5.15 years) were randomly allocated to rate either 50 male face images or 50 female face images for distinctiveness using a 1 (not very distinctive) to 7 (very distinctive) scale. Trial order was fully randomised. Images had been standardised on pupil position and clothing masked prior to rating and the individuals photographed posed with neutral expressions, front-on to the camera, and with direct gaze. Male and female face images depicted young adult white men (mean age = 24.2 years, SD = 3.99 years) and young adult white women (mean age = 24.3 years, SD = 4.01 years), respectively. Ratings were collected using the Experimentum data-collection platform (DeBruine et al., 2020). Cronbach's alphas were high for ratings of both male faces (Cronbach's alpha = .98) and female faces (Cronbach's alpha = .97). The mean distinctiveness rating for male faces was 3.89 (SD = 0.65) and for female faces was 3.86 (SD = 0.51).

As mentioned in Chapters 2 and 3, DeBruine and Jones (2022) had obtained these images from 3d.sk (a company that collates and provides images for artist references and avatar generation), the depicted individuals are Slovakian members of the public recruited by the 3d.sk company through adverts on social media and in the Slovakian press, and the stimuli have been used in several previous studies (e.g., DeBruine et al., 2019; Jones et al., 2018). Although the distinctiveness ratings were obtained from an open-access image set (DeBruine & Jones, 2022), they had not been analysed for any previous studies. Raters were members of the public recruited through social media links (e.g., stumbleupon.com) and ratings were collected using the Experimentum platform (DeBruine et al., 2020). Although no attention checks were employed when collecting these ratings, the quality (and therefore suitability) of the collected ratings is evidenced by the high Cronbach's alphas, which exceed cutoffs given for data quality checks in Registered Reports (e.g., Jones et al., 2021). Example images are shown in Chapter 2's Figure 1.

Measured distinctiveness of face shape

Face-shape distinctiveness scores were calculated from each photograph using the facefuns package (Holzleitner & DeBruine, 2021) in R (R Core Team, 2021). This technique has been used to measure face-shape distinctiveness in many previous studies (e.g., Cai et al., 2019; Dong et al., 2023; Holzleitner et al., 2019; Lee et al., 2016; see also Chapters 2 and 3). Shape components were first derived from Principal Component Analysis (PCA) of 132 Procrustes-aligned landmark points (see Holzleitner et al., 2019 for a diagram showing these facial landmarks) on each of the 50 male and 50 female face images. We then used these shape principal components to measure the distance each face was from the mathematical average shape for the sample of faces of the same sex. That is, the average shape values for the same-sex sample were calculated and, for each image, the Euclidean distance from the average was derived. Higher scores indicate that the face lies a further distance away from the average (i.e., had a more distinctive shape). We measured distinctiveness scores for male and female faces separately in light of evidence that faces are primarily processed relative to sex-specific prototypes (e.g., Little et al., 2005; Rhodes et al., 2011).

Results

All analyses were carried out using R (R Core Team, 2021), with the packages kableExtra 1.3.4 (Zhu, 2021), lme4 (Bates et al., 2015a), lmerTest 3.1-3 (Kuznetsova et al., 2017), jtools 2.2.3 (Long, 2022), psych 2.2.5 (Revelle, 2022), robustHD 0.7.3 (Alfons, 2022), and tidyverse 1.3.1 (Wickham, 2021). All data, full outputs, and analysis code are publicly available on the Open Science Framework (https://osf.io/7xbec/).

First, we analysed distinctiveness ratings using a regression analysis. The mean distinctiveness rating for each face served as the dependent variable. The regression model included shape distinctiveness scores, face sex (effect coded so that +0.5 corresponded to female faces and -0.5 corresponded to male faces), and the interaction between shape distinctiveness scores and face sex as predictors. Results of this analysis are summarised in Table 1. Neither the main effect of face sex nor the interaction between face sex and shape distinctiveness were significant. Although the main effect of shape distinctiveness was significant, the correlation between rated distinctiveness and measured shape distinctiveness was relatively weak (r = .24, p = .017). The correlation between rated distinctiveness and measured shape distinctiveness is shown in Figure 1.

Table 1. Results of the regression analysis testing for a relationship between shape distinctiveness and mean rated distinctiveness.

	Estimate	Standard error	t value	p value
Intercept	3.867	0.057	67.844	< .001
Shape distinctiveness	0.151	0.058	2.592	0.011
Face sex	-0.004	0.114	-0.037	0.971
Shape distinctiveness x Face sex	-0.148	0.117	-1.274	0.206

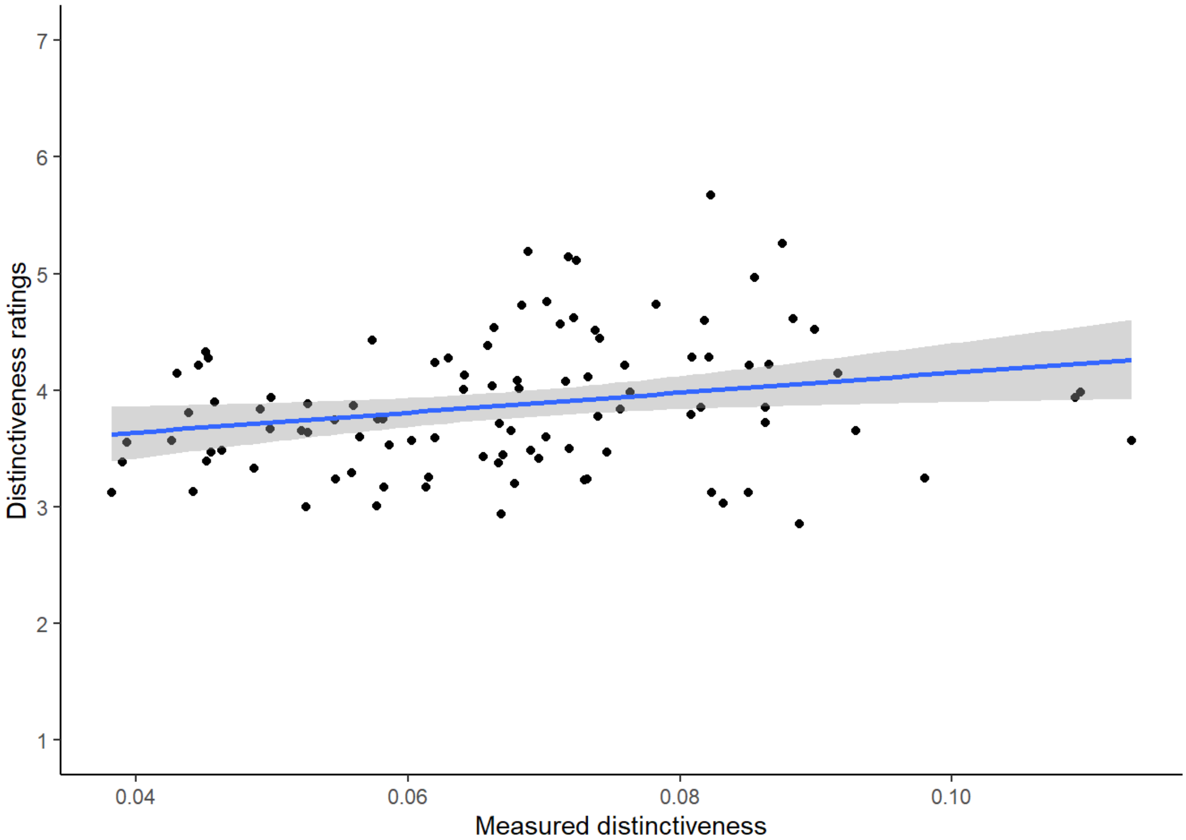

Figure 1. The correlation between measured shape distinctiveness and mean rated distinctiveness. The shaded area shows 95% confidence intervals.

In addition to the analyses described above, we also analysed distinctiveness ratings using a linear mixed effects model. Individual assessments of individual stimuli (rather than mean scores) served as the dependent variable in this analysis. This analysis allows variation across both raters and stimuli to be modelled. Analysis code and full results for these analyses are given on the Open Science Framework (https://osf.io/7xbec/). Results were consistent with those of our initial analyses (i.e., also showed a significant, but relatively weak, correlation between rated distinctiveness and measured shape distinctiveness that was not qualified by a significant interaction with face sex).

Linear regression analyses were also conducted to establish whether adding rated distinctiveness to models predicting rated health (ratings from Chapter 2) and rated trustworthiness (ratings from Chapter 3) from shape distinctiveness scores significantly increased the percentage of explained variance. For trustworthiness ratings, adding rated distinctiveness as an additional predictor increased the percentage of explained variance from 4% to 24%, which was a significant increase ($F = 13.33$, $p < .001$). For health ratings, adding rated distinctiveness as an additional predictor increased the percentage of explained variance from 8% to 9%, which was not a significant increase ($F = 1.59$, $p = .209$). Again, analysis code and full results for these analyses are given on the Open Science Framework (https://osf.io/7xbec/).

Discussion

The current study tested for a possible correlation between distinctiveness ratings of faces and a more shape distinctiveness measured from face images using a computer graphics method (measured distinctiveness). Although these two distinctiveness assessments were positively and significantly correlated, the correlation was weak ($r = .24$). Our findings are consistent with Kleisner et al. (2024b), who recently reported a weak negative relationship between shape distinctiveness measured from face images and typicality ratings (typicality and distinctiveness ratings of faces are very highly correlated, Dewhurst et al., 2005). Together, these findings suggest that the method used to assess distinctiveness (measured or rated) should be an important consideration when interpreting studies reporting correlations between distinctiveness and social judgments of faces.

Why are measured shape distinctiveness and distinctiveness ratings only weakly correlated, given they are often treated interchangeably in the literature? One possibility is that distinctiveness ratings of faces are influenced by factors other than distinctiveness. For example, the well-established ‘beauty is good’ stereotype (Langlois et al., 2000; Rhodes, 2006) may cause people to attribute low distinctiveness to attractive individuals irrespective of actual facial distinctiveness. Distinctiveness ratings of faces are also reliably influenced by recent visual experience, such that novel faces with a particular distinctive characteristic are judged to be less distinctive after viewing other faces with that characteristic (i.e., perceptual adaptation effects, Little et al., 2005 and Rhodes et al., 2003b). Although measured shape distinctiveness will not be influenced by stereotypes and perceptual adaptation effects, it will also not capture the distinctiveness of surface characteristics of faces (e.g., skin tone, facial hair, scarring) that are likely to contribute to distinctiveness ratings of faces. While the two methods used in the current study capture some common information (as evidenced by the significant positive correlation), they will also capture some unique information (as evidenced by the low proportion of shared variance). Further research exploring these issues may shed important light on what aspects of facial distinctiveness drive social judgments of faces and how this varies according to the social judgment being investigated, as well as exploring whether the weak association between measured shape distinctiveness and rated distinctiveness observed in the current study generalises to other image sets, including ones depicting other ethnicities.

Although the relatively weak correlation between measured and rated distinctiveness observed in the current study replicates findings reported by Kleisner et al. (2024b), further replication using other image sets will allow for more accurate estimation of the strength of the correlation between these two methods for assessing facial distinctiveness. Such work could also investigate the extent to which the combined effects of rated and measured distinctiveness explore more variance in social judgments of faces than either measure does individually and whether this pattern of results differs according to the social judgment being investigated.

Related to the point made above, we also conducted linear regression analyses to establish whether adding rated distinctiveness to models predicting rated health (ratings from Chapter 2) and rated trustworthiness (ratings from Chapter 3) from shape distinctiveness scores significantly increased the percentage of explained variance. Adding distinctiveness ratings to the model significantly and substantially increased the percentage of explained variance when trustworthiness ratings were the outcome variable, but not when health ratings were the outcome variable. The difference in results of these analyses for perceived health and trustworthiness underlines the potential importance of considering how distinctiveness is measured when synthesising the literature on distinctiveness and social judgments of faces and suggests that aspects of distinctiveness other than shape may contribute more to perceptions of trustworthiness than health perceptions (at least in this image set). These results also suggest that focusing on shape distinctiveness only in Chapter 3 may have substantially underestimated the role averageness plays in perceptions of trustworthiness.

Many studies have reported negative correlations between social judgments of faces (e.g., perceptions of attractiveness, health, and trustworthiness) and distinctiveness.

However, these studies have typically used one of two different methods to assess distinctiveness (distinctiveness ratings or measured shape distinctiveness), presenting a potential challenge to researchers wishing to digest the large literature on distinctiveness and social judgments of faces. Here we found that distinctiveness measures produced using these two methods were positively correlated, but that the correlation was weak. Thus, we recommend that researchers pay close attention to the method used to assess distinctiveness when considering studies reporting correlations between social judgments of faces and distinctiveness and resist the temptation to treat these two methods as equivalent.

Chapters 2, 3, and 4 found that averageness/distinctiveness of face shape significantly predicted social judgments of faces (health, trustworthiness, and distinctiveness). Furthermore, Chapters 2 and 3 highlighted the importance of considering multiple shape predictors simultaneously. A potentially important limitation of the approach used in these studies (and in the social judgments of faces literature more generally) is that they did not consider potential interactions between multiple predictors of social judgments of faces. Consequently, Chapter 5 investigated whether perceptions of attractiveness and abusiveness interacted to predict hypothetical dating decisions when women viewed male faces or whether perceptions of attractiveness and abusiveness have independent main effects. As suggested in Chapter 3, predictors were derived from Principal Component Analysis of multiple rated traits. While the studies reported in this thesis so far have used carefully standardised face images as stimuli, Chapter 5 used unstandardised images, which arguably have greater ecological validity.

Chapter 5. Testing for individual differences in the effects of men's physical attractiveness and perceived abusiveness on women's hypothetical dating decisions

Leger, K., Jones, B. C., & Shiramizu, V. K. (2025). Scientific Reports, 15(1), 20667.

Abstract

Romantic-partner choice is a fundamental human behaviour. However, the factors that influence partner choice remain poorly understood. Here we investigated (1) how women’s first impressions of potential partners’ physical attractiveness and potential for abusive behaviour based on face images influence hypothetical dating decisions and (2) possible moderating effects of individual differences in women's sensation seeking, sociosexual orientation (i.e., openness to uncommitted sexual relationships), current partnership status, and self-perceived mate value (i.e., self-rated attractiveness). Physical attractiveness of potential dates, but not perceptions of potential for abusive behaviour, was a strong predictor of reported dating intentions, but this effect of physical attractiveness was weaker among women who scored higher on sensation seeking. None of the other individual-difference variables had significant effects. Collectively, these findings present further evidence for the importance of physical attractiveness in dating and partner choices and highlight the role sensation seeking appears to play in individual differences in the effect of men’s physical attractiveness on women’s dating intentions.

Introduction

Although choosing a romantic partner is a fundamental human behaviour, the factors that influence romantic-partner choice remain poorly understood. Nonetheless, multiple lines of evidence suggest that the physical attractiveness of potential partners plays a key role in romantic-partner choices. For example, people prefer to date and marry more physically attractive individuals (for a meta-analytic review see Langlois et al., 2000) and the physical attractiveness of potential partners is a good predictor of both swiping decisions made on dating apps (Chopik & Johnson, 2021) and dating decisions made following speed-dating events (Asendorpf et al., 2011).

People form a wide range of first impressions of individuals' personality traits based on facial appearance (for reviews see Todorov et al., 2008, 2013) and it is well-established that these first impressions, though often inaccurate, can influence subsequent behaviour (for a review see Olivola et al., 2014). Consequently, Olivera-La Rosa et al. (2019) recently proposed that a better understanding of the role these first impressions play in dating decisions might provide important insights into the processes that influence such decisions, particularly in the context of choices made on dating apps. Given that dating increases women's risk of violence (and sexual violence in particular, Filice et al., 2022), one might reasonably expect that first impressions of faces relating to potential partners' propensity to abuse their partners would play an important role in women's dating decisions. Indeed, Shuster et al. (2024) recently reported that threat-related perceptions of potential partners' face images had a negative effect on reported dating intentions in a hypothetical dating-decision task.

In light of the above, the current study investigated the roles that attractiveness- and violence-related perceptions play in hypothetical dating decisions when heterosexual women assessed images of men's faces. Male faces were first rated by one group of women for a range of attractiveness- and violence-related traits. These ratings were then subjected to Principal Component Analysis (PCA) to identify the underlying dimensions. This PCA showed that the trait ratings were underpinned by distinct physical attractiveness and perceived abusiveness dimensions. Next, a different group of women assessed the same male faces in a hypothetical dating decisions task where they indicated how likely they would be to date each man. Because some previous research has reported that people are often more willing to discount negative traits (e.g., a sexual history suggesting an individual may be more likely to have sexually transmitted infections) when assessing more physically attractive potential partners (Agocha & Cooper, 1999; Henderson et al., 2005), the physical attractiveness and perceived abusiveness dimensions may interact to predict hypothetical dating decisions.

In addition to the above, we tested for possible moderating effects of individual differences in women's sensation seeking, sociosexual orientation (i.e., openness to uncommitted sexual relationships), current partnership status, and self-perceived mate value (i.e., self-rated attractiveness). Sociosexual orientation, current partnership status, and self-perceived mate value were assessed because of previous research suggesting that women who consider themselves to be more attractive (for a review see Docherty et al., 2020), are currently in a relationship (for a review see Little et al., 2011), or who are more open to uncommitted sexual relationships (for a review see Ekrami et al., 2021) show stronger preferences for masculine and/or physically attractive men. Sensation seeking was assessed because of previous work suggesting that sensation seeking predicts individual differences in how people integrate traits that are desirable and undesirable traits in potential partners (Henderson et al., 2005).

Methods

Ethics

All procedures were approved by the Department of Psychological Sciences and Health (University of Strathclyde) Ethics Committee, all work was undertaken in accordance with the Declaration of Helsinki, and all participants provided informed consent. Participant Information and Consent forms are given in the appendices of this thesis.

Stimuli

Stimuli were taken from an open-access database (Nightingale & Farid, 2022) of 200 AI-generated male faces of diverse ethnicity (Black, White, East Asian, and West Asian faces) shown mostly with smiling expressions (see Figure 1 for example images). Nightingale and Farid (2022) have previously shown that people cannot distinguish these AI-generated images from control images (i.e., images of real people). Twenty heterosexual women (mean age = 29.75 years, SD = 3.58 years) were recruited via prolific and judged the age of these 200 male faces (mean age = 32.25 years, SD = 14.06 years, Cronbach's alpha for age judgments = .98). Trial order was fully randomised. These age ratings were used to randomly select 25 Black, 25 White, 25 East Asian, and 25 West Asian faces that were perceived, on average, to be between 18 and 40 years of age (mean age of this subset of images

= 29.45 years, SD = 5.29 years). These 100 male faces images served as stimuli for the subsequent parts of the study. All data and analysis code for this part of our study are publicly available on the Open Science Framework (https://osf.io/ugpxs/).

Figure 1. Examples of face stimuli used in our study.

Deriving Perceived Abusiveness and Physical Attractiveness components

Two hundred and thirteen heterosexual women (mean age = 28.89 years, SD = 4.23 years) were recruited via Prolific and randomly allocated to rate the 100 male faces for one of eight questions using a seven-point scale (1 = much less than average, 7 = much more than average). The eight questions were “How likely is this man to resolve arguments with their partner or a potential partner by discussing the problems?” (Cronbach’s alpha = .87), “How likely is this man to behave aggressively towards their partner or a potential partner by shouting, swearing at them, or insulting them?” (Cronbach’s alpha = .81), “How likely is this man to physically assault their partner or a potential partner?” (Cronbach’s alpha = .86), “How likely is this man to coerce their partner or a potential partner to have sex with them?” (Cronbach’s alpha = .81), “How likely is this man to physically injure their partner or a potential partner?” (Cronbach’s alpha = .85), “How attractive is this man?” (Cronbach’s alpha = .89), “How good looking is this man?” (Cronbach’s alpha = .90), and “How sexy is this man?” (Cronbach’s alpha = .92). The first five questions described above were chosen to reflect the five subscales of Straus et al's (1996) Revised Conflict Tactics Scale (negotiation, psychological aggression, physical assault, sexual coercion, injury), which assesses both the extent to which partners engage in physical and psychological attacks and the extent to which partners use negotiation and reasoning to deal with conflict. Trial order was fully randomised. Although no attention checks were employed when collecting these ratings, the quality (and therefore suitability) of the collected ratings is evidenced by the high Cronbach's alphas, which exceed cutoffs given for data quality checks in Registered Reports (e.g., Jones et al., 2021). Ratings were collected using the Experimentum platform (DeBruine et al., 2020). Note that attractiveness ratings of these unstandardized AI-generated faces were only slightly higher than the mean attractiveness ratings of the unstandardised male faces used in previous chapters (mean attractiveness rating = 2.64, SD = 1.46, Lee et al., 2025).

Table 1. Descriptive statistics (means and SDs) for ratings used to construct the Perceived Abusiveness and Physical Attractiveness components.

Rated question	Mean	SD
"How attractive is this man?"	3.09	1.53
"How likely is this man to behave aggressively towards their partner or a potential partner by shouting, swearing at them, or insulting them?"	3.15	1.36
"How likely is this man to coerce their partner or a potential partner to have sex with them?"	3.39	1.29
"How good looking is this man?"	2.94	1.41

"How likely is this man to physically assault their partner or a potential partner?"	3.18	1.32
"How likely is this man to physically injure their partner or a potential partner?"	3.33	1.39
"How likely is this man to resolve arguments with their partner or a potential partner by discussing the problems?"	4.00	1.41
"How sexy is this man?"	2.85	1.65

Next, we calculated the mean rating for each face on each of these traits (see Table 1) and subjected these scores to Principal Component Analysis (PCA) with varimax rotation using the R package Psych 2.3.6 (Revelle, 2023). This PCA produced two components that explained 49% and 41% of the variance in scores, respectively. The first component was highly correlated with ratings for the five questions assessing perceptions of the likelihood of engaging in abusive behaviours. We labelled this component the Perceived Abusiveness component. The second component was highly correlated with ratings for the three questions assessing perceptions of physical attractiveness. We labelled this component the Physical Attractiveness component. Correlations between individual traits and both components are shown in Table 2. All data (i.e., ratings) and analysis code for this part of our study are publicly available on the Open Science Framework (https://osf.io/ugpxs/). Images that scored highest and lowest on each component are also available on the Open Science Framework (https://osf.io/ugpxs/).

Table 2. Correlations between individual traits and the Perceived Abusiveness and Physical Attractiveness components. Correlations with absolute values greater than .7 are shown in bold.

	Perceived Abusiveness component	Physical Attractiveness component
How likely is this man to physically assault their partner or a potential partner?	**0.945**	0.012
How likely is this man to behave aggressively towards their partner or a potential partner by shouting, swearing at them, or insulting them?	**0.941**	0.070
How likely is this man to physically injure their partner or a potential partner?	**0.932**	0.176
How likely is this man to coerce their partner or a potential partner to have sex with them?	**0.743**	0.574
How sexy is this man?	0.116	**0.963**
How good looking is this man?	-0.006	**0.967**
How attractive is this man?	-0.027	**0.965**
How likely is this man to resolve arguments with their partner or a potential partner by discussing the problems?	**-0.850**	0.393

Hypothetical dating-decision task and individual-difference measures

One hundred heterosexual women (mean age = 28.39 years, SD = 4.37 years) were recruited from Prolific and rated the 100 male faces for the question “If you were looking for someone to date, how interested would you be in dating this person?” using a seven-point scale (1 = not very, 7 = very). Trial order was fully randomised. Figure 2 shows the interface for this task.

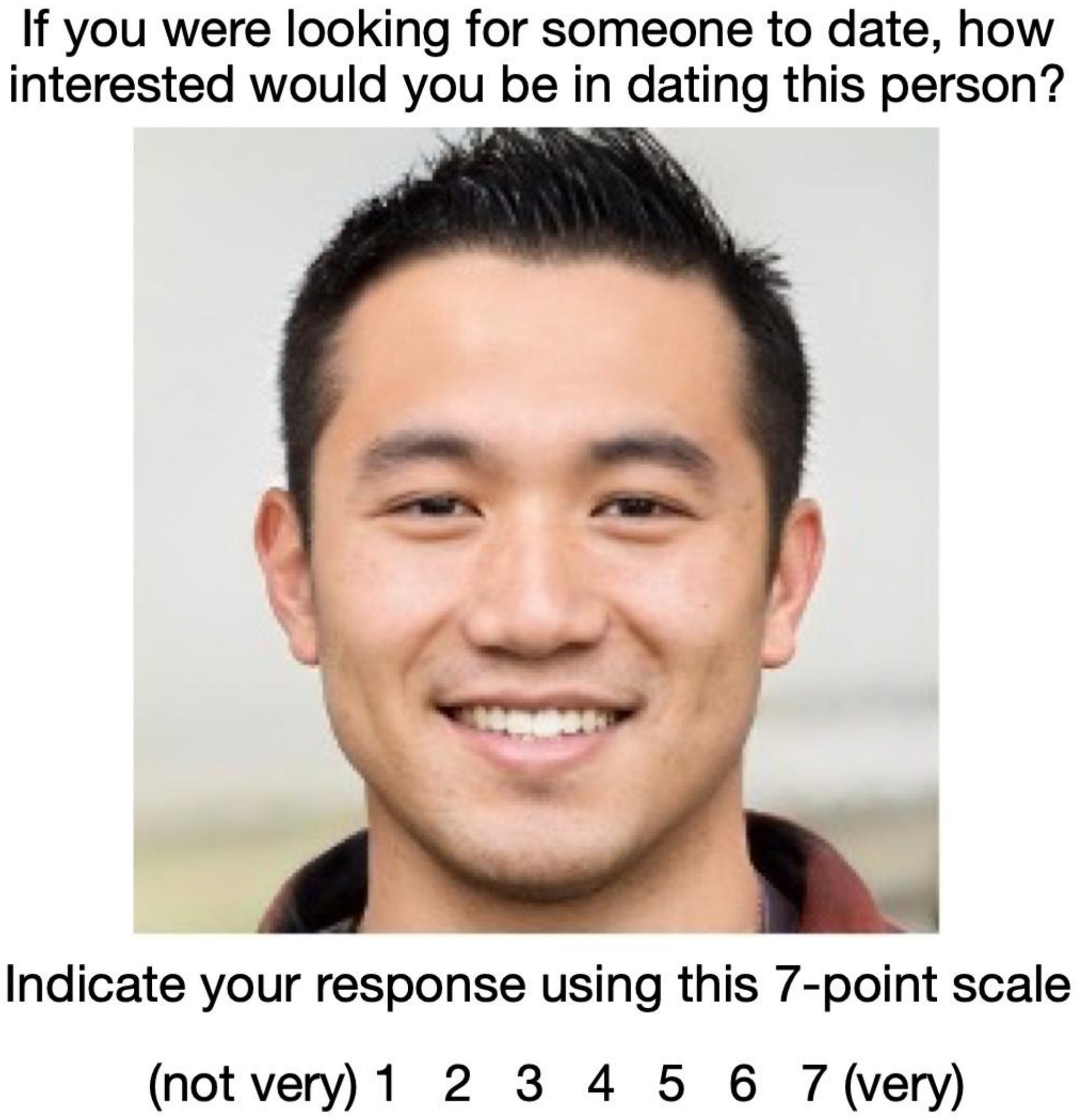

Figure 2. Illustration of a trial assessing dating intentions.

These women also completed Penke and Asendorpf’s (2008) Revised Sociosexual Orientation Inventory (SOI-R, Cronbach’s alpha = .80, M = 27.11), Hoyle et al’s (2002) Brief Sensation Seeking Scale (BSSS, Cronbach’s alpha = .82, M = 21.21), and Edlund and Sagarin’s (2014) Mate Value Scale (MVS, Cronbach’s alpha = .93, M = 17.99). Participants also reported whether they were currently in a romantic relationship (65 women were in a relationship, 35 women were not in a relationship).

Penke and Asendorpf's (2008) Revised Sociosexual Orientation Inventory is a nine-item questionnaire measuring openness to uncommitted sexual relationships. Participants respond to questions such as "With how many different partners have you had sexual intercourse without having an interest in a long-term committed relationship with this person?", using a nine-point scale. Hoyle et al's (2002) Brief Sensation Seeking Scale is an eight-item questionnaire measuring dispositional sensation seeking. Participants respond to questions such as "I like wild parties" using a five-point scale. Edlund and Sagarin's (2014) Mate Value Scale is a four-item questionnaire assessing perceptions of own mate value. Participants respond to questions such as "Overall, how would you rate your level of desirability as a partner on the following scale?", using a seven-point scale. For each questionnaire, a single score can be calculated, with higher scores indicating greater openness to uncommitted sexual relationships, higher sensation seeking, and higher mate value, respectively. The order in which participants completed the hypothetical dating-decision task and questionnaires was fully randomised. Scores on the BSSS were positively and significantly correlated with scores on the SOI-R (r = .32, N = 100, p = .001) and positively correlated with scores on the MVS, although this correlation was not significant (r = .19, N = 100, p = .056). Scores on the MVS and SOI-R were not significantly correlated (r = .12, N = 100, p = .121).

Results

All data and analysis code are publicly available on the Open Science Framework (https://osf.io/ugpxs/). Responses were analysed using a linear mixed effects model carried out in RStudio (R Core Team, 2023) using the lmerTest 3.1.3 (Kuznetsova et al., 2017) package. Responses on the hypothetical dating-decision task served as our dependent variable. Predictors were scores on the Perceived Abusiveness component, Physical Attractiveness component, SOI-R (z-scored), MVS (z-scored), BSSS (z-scored), and partnership status (effect coded so that 0.5 corresponded to being in a relationship and -0.5 corresponded to not being in a relationship). The model included all possible two-way and three-way interactions, except for those involving multiple individual-difference measures (i.e., possible interactions including more than one of SOI-R, MVS, BSSS, or partnership status were not included in the model). The model also included, by-rater and by-stimulus random intercepts, by-rater random slopes for the interaction between Perceived Abusiveness component and Physical Attractiveness component, and by-stimulus random slopes for SOI-R (z-scored), MVS (z-scored), BSSS (z-scored), and partnership status. Full results of this analysis are shown in Table 3.

Table 3. Results of our linear mixed effects model.

	Estimate	SE	t	df	p
Intercept	2.473	0.102	24.275	102.746	< 0.001
Perceived Abusiveness component	-0.013	0.023	-0.563	136.526	0.574
Physical Attractiveness component	0.600	0.039	15.589	124.76	< 0.001

SOI-R	0.102	0.104	0.979	99.140	0.330
MVS	-0.144	0.105	-1.376	99.257	0.172
BSSS	-0.198	0.103	-1.910	99.876	0.059
Partnership status	0.118	0.207	0.570	99.048	0.570
Perceived Abusiveness component * Physical Attractiveness component	0.011	0.019	0.569	106.956	0.570
Perceived Abusiveness component * SOI-R	0.016	0.019	0.861	92.871	0.391
Physical Attractiveness component * SOI-R	0.021	0.037	0.557	99.458	0.579
Perceived Abusiveness component * MVS	0.012	0.019	0.614	94.400	0.540
Physical Attractiveness component * MVS	-0.017	0.037	-0.459	100.266	0.647
Perceived Abusiveness component * BSSS	0.025	0.020	1.288	107.029	0.201
Physical Attractiveness component * BSSS	-0.077	0.037	-2.055	104.888	0.042
Perceived Abusiveness component * Partnership status	0.020	0.037	0.546	90.524	0.587
Physical Attractiveness component * Partnership status	0.100	0.074	1.363	98.752	0.176

Perceived Abusiveness component * Physical Attractiveness component * SOI-R	-0.009	0.013	-0.692	72.663	0.491
Perceived Abusiveness component * Physical Attractiveness component * MVS	0.011	0.013	0.823	73.398	0.413
Perceived Abusiveness component * Physical Attractiveness component * BSSS	0.017	0.014	1.171	87.984	0.245
Perceived Abusiveness component * Physical Attractiveness component * Partnership status	-0.006	0.026	-0.240	69.261	0.811

There was a significant positive effect of the Physical Attractiveness component (estimate = 0.600, SE = 0.039, t = 15.589, df = 124.760, $p < .001$) and a significant interaction between the Physical Attractiveness component and BSSS (estimate = -0.077, SE = 0.037, t = -2.055, df = 104.888, p= .042). This interaction is shown in Figure 3. No other effects were significant. Pseudo R squares for this model were .166 (fixed effects) and .599 (total). Simple slopes analyses showed that the interaction between the Physical Attractiveness component and BSSS occurred because women who scored higher on the BSSS showed a weaker effect of the

Physical Attractiveness component on hypothetical dating decisions (see https://osf.io/ugpxs/ for full results of this simple slopes analysis).

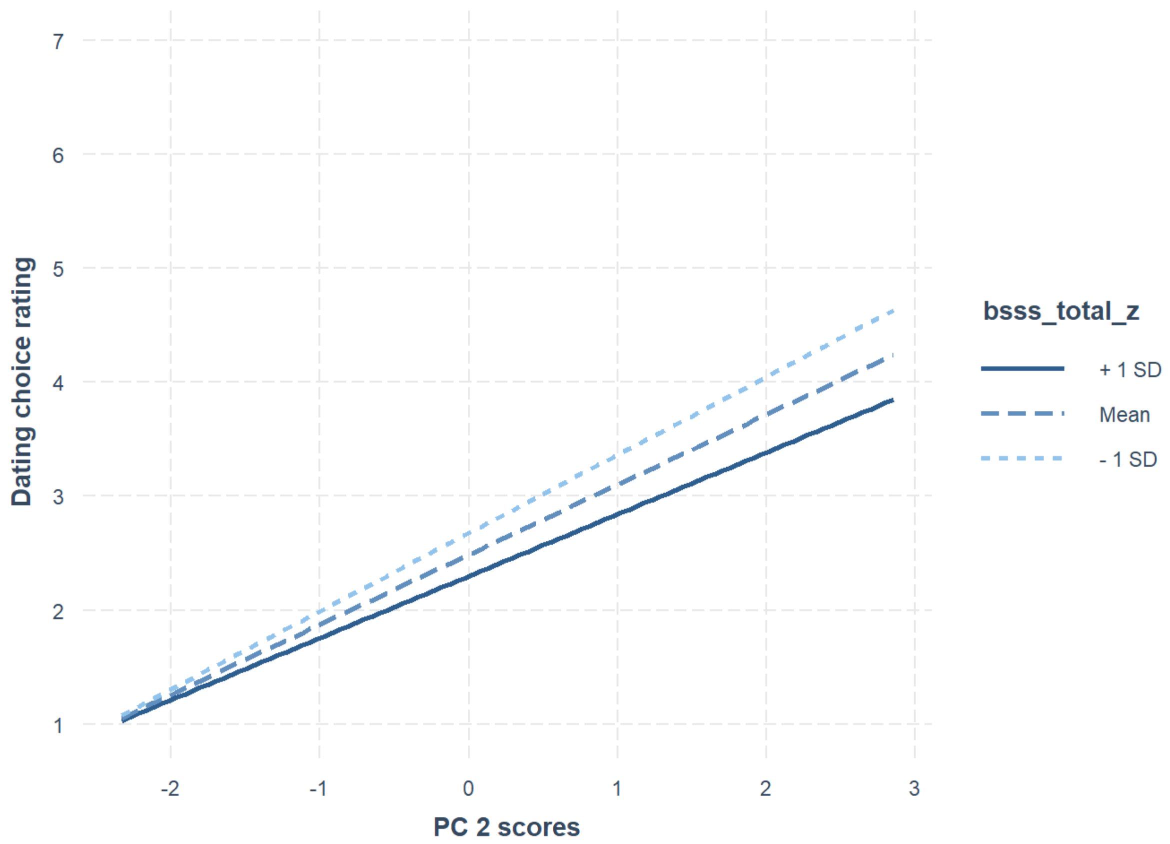

Figure 3. The significant interaction between the Physical Attractiveness component (PC2) and BSSS (Brief Sensation Seeking Scale).

At the suggestion of a Reviewer, we ran an additional version of our main analysis, this time excluding women who responded 1 on 75% or more of the trials as a robustness check. This analysis excluded 28 women and showed the same pattern of results, although here the interaction between physical attractiveness and BSSS was not significant ($p = .056$). This robustness check is reported in full at https://osf.io/ugpxs/.

We also carried out simplified versions of our main analysis, in which we tested for possible effects of SOI-R, MVS, BSSS, and partnership status in separate models (i.e., we ran four further models in total, each with a different individual differences measure included in the model). The effect of the Physical Attractiveness component was significant and positive in all four models (all estimates > 0.605, all $t > 15.526$, all $p < .001$). Neither the effect of the Perceived Abusiveness component nor the interaction between the Physical Attractiveness and Perceived Abusiveness components was significant in any of these models. In these models, the only significant effect that involved any of our individual difference measures (SOI-R, MVS, BSSS, and partnership status) was a significant interaction between scores on the Physical Attractiveness component and scores on the BSSS (estimate = -0.071, SE = 0.035, $t = -2.022$, df = 105.551, $p = .046$). In other words, the pattern of results observed in these simplified models are, in all cases, identical to the pattern observed in our initial main analysis.

Discussion

Principal Component Analysis (PCA) of ratings of faces on abusiveness- and attractiveness-related characteristics revealed two distinct components, reflecting Perceived Abusiveness and Physical Attractiveness, respectively. This pattern of results is potentially noteworthy, since it suggests that impressions of abusiveness-related traits are not simply a consequence of the well-established attractiveness halo effect (Langlois et al., 2000). Analyses of reported dating intentions on a hypothetical dating-decisions task revealed a strong positive effect of the Physical Attractiveness component, consistent with prior work suggesting that perceptions of physical attractiveness are particularly important for dating intentions and partner choice (e.g., Asendorpf et al., 2011; Chopik & Johnson, 2021).

Contrary to our predictions, the Physical Attractiveness and Perceived Abusiveness components did not interact to predict reported dating intentions. This null result for the interaction between the Physical Attractiveness and Perceived Abusiveness components is somewhat surprising, given previous work reporting that undesirable traits had weaker negative effects on reported dating intentions when assessing more attractive individuals (e.g., Agocha & Cooper, 1999; Henderson et al., 2005). Indeed, the Perceived Abusiveness component did not significantly predict reported dating intentions. Although this latter null result is somewhat surprising, it is possible that women are aware that such impressions are misleading (i.e., women are aware that perceptions of potential partners' propensity to abuse their partners are often inaccurate) and discount these impressions accordingly. That women's dating intentions were better predicted by physical attractiveness than threat-related perceptions is somewhat surprising, given previous work using a trust game that found women's trusting behaviour was better predicted by the threateningness than physical attractiveness of male partners (Brustkern et al., 2021). Together, these results highlight potentially substantial differences in the decision-making processes that underpin responses in trust games and hypothetical dating decisions.

Our null results for predicted effects of the Perceived Abusiveness component are at odds with Shuster et al's (2024) finding that threat-related perceptions of potential partners' face images had a negative effect on reported dating intentions in a hypothetical dating-decision task. Shuster et al. (2024) altered the perceived threat of face images by experimentally manipulating face-shape characteristics associated with perceived dominance. The differences between our results and those reported by Shuster et al. (2024) are puzzling. It is possible that methodological differences between Shuster et al's study and our study at least partly contribute to the different patterns of results. For example, while we employed 90 face images, Schuster et al. used 4, and while we used AI generated faces, Schuster et al. used images of real individuals in which threat cues were experimentally manipulated. In Schuster et al's work, but not our study, the face images were also accompanied by a short text bio.

A potential limitation of the study is that different participants completed the dating-decisions task and rated the traits used to construct the perceived abusiveness and physical attractiveness components. However, on this issue, it is worth noting that some researchers have argued that using the same participants to rate predictor and outcome variables in studies of face perception can inflate the correlations between these variables (e.g., Rhodes, 2006). Furthermore, the Cronbach's alphas for all traits were reasonably high, suggesting the components are likely to generalise relatively well to new groups of participants. Nonetheless, it is possible that the lower Cronbach's alphas for the traits used to construct the perceived abusiveness component (compared to those used to construct the physical attractiveness component) may have contributed to the null results we observed for perceived abusiveness, particularly given the emotional expressions shown in the images were somewhat homogenous (i.e., generally positively valenced). These issues may be useful to explore in future research, along with other factors previously shown to influence partner and face preferences (e.g., the temporal context of the relationship for which individuals were assessed, i.e., short- versus long-term relationships, Gangestad & Simpson, 2000). Similarly, the extent to which there are differences in responses on hypothetical dating decisions and actual partner choices are poorly understood, as are the extent to which trait ratings and spontaneously generated appearance-based first impressions. Again, such differences may contribute to our null results and are issues we recommend be considered in future research.

The only significant effect involving any of the individual difference measures we considered in our study (sensation seeking, self-perceived mate value, sociosexual orientation, and partnership status) was a significant interaction between sensation seeking and the Physical Attractiveness component. This interaction reflected women who scored higher on a measure of sensation seeking showing a weaker positive effect of the Physical Attractiveness component. This pattern of results is consistent with other research suggesting that individuals who score higher on sensation seeking tend to generally be less ‘picky’ (i.e., discriminating) when assessing potential partners (e.g., Henderson et al., 2005, 2006).

The specific facial characteristics that influence perceived abusiveness are not well known. Face-shape masculinity is one candidate cue, given it is thought to be correlated with impressions of physical dominance and aggressiveness (Oosterhof & Todorov, 2008). However, it is unlikely to be the characteristic that drives perceptions of abusiveness (see Dong et al., 2023 for evidence that methodological issues may have led researchers to overestimate the importance of shape masculinity for dominance-related perceptions). The role of other facial characteristics (e.g., facial width-to-height ratio and/or demeanour), as well as social stereotypes related to characteristics such as body size, age, and ethnicity, may also play a role.

In conclusion, our results suggest that perceptions of attractiveness- and violence-related traits can be dissociated, that impressions of men's physical attractiveness (but not violence-related traits) are a strong predictor of women's reported dating intentions, and that this effect of physical attractiveness is stronger among women who score low on sensation seeking. Thus, our work presents further evidence for the importance of physical attractiveness in dating and partner choices and highlight the role sensation seeking appears to play in individual differences in the effect of men's physical attractiveness on women's dating intentions.

Chapter 6. General Discussion

This thesis investigated the roles of multiple characteristics of face shape (i.e., sexual dimorphism, symmetry, and averageness) that have been theorized to contribute to social judgments of faces. However, while most previous studies have investigated these traits using manipulated images and forced-choice methods and/or investigated the effects of these characteristics only in isolation (i.e., tested for relationships between face shape and ratings using simple correlations only), the current studies considered multiple predictors simultaneously and employed natural (rather than manipulated) face images.

Summary of main findings

The first empirical study (Chapter 2) investigated the potential relationships between health ratings of male and female faces and three characteristics of face shape that are theorized to signal health according to “good genes” theories: symmetry, averageness, and sexual dimorphism. Rather than employing manipulated stimuli and forced-choice tests, which have been criticized for lacking ecological validity, the current studies used established image-analysis methods (e.g., Cai et al., 2019; Holzleitner et al., 2019) to objectively measure these traits in natural (rather than manipulated) face images that were rated individually. We also tested for relationships between health ratings and objective measures of these facial characteristics using two different types of regression models: one type where each shape characteristic was tested individually and another type where all three shape characteristics were included in the same model.

When examining each facial characteristic individually (i.e., in separate regression models), our results showed that faces rated higher in perceived health had more symmetrical and more average face shapes. This replicates previous studies reporting that healthier-looking faces had more symmetrical (Fink et al., 2006; Grammar & Thornhill, 1994; Jones et al., 2001; Penton-Voak et al., 2001; Rhodes et al., 2001a, 2007) or more average (Grammar & Thornhill, 1994; Jones, 2018; Rhodes et al., 2001b, 2007) face shapes. However, contrary to previous studies reporting correlations between health ratings and sexual dimorphism (e.g., Rhodes et al., 2003a), our study found no significant correlation between sexual dimorphism and health ratings.

Results from our second set of analyses, in which all three characteristics of face shape were added as predictors in the same model, showed a different pattern. Here, we again observed a significant relationship between averageness and health ratings, but observed no significant relationship between health ratings and symmetry. These results are similar to those of Kleisner et al. (2024a), whose study also found that the effects of symmetry on attractiveness became non-significant when averageness was included in the same model. Furthermore, a mediation analysis showed that averageness mediated the relationship between symmetry and health ratings by approximately 46%. This suggests that symmetry's relationship with perceived health may be at least partly driven by the positive effect of averageness. The differences between the simple and multiple regression analyses demonstrate the importance of multivariate approaches when evaluating the influence of facial characteristics in social judgments of faces, as these traits can often be intercorrelated (Holzleitner et al., 2019).

For sexual dimorphism, when it was entered in the same model as symmetry and averageness, results indicated that healthier-looking female faces have more feminine face shapes, but that healthier-looking male faces do not have more masculine face shapes. This difference in the possible effects of sexual dimorphism on health ratings of male and female faces is consistent with results from some previous studies (Foo et al., 2017; Rhodes et al., 2007). It is important to note, however, that the association between femininity and health ratings of women's faces was only significant when we controlled for other aspects of face shape (averageness and symmetry), suggesting that femininity is unlikely to significantly influence social judgments of perceived health during naturally occurring social interactions where natural faces vary on multiple different characteristics simultaneously.

Similar in design to the first study, our second empirical study (Chapter 3) investigated the possible relationships between trustworthiness ratings of natural (i.e., unmanipulated) face images and objective assessments of two aspects of face shape considered important in trustworthiness perceptions: averageness and sexual dimorphism. Our results demonstrated that natural faces that were objectively more average in face shape were also rated as more trustworthy compared to less average faces. This aligns with previous research reporting that trustworthy-looking faces tend to be more average (Ryali et al., 2020; see also Sofer et al., 2015). However, it extends previous findings by demonstrating that the significant effect of averageness on trustworthiness ratings found in manipulated stimuli also generalizes to our sample of natural face images.

By contrast with Chapter 3's results for averageness, sexual dimorphism of face shape was not significantly correlated with trustworthiness ratings. This is perhaps surprising given the large number of previous studies finding a large effect of femininity on trustworthiness when using manipulated stimuli (e.g., Buckingham et al., 2006; Perrett et al., 1998; Smith et al., 2009; but see also Alharbi et al., 2020). Thus, our null results for femininity and trustworthiness ratings of unmanipulated face images add to the recent literature suggesting that effects of sexual dimorphism found using manipulated face images often fail to generalize to judgments of natural face images (Dong et al., 2023; Jones & Jaeger, 2019; Lee et al., 2021; Scott et al., 2010). A quadratic effect of sexual dimorphism indicated that faces with average levels of sexual dimorphism were judged most trustworthy, consistent with the finding that averageness is an important predictor of trustworthiness ratings.

Ultimately, these results suggest that averageness of face shape plays a more important role in trustworthiness perceptions than does sexual dimorphism or symmetry. They are also consistent with the existence of an "anomalous-is-bad" stereotype whereby perceivers tend to erroneously ascribe negative personality traits to individuals who appear distinctive (Workman et al., 2021). The studies reported in Chapters 2 and 3 both suggest that shape averageness is particularly important for social judgments of faces. However, both of these studies used the same open-access image set (DeBruine & Jones, 2022). Consequently, further work is needed to establish if the apparent importance of averageness for social judgments of faces seen in the current studies generalises to other image sets. On this point, it is potentially noteworthy that other studies using different image sets have reported similar patterns of results to those observed here. For example, Shiramizu et al.

(2024) found that averageness, but not sexual dimorphism, predicted pro-social judgments of face images and Kleisner et al. (2024a) found that averageness was a better predictor of facial attractiveness than sexual dimorphism or symmetry. Using the same images as the current studies, Lee et al. (2025) also found that averageness was a better predictor of facial attractiveness than sexual dimorphism or symmetry. Collectively, these findings suggest the results reported here are unlikely to be specific to the particular image set employed in the current studies, although further work is needed to clarify this issue.

A key result from Chapters 2 and 3 was the significant role that shape averageness appears to play in health and trustworthiness ratings of faces, at least in the reported analyses of DeBruine and Jones' open-access image set. These results are consistent with other recent studies using the same types of study designs and finding that averageness plays a more important role in attractiveness judgments of faces than either sexual dimorphism or symmetry (Kleisner et al., 2024a; Lee et al., 2025). However, a challenge when considering the literature on the role of averageness (or its opposite, distinctiveness) in social judgments of faces is that some previous studies have assessed averageness objectively (i.e., have measured it from face images) (Kleisner et al., 2024a, 2004b; Komori et al., 2009a, 2009b; Lee et al., 2025; Rhodes et al., 2021a, 2021b; Sofer et al., 2015), while others have assessed averageness of faces using distinctiveness ratings (i.e., ratings made by participants) (Rhodes et al., 1999, 2001a, 2001b). This raises the question of the extent to which rated and measured distinctiveness of faces are correlated.

In light of the above, the third empirical study (Chapter 4) examined a potential correlation between distinctiveness ratings of faces and an objective measure of shape distinctiveness derived from face images. Results suggested that distinctiveness ratings made by participants and the objective measure of shape distinctiveness of our sample of faces were significantly and positively correlated, but that this correlation was relatively weak (r=.24). This finding suggests that researchers should take into account how distinctiveness was assessed when considering findings for social judgments of unmanipulated face images and distinctiveness.

For the fourth empirical study (Chapter 5), we shifted our focus from examining facial traits that influence social judgments of faces to investigating the impact of social judgments of faces on hypothetical social behaviors. Specifically, we looked at the possible influences of perceived attractiveness and perceived potential for abusiveness on heterosexual women’s hypothetical dating decisions made on the basis of unstandardized images of male faces. We also examined the potential moderating effects of individual differences in women’s sensation seeking, sociosexual orientation (openness to casual sexual relationships), partnership status, and self-perceived mate value (self-rated attractiveness). Results suggested that perceived physical attractiveness, but not perceived abusiveness, predicted women’s hypothetical dating decisions. The strong positive effect of the Physical Attractiveness component on hypothetical dating decisions is consistent with prior work suggesting that perceptions of physical attractiveness are particularly important for dating intentions and partner choice (e.g., Asendorpf et al., 2011; Chopik & Johnson, 2021). Only sensation-seeking moderated this effect of physical attractiveness, such that women scoring higher on sensation-seeking showed weaker effects of physical attractiveness on their hypothetical dating decisions. This pattern of results is consistent with previous studies suggesting that individuals who score higher on sensation seeking tend to be less discriminating in their choices of partners (e.g., Henderson et al., 2005, 2006).

Perhaps the most noteworthy finding in Chapter 5 is that, in our Principal Components Analysis (PCA) of ratings of male faces, ratings of potential abusiveness and ratings of attractiveness reflected separable perceptual dimensions. This suggests that impressions of abusiveness-related traits are not simply a byproduct of the attractiveness halo effect (Langlois et al., 2000), meaning that attractive faces can also look potentially aggressive, and vice versa.

Chapter 5's null result for the effect of perceived abusiveness on women's hypothetical dating decisions is surprising and appears to contradict Shuster et al.'s (2024) study, which found that perceived threat in face images had negative effects on hypothetical dating decisions. However, it is worth noting that our study differed in certain aspects from theirs. For example, we used naturalistic face images, whereas Shuster et al. used manipulated face images. It is then possible that Chapter 5's results are further evidence that findings for manipulated images do not generalize straightforwardly to perceptions of naturalistic face images.

Limitations and future directions

Perhaps the most important finding from the studies reported in this thesis is that shape averageness reliably predicts social judgments of male and female faces better than either sexual dimorphism or symmetry, at least in the reported analyses of DeBruine and Jones' open-access image set (Chapters 2 and 3). This pattern of results is consistent with those from other recent studies with similar designs that examined shape predictors of facial attractiveness (e.g., Kleisner et al., 2024a; Lee et al., 2025). While these findings collectively implicate prototypicality of face shape in social judgments of faces, why facial averageness predicts social judgments remains unclear. Two explanations that have been advanced for the link between averageness and social judgments are the good genes explanation, which suggests that averageness influences social judgments of faces because it is a cue of health, and the perceptual bias explanation, which suggests that averageness predicts social judgments because more average faces can be processed more easily and efficiently (see Rhodes, 2006 for a detailed discussion of these two explanations). These explanations are not necessarily mutually exclusive (i.e., both explanations could contribute to preferences for average faces). Further work on why averageness influences social judgments of faces is needed to clarify this issue. To date, most research on this issue has focused on establishing whether or not averageness is correlated with measures of health or with indices of processing efficiency (Cai et al., 2019; Trujillo et al., 2014). A complementary approach in which analyses test the extent to which health-related and/or familiarity-related perceptions mediate positive appraisals of average faces may be a useful additional way to investigate this issue. For example, some research has already ready reported that health perceptions contribute to the appeal of average faces (Rhodes et al., 2007) and that impressions of familiarity also contribute to the appeal of average stimuli (Bainbridge et al., 2013). However, no study has yet combined these two approaches in a single study. Doing so may provide new insights into why average faces are ascribed positive traits.

A limitation of the current studies was that they focused on the role of shape information only in predicting social judgments of faces. While this approach allowed us to compare the contributions of averageness, symmetry and sexual dimorphism, it meant that the possible effects of surface information (e.g., facial colouration and/or surface texture) to be considered. This is potentially noteworthy since previous studies suggest that surface and shape information contribute independently to ratings of facial attractiveness and dominance (Torrance et al., 2014). Although evidence that specific colour dimensions reliably predict social judgments is somewhat mixed (e.g., Cai et al., 2019; Stephen et al., 2012), further work considering surface information alongside shape information is likely to increase the predictive power of facial characteristics when predicting social judgments. Importantly, it is possible that which specific components of facial distinictiveness contribute to social judgments may differ according to the social judgment being considered. Results reported in Chapter 4 provide some initial support for this possibility. In Chapter 4, linear regression models showed that adding rated distinctiveness to a model with shape distinctiveness as the main predictor significantly and substantially increased the percentage of explained variance for trustworthiness ratings, but not for health ratings. One interpretation of this pattern of results is that components of distinctivness other than shape contribute more to trustworthiness ratings than they do to health ratings. Further work using different image sets may further illuminate this possibility.

Similarly, shape characteristics that were not considered in the current work, such as correlates of adiposity and height (e.g., Batres et al., 2015; Wolffhechel et al., 2014), are also likely to contribute to social judgments of faces. Considering these additional sources of shape information might give a more complete understanding of how facial cues influence social judgments. A challenge for such studies is that there is less consensus among researchers in how best to assess these additional characteristics. Data-driven methods, in which PCA is used to identify the sources of variation within a set of stimuli and how these relate to social judgments, go some way to addressing this issue (Holzleitner et al., 2019). However, describing the key components that relate to social judgments and mapping those to theories of first impressions is often not straightforward.

A further limitation of the current studies is that they mostly employed face stimuli representing young white adults. Although Chapter 5 went some way towards addressing this issue by employing face stimuli with greater diversity in terms of ethnicity, this limitation means that the current studies cannot speak to the apparent importance of averageness for social judgments of faces that are not white (i.e., the results might not generalize to other types of faces). This focus on white faces is not only a limitation of the current work, but also a limitation of research on social judgments of faces more generally (see Cook & Over, 2021 for a discussion of this issue). While the current studies do not address the extent to which the findings for averageness generalize to samples of faces with greater diversity ethnicity, some other recent work does speak to this issue. For example, Shiramizu et al. (2024) analysed ~11,000 participants' ratings of a sample of face images containing White, Black, East Asian, and Latinx individuals, finding that shape averageness, but not shape sexual dimorphism, was significantly correlated with ratings of prosocial traits (e.g., trustworthiness). Moreover, this pattern of results was observed when participants were from a wide range of world regions and also differed little among world regions. Other work has also reported positive effects of shape averageness on attractiveness judgments of East Asian faces (Perrett et al., 1994; Rhodes et al., 2007). While more work is needed on this issue, these results suggest that the current findings for averageness and social judgments of faces may not be limited to ratings of white faces. Work investigating how other aspects of stimulus diversity (e.g., diversity in age) influence the putative link between averageness and ratings of prosocial traits is needed to further interrogate possible constraints on the generalizability of the anomalous is bad stereotype.

A final limitation of the current work that I would like to acknowledge and discuss is the ecological validity of the stimuli and testing paradigms employed. Although the methods employed in this thesis arguably have greater ecological validity than those in studies using forced choice methods and experimentally manipulated face stimuli, the highly standardized face images employed in Chapters 2, 3 and 4 arguably still have low ecological validity. The unstandardized images employed in Chapter 5 go towards addressing this issue (see Bainbridge et al., 2013 and Sutherland et al., 2013 for examples of other studies employing unstandardized or ‘ambient’ images), but more can certainly be done to increase the ecological validity of testing paradigms used in studies of first impressions and to better understand how well perceptions of standardized images predict impressions formed during real face-to-face interactions. For example, recent studies have investigated how well ratings of standardised face images predict assessments made during short ‘speed-dating’ style face-to-face interactions (Zhao et al., 2023). These studies have found that ratings of some traits (e.g., attractiveness, prosociality) from standardized face images predict impressions formed during face-to-face interactions relatively well. Further work using this method would increase understanding of when and where use of standardized stimuli is particularly problematic. Such studies could also investigate how people integrate information from facial cues with other types of information (e.g., vocal and body cues, explicit social and personal information).

Conclusion

Many previous studies examining the role of shape information in social judgments of faces have experimentally manipulated averageness, symmetry, or sexual dimorphism using computer graphics methods and assessed social judgments using forced-choice paradigms. These studies have typically reported relatively large effects of face shape on social judgments. Due to criticisms that this approach has poor ecological validity and may not accurately reflect how people use facial shape when judging more realistic stimuli that vary simultaneously on multiple dimensions, this thesis investigated the role that face shape plays in health perceptions and perceptions of the trustworthiness of natural (i.e., unmanipulated) faces. While findings from these studies suggested that less distinctive faces were perceived to be healthier and more trustworthy, at least in the reported analyses of DeBruine and Jones' open-access image set, evidence that sexual dimorphism predicted these perceptions was much more limited. Thus, these findings contribute to a growing picture in the literature suggesting that, while the experimental approach can reveal what facial characteristics people *can* use to form first impressions, they may be misleading regarding what information people actually *do* use when viewing natural face stimuli.

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Appendices

Appendix 1:

Participant information sheet and consent form for study 1

Participant Information Sheet for Ben Jones

Name of department: School of Psychological and Health Sciences
Title of the study: Making dating decisions

Introduction
This project investigates the social stereotypes that people hold about faces. The project is being run by Prof Benedict Jones, Ms Kathlyne Leger, Dr Victor Shiramizu, School of Psychological and Health Sciences, University of Strathclyde. Prof Jones can be contacted at benedict.jones@strath.ac.uk if you have any questions or comments on this research.

What is the purpose of this research?
Previous research suggests that the stereotypes we form about people based on their appearance inform dating decisions. This project will continue that work by investigating what aspects of appearance influence abuse-related and attractiveness-related perceptions.

Do you have to take part?
No, you do not. Participation in the project is voluntary and you are free to stop at any time. However, you will only receive payment if you complete the study in full. Since all data are fully anonymous, you will not be able to request that your data be destroyed.

What will you do in the project?
You will be asked to report your age, gender, and sexual orientation. You will then be shown images of 100 men and asked to rate each man on a specific trait using a 1 (much less than average) to 7 (much less than average) scale. Some of these traits may relate to violent or sexual conduct within relationships. Participation should take approximately 10 to 15 minutes.

What information is being collected in the project?
Only your age, gender, sexual orientation, and image rating data will be recorded and these will be fully anonymised.

Who will have access to the information?
During data collection and analyses, only the researchers running the project will have access to the data. When the results are published, the anonymous data will be made publicly accessible on the Open Science Framework servers. We do this so that other researchers can confirm our results by rerunning the analyses.

Where will the information be stored and how long will it be kept for?
During data collection and analyses, data will be stored on a secure server and can be accessed only by the researchers running the project. When we publish our results, the anonymous data will be made publicly accessible on the Open Science Framework servers. We do this so that other researchers can confirm our results by rerunning the analyses. The data will be retained indefinitely.

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

What happens next?
Next you will be invited to consent to take part in the study. If you have any questions you would like answered at this point, please email Prof Ben Jones benedict.jones@strath.ac.uk. If you would prefer not to participate, thank you for your time.

Researcher contact details:
If you have any questions about this study, please email Prof Ben Jones benedict.jones@strath.ac.uk

Chief Investigator details:

Prof Ben Jones benedict.jones@strath.ac.uk and Dr Victor Shiramizu victor.shiramizu@strath.ac.uk

This research was granted ethical approval by the School of Psychological Sciences and Health Ethics Committee.

If you have any questions/concerns, during or after the research, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact:

School of Psychological Sciences and Health Ethics Committee
University of Strathclyde
Graham Hills Building
50 George Street
Glasgow
G1 1QE

Email: hass-psh-ethics@strath.ac.uk

Consent Form for Ben Jones and Victor Shiramizu

Name of department: School of Psychological and Health Sciences
Title of the study: Making dating decisions

- I confirm that I have read and understood the Participant Information Sheet for the above project and the researcher has answered any queries to my satisfaction.
- I confirm that I have read and understood the Privacy Notice for Participants in Research Projects and understand how my personal information will be used and what will happen to it (i.e. how it will be stored and for how long).
- I understand that my participation is voluntary and that I am free to stop participating in the project at any time, up to the point of completion, without having to give a reason and without any consequences.
- I understand that anonymised data (i.e. data that do not identify me personally) cannot be withdrawn once they have been included in the study.
- I understand that no information that identifies me will be recorded or made publicly available.
- I understand that my anonymous data will be made publicly accessible on the Open Science Framework so that other researchers can confirm the results of this study.
- I consent to being a participant in the project.

CLICK HERE TO CONFIRM THAT YOU CONSENT TO PARTICIPATE IN THIS STUDY

Appendix 2

Participant information sheet and consent form for Chapter 5

Participant Information Sheet for Ben Jones

Name of department: School of Psychological and Health Sciences
Title of the study: Making dating decisions

Introduction
This project investigates the social stereotypes that people hold about faces. The project is being run by Prof Benedict Jones, Ms Kathlyne Leger, Dr Victor Shiramizu, School of Psychological and Health Sciences, University of Strathclyde. Prof Jones can be contacted at benedict.jones@strath.ac.uk if you have any questions or comments on this research.

What is the purpose of this research?
Previous research suggests that there are considerable individual differences in how people make dating-related decisions. This project will continue that work by further investigating some of the factors that are thought to contribute to these individual differences.

Do you have to take part?
No, you do not. Participation in the project is voluntary and you are free to stop at any time. However, you will only receive payment if you complete the study in full. Since all data are fully anonymous, you will not be able to request that your data be destroyed.

What will you do in the project?
You will be asked to report your age, gender, and sexual orientation. You will then be shown images of 100 men and asked to indicate whether or not you would be interested in dating them. You will also be asked to complete some questionnaires that have previously been found to predict individual differences in dating decisions. These questionnaires include ones that assess your openness to casual sex (e.g., "With how many different partners have you had sexual intercourse without having an interest in a long-term committed relationship with this person?) and perceptions of your own attractiveness. You do not have to answer any questions you are uncomfortable answering. Participation should take approximately 10 to 15 minutes.

What information is being collected in the project?
Only your age, gender, sexual orientation, judgments about the images, and questionnaire responses will be recorded and these will be fully anonymised.

Who will have access to the information?
During data collection and analyses, only the researchers running the project will have access to the data. When the results are published, the anonymous data will be made publicly accessible on the Open Science Framework servers. We do this so that other researchers can confirm our results by rerunning the analyses.

Where will the information be stored and how long will it be kept for?
During data collection and analyses, data will be stored on a secure server and can be accessed only by the researchers running the project. When we publish our results, the anonymous data will be made publicly accessible on the Open Science Framework servers. We do this so that other researchers can confirm our results by rerunning the analyses. The data will be retained indefinitely.

Thank you for reading this information – please ask any questions if you are unsure about what is written here.

What happens next?
Next you will be invited to consent to take part in the study. If you have any questions you would like answered at this point, please email Prof Ben Jones benedict.jones@strath.ac.uk. If you would prefer not to participate, thank you for your time.

Researcher contact details:
If you have any questions about this study, please email Prof Ben Jones benedict.jones@strath.ac.uk

Chief Investigator details:

Prof Ben Jones benedict.jones@strath.ac.uk and Dr Victor Shiramizu victor.shiramizu@strath.ac.uk

This research was granted ethical approval by the School of Psychological Sciences and Health Ethics Committee.

If you have any questions/concerns, during or after the research, or wish to contact an independent person to whom any questions may be directed or further information may be sought from, please contact:

School of Psychological Sciences and Health Ethics Committee
University of Strathclyde
Graham Hills Building
50 George Street
Glasgow
G1 1QE

Email: hass-psh-ethics@strath.ac.uk

Consent Form for Ben Jones and Victor Shiramizu

Name of department: School of Psychological and Health Sciences
Title of the study: Making dating decisions

- I confirm that I have read and understood the Participant Information Sheet for the above project and the researcher has answered any queries to my satisfaction.
- I confirm that I have read and understood the Privacy Notice for Participants in Research Projects and understand how my personal information will be used and what will happen to it (i.e. how it will be stored and for how long).
- I understand that my participation is voluntary and that I am free to stop participating in the project at any time, up to the point of completion, without having to give a reason and without any consequences.
- I understand that anonymised data (i.e. data that do not identify me personally) cannot be withdrawn once they have been included in the study.
- I understand that no information that identifies me will be recorded or made publicly available.
- I understand that my anonymous data will be made publicly accessible on the Open Science Framework so that other researchers can confirm the results of this study.
- I consent to being a participant in the project.

CLICK HERE TO CONFIRM THAT YOU CONSENT TO PARTICIPATE IN THIS STUDY